Research Article

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An Evaluation of Effect of the Temporary Soft Liners on the Transverse Strength of the Heat Polymerized and Autopolymerized Denture Base Acrylic Resins

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ABSTRACT

Aim and Objective: The objective of the study was to evaluate & compare the effect of the temporary soft liners on the transverse strength of heat polymerized & auto polymerized denture base acrylic resins.

Materials and Method: A total of one hundred sixty samples were fabricated using two brands of heat cure& self-cure acrylic resins. Temporary soft liner was applied on all samples. All the samples were kept in artificial saliva to simulate the natural oral environment for forty-eight hours. All the samples were then tested for transverse flexural strength under Instron universal testing machine.

Result: A statistically significant difference was found between the transverse strength of heat cure & self-cure acrylic resin after the application of temporary soft liners.

Conclusion: Transverse strength of self cure acrylic resin was reduced significantly more after application of temporary soft liners as compared to heat cure acrylic resin with temporary soft liner.

Keywords: Transverse strength, Fatigue failure, heat cure, self cure, temporary soft liners.

INTRODUCTION

From almost the time that the dentistry achieved a professional status, there has been a constant search for an ideal denture base material.Dr. Walter Wright in 1937[1], introduced a Polymethyl Methacrylate, commonly referred to as acrylic resin, as a denture base material, since then the dental profession has relied upon Polymethyl Methacrylate, as a preferred material for denture base.Many features such as ease of manipulation, repair, relining and rebasing, good esthetics and low cost have contributed to the success of acrylic resins (Polymethyl Methacrylate) as the most commonly used denture base material today.

Under certain conditions of health debilitation or ill-fitting dentures, oral tissues may become inflamed and distorted. Relining the ill fitting dentures with the soft liner allows the tissues to return to normal without discontinuing the use of dentures, after which the new denture can be made.Soft liners have found several applications in Prosthetic dentistry. Soft liner is a layer of compressible material that separates the hard denture base material from the oral mucosa of the residual ridge. These soft liners are used as an

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essential adjunct in contemporary prosthetic treatment and management of traumatized oral mucosa and atrophic residual alveolar bone. The soft liners are supplied in the form of powder and liquid. The powder contains polymethacrylate and liquid contains solvent such as Ethyl alcohol and plasticizers such as Butylthalate, Butylglycolate. Matthews in 1945[2]realised the importance of conditioning soft tissues prior to the prosthetic treatment and suggested that the old dentures should not be worn for a period of 48 hours, before impressions are made as this would facilitate the recovery of the deformed and traumatized soft tissues. Lytle found that most patients were not willing to be without dentures during the treatment phase and suggested that a soft material such as zinc oxide eugenol paste or silicone impression material should be used to line the old dentures in order that the tissues may recover.Regali and Kydd (1953)[3] found that the acrylic resin dentures have shown to flex in function to a greater degree than metal base dentures.Barber(1934)[4] suggested the need for flexure fatigue studies, as he proved that artificial dentures were subjected to flexure or bends during mastication.

Acrylic resin dentures have been shown to flex in function much greater than could be expected. Poor tissue adaptation permits greater flexure of dentures and often results in fatigue failure. A single upper denture against natural lower teeth receives more stress than does a complete maxillary denture opposing a complete mandibular denture, often this presents a breakage problem. The recent widespread use of resilient liners has created a fatigue failure problem.[5]It has been stated by some authors that the temporary soft liners are known to have some effects on the transverse strength of the acrylic resins (Polymethyl Methacrylate). Hard acrylic bases may become more flexible and weaken after addition of soft liner so that the occurrence of fracture is increased compared to dentures constructed solely from hard acrylic materials.

The present study was therefore planned to evaluate the effect of temporary soft liners on the transverse strength of the acrylic resins using different brands of acrylic resins both heat polymerized and auto polymerized.

AIM AND OBJECTIVES

The Aim of the study was to evaluate &compare the effects of Temporary soft liners on the Transverse strength of Heat polymerized &Autopolymerized acrylic resins.

The Objectives of this study were as follows

1. To evaluate and compare the effects of temporary soft liners on the transverse strength of the Stellon-heatcure and self cure acrylic resin.

2. To evaluate and compare the effects of temporary soft liners on the transverse strength of theAcralyn – H heat cure and self cure acrylic resin.

3. To compare the effect of the temporary soft liners on the transverse strength of the Stellon –heat cure and Acralyn -H heat cure acrylic resins.

4. To compare the effect of the temporary soft liners on the transverse strength of the Stellon –self cure and Acralyn -H self cure acrylic resins.

