



Original Research Article

A Comparative Study of Microleakage of Heat Cure Silicone Soft Liner and Self Cure Silicone Soft Liner with Heat Cure Acrylic Denture Base after Accelerated Aging and Surface Treatment - An In Vitro Study

C. Sabarigirinathan¹, K. Muthukumar², K. Vinayagavel³, S. Vinayakam⁴, Sunil Kumar², M. Rajakumar⁵,
C. Selvamani²

¹Professor and HOD, ²PG student, ³Professor, ⁴Sr. Assistant Professor, ⁵Reader,
Department of Prosthodontics, Tamil Nadu Govt. Dental College & Hospital, Chennai.

Corresponding Author: K. Vinayagavel

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ABSTRACT

Purpose: to compare microleakage of heat cure silicone soft liner and self cure silicone soft liner with heat cure acrylic denture base after accelerated aging and surface treatment

Materials and methods: 60 acrylic soft liner disks with dimensions of 10 * 2 mm were prepared in heat cure acrylic denture base resin as base were then divided into 6 groups with 10 samples of each to test the microleakage Non Sandblasted- Group H1, Group S1, Group S2, Sandblasted - Group H1A, Group S1A, Group S2A. Microleakage evaluation tests were carried out with a 64 slice CT scanner after immersing the samples in omnipaque contrast medium.

Results: The mean value in H1 sample is 0.90 which is less than the mean values of S1 and S2 samples which are 1.4 and 2.5 respectively, shows statistically significant ($p=.02$). The mean value in H1A sample is 0.80 which is greater than the mean values of S1A sample which is 0.4, shows H1A statistically significant.

Conclusion: The result of the present study revealed that heat cure soft liners show minor degree of penetration of penetration compared to self cure soft liners. Treating the acrylic denture base surface by sand blasting with Al_2O_3 significantly improved the bonding of silicone based soft liner to the acrylic denture base. The heat cure silicone soft liner Molloplast B shows the lowest leakage followed by the silicone soft liners Ufigel P and GC Reline, shows least leakage.

Keywords: Self cure silicone Soft liner, Heat cure silicone soft liner, Micro leakage, Bonding ability, Heat cure acrylic denture base.

INTRODUCTION

In prosthetic dentistry the use of denture soft liner has increasingly come into favour for various applications. Currently for practical purpose denture base material are made of rigid materials. Resilient lining materials have been introduced to provide a

cushion effect between denture base and the supporting tissues, and allow for a more uniform distribution of stress at the mucosa interface. ^[1]

These liners are most commonly used in patients who are unable to tolerate the pressures transmitted by prosthesis

because of thin mucosa or severe alveolar ridge resorption. The ability to achieve the cushioning effect depends mostly on the viscoelastic properties and durability of the liner material. [2]

The major draw backs in silicone soft liners are the lack of durable bond to denture base resin. The bond between the heat polymerised acrylic resin and silicone soft liners failed quite too often requiring repeated relines. This failure results when the soft lining material swells due to water sorption leading to stress build up between the bonding surfaces or viscoelastic properties of the material may change. [3]

Debonding of liners from denture base is one of the factors that influence the longevity of soft denture liners, debonding of soft liners attribute to microleakage at the interface. This study was performed to evaluate microleakage occurs between self and heat cure soft liners. The effect of surface ageing treatment of the heat polymerised acrylic base material with accelerated aging and was performed with use of CT scan.

MATERIALS AND METHODS

A total number of 60 acrylic disks with dimensions of 10*2 mm were prepared in heat cure acrylic denture base resin. The polymethylmethacrylate disks were ground with 320 grit silicone carbide paper to remove surface irregularities and excess material. The self cure and heat cure acrylic disks are then placed over these acrylic disks after surface treatment of the acrylic disks. These 60 acrylic soft liner disks were then divided into 6 groups with 10 samples of each to test the microleakage-
Non Sandblasted- Group H1, Group S1, Group S2,
Sandblasted - Group H1A, Group S1A, Group S2A.

Sample preparation

Two cylindrical dies were prepared of which 10mm diameter and 2mm thickness and other one having 10mm diameter and 1mm thickness. These are used to fabricate acrylic and soft liners disk respectively. Mold space was created from one size of 10mm*2mm. Wax disks were prepared by pouring the molten wax into the mold space. Total of 60 wax patterns were prepared. Normal flasking and dewaxing procedure was carried out heat cure resin was packed and cured.

The circular shaped steel dies 10*1 mm were used to make wax patterns and it is placed over the heat cure acrylic disk dimension of 10*2mm and flasking, dewaxing procedure done. Adhesives are applied over the acrylic disk and heat cure soft liner was packed and cured.

H1 sample preparation done normally whereas in H1A sample preparation surface of acrylic disk was sand blasted with 50 μm Al_2O_3 and then flasking procedure was carried out.

The mold space for selfcure soft liners were prepared in the same manner as that of heat cure soft liners. After dewaxing acrylic disk surface was coated with Primer R and dried with clean air. Self cure soft liner was packed over the acrylic disk in the mold space. After bench press of 10 minutes samples were removed and excess were trimmed.

S1 and S2 Samples were prepared as described above. For S1A and S2A sample acrylic disks were sandblasted with 50 μm Al_2O_3 and then flasking procedure was carried out.

Samples for accelerated ageing:

60 samples were placed in water bath at a controlled temperature $52 \pm 1^\circ\text{C}$ for 10 seconds. Then samples are switch over to a controlled temperature of $5 \pm 1^\circ\text{C}$ for 10 seconds. Procedure was repeated for 300 cycles with these controlled temperature.

Preparing the samples for slice CT scan to evaluate microleakage

All samples are immersed in OMNIPAQUE. It consist of contrast material Iohexol of 350 mg/ 1ml since it of higher concentration it is diluted to concentration of 5ml contrast media with 10 ml of saline. All sample were immersed in it and kept for 2 days and subjected to slice CT scan for detection of micro leakage.

The amount of penetration of contrast medium in between the acrylic disk and soft liners suggest the presence and the degree of microleakage. Sagittal section of the samples is taken into consideration for microleakage detection. The depth and height of penetration of contrast media are measured and analysed. The heat cure and self cure soft liners were compared. Similarly the samples that were sand blasted are also evaluated.



Acrylic disk with soft liner



Samples in 64 slice CT scanner



Metallic steel dies



Heat cure acrylic disk

Microleakage Evaluation:

0= no evidence of slight penetration of contrast media at the interface of the acrylic resin and soft liner (0mm)

1= evidence of slight penetration of contrast media at the interface of the acrylic resin and soft liner (≤ 2.5 mm)

2= evidence of penetration of contrast media up to half the interface of the acrylic resin and soft liner (≥ 2.5 mm and ≤ 5 mm)

3= evidence of penetration of contrast media up to three fourths the interface of the acrylic resin and soft liner (≥ 5 mm and ≤ 7.5 mm)

4= evidence of penetration of contrast media completely covering the interface of the acrylic resin and soft liner (≥ 7.5 mm and 10mm)

RESULTS

The degree of microleakage was evaluated. All data were evaluated and statistical comparisons were made by T –

test, one way ANOVA with Bonferroni correction.

Table I Silicone soft liner (without sand blasting)

samples	Degree of microleakage (non - sand blasted)					
	N	0	1	2	3	4
H1	10	5	3	1	1	0
S1	10	2	3	4	1	0
S2	10	1	1	3	2	3

Shows the lowest degree of microleakage seen on H1 samples and highest degree of microleakage on S2.