MATERIALS AND METHOD

This in – vitro Study was divided into Two Steps.

1. Preparation of the heat cure and self cure acrylic resin samples with and without temporary soft liners.
2. Testing of the physical property (Transverse Strength) of the samples.

Materials used in the Study[fig.1]

A.Acrylic Resins: Both heat cure and self cure acrylic resins were used.

Stellon – heat cure acrylic resin.(Dental Products of India limited, Made in India)
Stellon – self cure acrylic resin.(Dental Products of India limited, Made in India)
Acralyn – H (cross linked) heat cure acrylic resin.(A Product of Asian Acrylates, Bombay, Made in India)
Acralyn – R self cure acrylic resin.(A Product of Asian Acrylates, Bombay, Made in India)

B. Soft liners: Temporary soft liners were used

Coe – Comfort (A Product of Coe – laboratories, Inc – Chicago, Illious, Made in U.S.A.)
Viscogel(Dental Products of India, Made in India)

Orthogel(Polydent's Products, Made in India)

C. Artificial Saliva: Artificial Saliva was prepared using Green wood's formula, with the following composition.

(i) Potassium Chloride 2.4 gms.
(ii) Tricalcium Phosphate 0.6 gms.
(iii) Potassium Sulphate 0.9 gms.
(iv) Potassium Hydrogen Phosphate 1.4 gms.
(v) Trisodium Phosphate 0.8 gms.
(vi) Egg albumin 5.0 gms.
(vii) Distilled water 1litre.

Description of the Metal mould[fig.2]

1. The base or lower plate

The lower plate of 4 mm thickness had eight rectangular elevations of 2 mm thickness, 60mm length, 20mm width. The space between each rectangular elevation was 15 mm.

2.The intervening plate

The intervening plate of 7 mm thickness, had rectangular depressions of 4.5 mm thickness, which when placed on the lower plate would fit snuggly.

3. The lid or upper plate – of 4 mm, thickness.

The rectangular elevations and depressions were of width 2 cm and length – 6 cm. Attachments for screws were made at the four corners and the centre of all the plates. The space between the elevations and depressions on tightening the screw attachments was 2.5 mm.

(A) Preparation of the acrylic resin samples [fig.3]

(a) Preparation of the heat cure acrylic resin samples

The powder and liquid of each brand of heat cure acrylic resin were mixed according to manufacturer's instructions. The powder liquid ratio was 3 : 1 by volume. After 10 – 12 minutes when mixed resin reached the dough stage, it was placed in the metal mould and covered with a sheet of cellophane paper. The upper plate placed and the metal mould screwed tightly one hour after packing , the mould was kept in a water bath at room temperature approximately 31 + 2ºC for curing. The temperature of the water bath was then slowly raised so that it started boiling after one hour and was allowed to boil for further half an hour. After bench cooling the metal mould was opened and the samples were finished and polished.

(b) Preparation of self cure acrylic resin samples.

The powder and liquid of the two brands of self cure acrylic resin were mixed according to manufacturer's instructions. After 2 minutes, the mixed dough was placed in the metal mould and was covered with a cellophane paper. The upper part or lid of the metal mould placed and the metal mould was screwed tightly and kept for half an hour. The metal mould was opened after half an hour and samples were finished and polished.

The acrylic resin samples on which temporary soft liners were added were roughened with sand paper, for adhesion of temporary soft liners. The soft lining materials were mixed according to manufacturer's instructions and were applied to one surface of acrylic resin samples in 2mm layer. Metal mould was used to ensure correct thickness of the soft liners.[fig.4]

Total 160 samples were prepared. The 10 samples of each brand of heat cure and self cure acrylic resins were kept as a control group ie without the soft liner. Remaining 10 samples of each brand of heat cure and auto self cure acrylic resin were lined with temporary soft liners – 'Coe – comfort', 'Viscogel', 'Orthogel' respectively.

The samples were divided as follows

Group (A)

10 – Stellon- heat cure acrylic resin samples without temporary soft liner (control group)

Group (B)

10 – Stellon- heat cure acrylic resin samples with 'Coe – comfort' soft liner.

Group (C)

10 – Stellon- heat cure acrylic resin samples with 'Viscogel ' soft liner.

Group (D)

10 – Stellon- heatcure acrylic resin samples with 'Orthogel' soft liner.

Group (E)

10 – Stellon – self cure acrylic resin samples without temporary soft liner (control group)

Group (F)

10 – Stellon- selfcure acrylic resin samples with 'Coe – comfort' temporary soft liner.