Table II Silicone soft liner (surface treated with sand blasting)

samples	Degree of microleakage (sand blasted)					
	N	0	1	2	3	4
H1A	10	7	2	1	0	0
S1A	10	4	5	0	1	0
S2A	10	3	1	1	3	2

Highest degree of microleakage on S2A and lowest degree on H1A

Table III One Way ANOVA – non sand blasted

samples	N	Mean	Std.Deviation	p value
H1	10	0.9	1.287	0.2
S1	10	1.4	0.966	
S2	10	2.5	1.354	
total	30	1.6	1.354	

Microleakage of heat cure and self cure silicone soft liner bonded to untreated surface of heat cure acrylic base group is significant.

Table IV Multiple comparison

Materials	materials	mean difference (i- J)	sig
H1	S1	-0.5	1
	S2	-1.6	0.02
S1	H1	0.5	1
	S2	-1.1	0.158
S2	H1	1.6	0.02
	S1	1.1	0.158

Mean difference among their respective sample group is significant 5% level.

Table V One Way ANOVA – surface treated sand blasted

samples	N	Mean	Std.Deviation	p value
H1A	10	0.4	0.699	0.12
S1A	10	0.8	0.919	
S2A	10	2	1.633	
total	30	1.07	1.311	

Microleakage of heat cure and self cure silicone soft liner bonded to treated surface of heat cure acrylic base group is significant.

Table VI Multiple comparison

Materials	materials	mean difference (i- J)	sig
H1A	S1A	-0.4	1
	S2A	-1.6	0.014
S1A	H1A	0.4	1
	S2A	-1.2	0.084
S2A	H1A	1.6	0.014
	S1A	1.2	0.084

Mean difference among their respective sample group is significant 5% level.

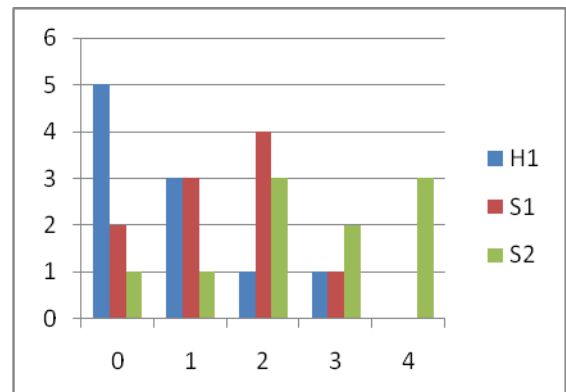
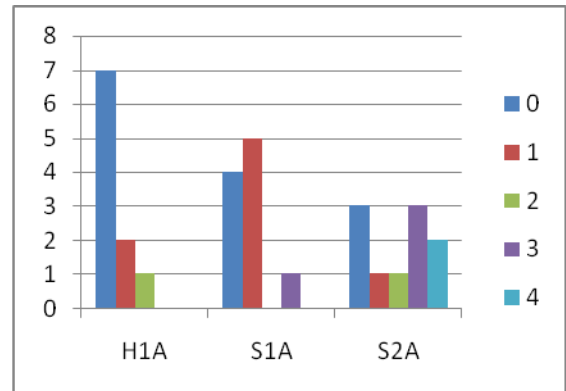
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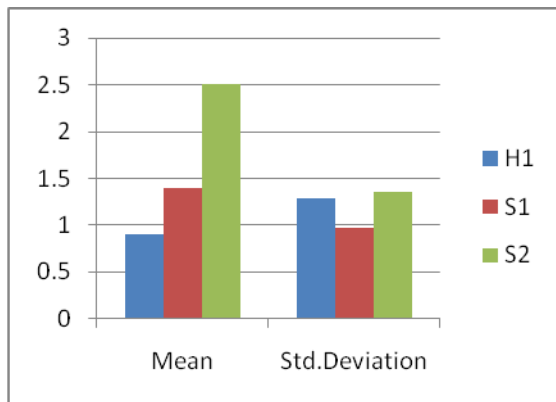
samples	N	Mean	Std.Deviation	P value
H1A	10	0.4	0.699	0.295
H1	10	0.9	1.287	