Group(G)

10 – Stellon – self cure acrylic resin samples with 'Viscogel' temporary soft liner.

Group (H)

10 – Stellon –self cure acrylic resin sampless with 'Orthogel' temporary soft liner.

Group (I)

10 – Acralyn – H (cross linked) heat cure acrylic resin samples without temporary soft liner (control group).

Group (J)

10 – Acralyn – H (cross linked) heat cure acrylic resin samples with'Coe – comfort' temporary soft liner.

Group (K)

10 – Acralyn – H (cross linked) heat cure acrylic resin samples with 'Viscogel' temporary soft liner.

Group (L)

10 – Acralyn – H (cross linked) heat cure acrylic resin samples with 'Orthogel' temporary soft liner.

Group (M)

10 – Acralyn – R – self cure acrylic resin samples without temporary soft liner (control group).

Group (N)

10 – Acralyn – R –self cure acrylic resin samples with 'Coe – comfort' temporary soft liner.

Group (O)

10 – Acralyn – R selfcure acrylic resin samples with 'Viscogel' temporary soft liner.

Group (P)

10 – Acralyn – R selfcure acrylic resin samples with 'Orthogel' temporary soft liner.

All the 160 samples were stored in a freshly prepared artificial saliva of PH 6-7 for 48 hours. Just before testing, samples were removed from artificial saliva, rinsed slowly under tap water, thoroughly dried with blotting paper.

[B] **Testing the prepared acrylic resin samples with and without temporary soft liners.[fig.5]**

An Instron Universal testing machine was used to test the strength of the acrylic resin samples. The acrylic resin samples were placed on the metal roller. The two ends of the samples were supported by metal roller having cylindrical surfaces of 3.2 mm in diameter and parallel to each other. The distance between the two metal rollers was kept 50 mm as per A.D.A. specifications. The central loading nose 3.2 mm in diameter was kept midway between the two supports. The crosshead rate of machine was adjusted till the loading nose just touched the surface of the acrylic resin sample. The load then was applied uniformly and slowly increased till the samples fractured.[fig,6] Strength was recorded by noting reading of applied load at which samples fractured.

The amount of load applied was calculated according to the number of divisions moved by the pointer, since one division signified 0.079 kg of load applied. The transverse strength was calculated according to the formula,

$$S = \frac{3PL}{2bd^2}$$

Where

S = Transverse strength
P = load applied
L = distance between supports
B = breadth of the sample
D = thickness of the sample

Fig 1:Armamentarium used in the study.

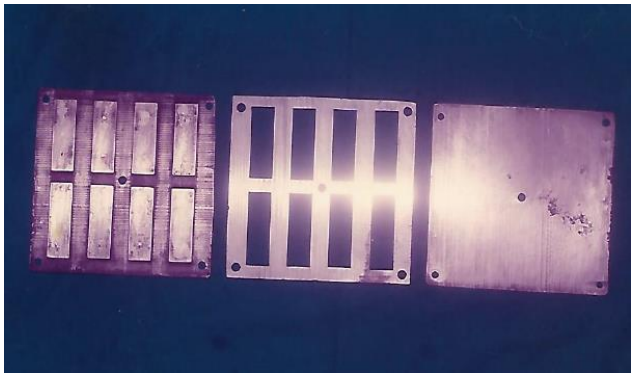


Fig 2: Photograph showing metal mould used for preparation of acrylic resin specimes with and without liners.

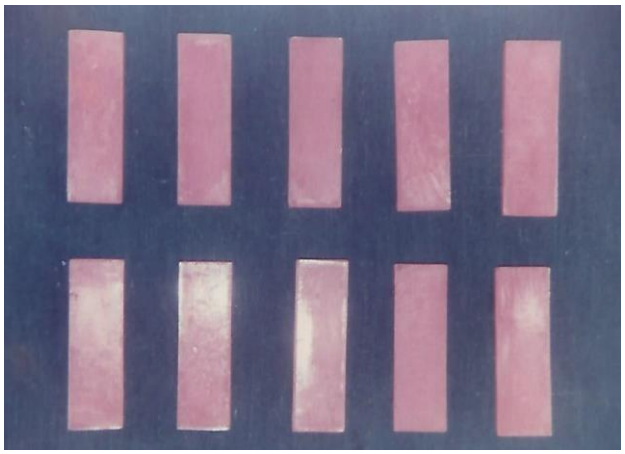


Fig 3: Photograph showing acrylic resin samples.