samples	N	Mean	Std.Deviation	P value
S1A	10	0.8	0.919	0.172
S1	10	1.4	0.966	

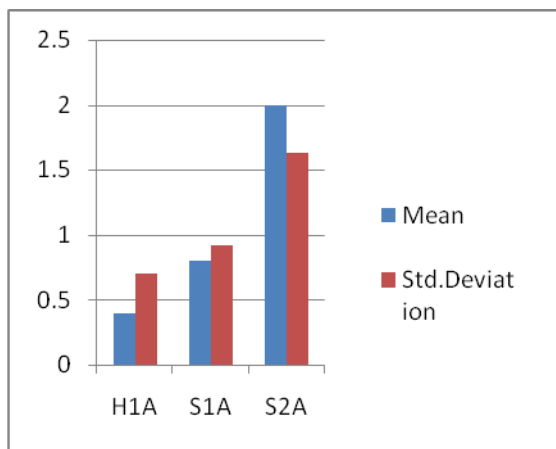
samples	N	Mean	Std.Deviation	P value
S2A	10	2	1.633	0.466
S2	10	2.5	1.354	

H1, S1, S2 are statistically significant





Multiple comparisons non Sand blasted



Multiple comparisons non Sand blasted

DISCUSSION

Resilient softliners are used to distribute functional loads by optimizing adaptation of the denture base to residual ridges, to reduce the stress concentration on residual ridge and to make dentures more comfortable.^[4]

Currently most of the clinicians prefer the auto polymerized soft lining materials as an alternative to heat cured soft liners because of their chair side usage, easy application and less laboratory procedures.

However one of the major drawbacks of soft liners is the lack of durable bond to the denture base. The bond between the heat polymerized acrylic denture base and the soft liners not found to be long lasting and requiring repeated relines.

Hence understanding the chemistry of the bonding of the soft liners with acrylic resin along with the nature of the bond and mechanism of bond failure will help us to overcome the problem and render better service to the patients to be rehabilitated by removable prosthesis.

Various workers have done elaborate study on the bonding of the soft liners with acrylic denture base by subjecting them to a variety of studies, which include aging process, tensile strength, peel strength, creep test etc.

This study was performed to evaluate the micro leakage between the self cure soft liner and heat cure soft liners with underlying heat cure acrylic base material with the effect of accelerated aging. The 64 slice CT scanner has been used to evaluate the micro leakage. The samples are also not cross sectioned to evaluate the seepage. The bonding ability of these resilient soft liners with treated and untreated surfaces of heat cure acrylic denture base was also evaluated in this study. The surface of heat cure acrylic denture base samples were treated with sand blasting to improve the bonding ability with soft liners.

From the result of this evaluation of micro leakage and bonding, it was found that the heat cure silicone soft liner bonded to the treated surface of the heat cure acrylic disk exhibited higher bonding ability than the self cure silicone soft liner bonded to the treated and untreated surface of the acrylic disk. Comparing the bonding of heat cure soft liner with surface treated and untreated heat cure acrylic disk, the former exhibited lesser amount of microleakage

The result of this study was correlated with that of previous studies done by various workers who had done elaborate studies. It was understood that the surface treatment of acrylic disk by sand blasting enhancing the penetration of the adhesive more effectively into the pores created

resulted in better bonding ability between the denture base and soft liner.

Leles et al used different chemical surface treatments to increase the bond strength between a hard chairside relined resin and a denture base material. Y.SinasiSarac et al used airborne-particle abrasion and methyl methacrylate wetting as a denture base resin pretreatment to examine the effect on micro leakage between silicone based resilient liner and denture base resin, by means of the radioactive tracer thallium-201. The authors reported that the swelling of the outer denture base by wetting and the penetration of the adhesive more effectively reduced the leakage of fluids within this interface compared to airborne particle. [5]

DuyguSarac et al found that treating the denture base resin surface with methyl methacrylate for 180 seconds prior to adhesive application reduced the microleakage and increased the bond strength when using silicone based resilient liners. [6]

The results of the present study reveal that treating the acrylic denture base by sand blasting with 50 um Al₂O₃ reduced the degree of microleakage by improving the efficiency of bonding between a silicone-based resilient lining material and denture base. The surface treated acrylic denture base shows better results than the untreated acrylic denture base with heat cure and self cure silicone soft liners. The statistical analysis of the micro leakage showed significant difference between the acrylic soft liner bonded to the treated surface of the acrylic denture base and the untreated surface of the denture base.

In (2003), Nesrin Anil et al investigated micro leakage at the interface of various soft liners and base materials. Within the limits of the study, the authors concluded that silanization of soft liners may be beneficial in reducing microleakage between the soft liner material and the

acrylic resin base. However, the reduction effect of sealant on microleakage may change after aging. [7]

It has been reported that the bonding between resilient lining materials and denture base materials is affected by aging in water, the nature of the denture base material and the temperature. Resilient denture liners immersed in water leach out plasticizers and absorb water. These two mechanisms affect the denture compliance and dimensional ability. The material becomes brittle and the external load is transferred to the interface.

Many techniques have been used to determine micro leakage between dental materials; use of bacteria, compressed air, chemical tracers, electrochemical changes, autoradiographic studies, scanning electron microscopy (SEM), and dye penetration. Use of radioisotopes can provide finer detail in leakage patterns as well as serve as a method to quantify and compare leakage values. Radionuclide imaging is accepted as a “gold standard” in physiologic visualization of the human body and is a part of routine diagnostic imaging procedures. High-performance gamma cameras and positron emission tomography are powerful tools used in nuclear medicine.

In the present study, contrast medium is used instead of dyes and the degree of penetration is evaluated by using 64 slice CT scanner. Advantage of this technique is that the diluted concentration of the contrast medium has a viscosity equal to that of saliva; so it penetrates easily through the interface between the acrylic denture base and the soft liner. In this CT scanner, there is no need for sectioning of samples to evaluate the microleakage. Sectioning of samples can lead to distortion of the contrast medium, which is avoided in this technique. This scanner allows to view the axial, coronal and sagittal view of each sample with slicing at different levels. This

technique easily quantitates and measures the degree of penetration.

This heat cure silicone soft liner contains no plasticizers as like self cure silicone soft liners and therefore it will not change its consistency secondary to leaching. Once polymerized, it provides a highly elastic prosthetic base with a rubbery consistency that bonds to the acrylate

In self cure silicone soft liner, the presence of plasticizers and other soluble materials lead to absorption of water and saliva lead to debonding of the soft liner from the acrylic base.

Adhesives based on ethyl acetate solvents produced stronger bond strengths than equivalent toluene based adhesives, particularly for materials of low compliance. Bond failure for toluene based adhesives was predominantly adhesive, where as that for ethyl acetate based adhesive was predominantly cohesive. Overall, the least resistance to peeling was exhibited by a material of low compliance (i.e. relatively stiff) bonded with a toluene based adhesive. When an ethyl acetate based adhesive was used, all materials exhibited a resistance to peeling with a predominantly cohesive mode of failure. [8]

The clinicians prefer the autopolymerized soft lining material as an alternative to heat cured soft liners because of their chair side usage, easy application and less laboratory procedures, from this study the heat cure silicone soft liners shows less microleakage, better bonding and gives better results than self cure silicone soft liners.

SUMMARY AND CONCLUSION

An in vitro study was conducted to evaluate the degree of microleakage between heat cure and self cure soft liners with acrylic denture base and the effect of surface treatment of acrylic denture base with sand blasting.

The result of the present study revealed that heat cure soft liners show minor degree of penetration of penetration compared to self cure soft liners. Treating the acrylic denture base surface by sand blasting with Al_2O_3 significantly improved the bonding of silicone based soft liner to the acrylic denture base. The heat cure silicone soft liner Molloplast B shows the lowest leakage followed by the silicone soft liners Ufigel P and GC Reline, shows least leakage. The aging process affects the degree of microleakage properties than the non aging procedures.

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