STATISTICAL ANALYSIS

The mean value and standard deviation were calculated by using paired 't' test

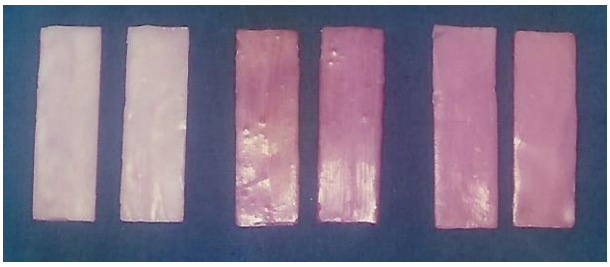


Fig 4: Acrylic resin specimen with soft liners 'Coe Comfort, Visco gel, Orthogel' respectively.

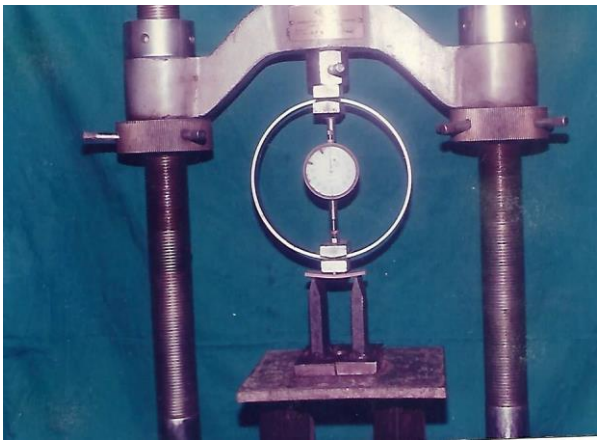


Fig 5: Photograph of specimen during testing.

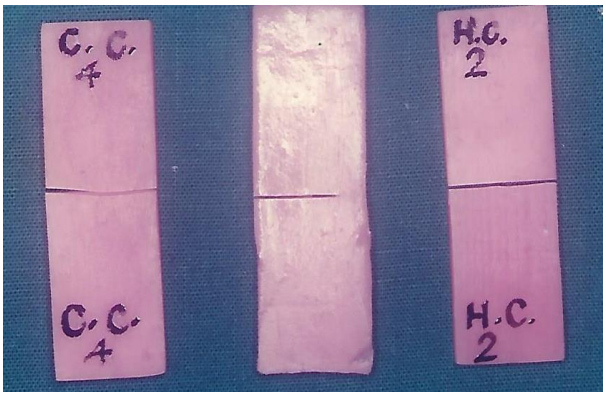


Fig 6: Photograph showing fractured samples.

To check whether the difference between the means of transverse strength of sample group (A) and sample group (B) is significant, the paired "t" test was performed.

$$t = \frac{x_1 - x_2}{\sqrt{S^2 (1/n1 + 1/n2)}}$$

Where S2 is the combined standard deviation of group (A) and group (B), obtained by the formula.

$$S^2 = \frac{n_1 S_1 + n_2 S_2^{\ 2}}{n_1 + n_2 - 2}$$

Null Hypothesis (Ho) Assumes that the transverse strength of the heat cure acrylic resin samples with and without soft liner is same or equal.

$$S^2 = \frac{n_1 S_1^2 + n_2 S_2^{\ 2}}{n_1 + n_2 - 2} = 513187 + 10812$$

$$10 + 10 - 2$$

$$= 29111.056$$

$$t = \frac{x_1 - x_2}{\sqrt{S^2 (1/n_1 + 1/n_2)}} = \frac{1229 - 955.9}{\sqrt{29111.056 (1/10 + 1/10}}$$

$$= 273.1 / 76.29$$

$$= 3.579$$

The calculated value of t is greater than the table value of t 0.05 at df 2.101. Therefore Null hypothesis is not accepted andthe difference between the means of sample group (A) and sample group (B) is significant. Hence the transverse strength of the heat cure acrylic resin samples with 'coe-comfort' soft liner is significantly lower than that of the heat cure acrylic resin samples without soft liner. This means that the 'coe-comfort' soft liner decreases the transverse strength of the stellon heat cure acrylic resin. To check whether the difference between the means of transverse strength of sample group (A) and sample group (C) significant, the paired "t" test was performed.

The calculated value of t = 3.578 is greater than the table, value of t 0.05 at df 2.101.Therefore null hypothesis is not accepted and the difference between means of sample group (A) and sample group (C) is significant. Hence the transverse strength of the heat cure acrylic resin. Samples with 'viscogel' soft liner is significantly lower than that of the heat cure acrylic resin samples without soft liner. To check whether the difference between the means of transverse strength of sample group (A) and sample group (D) is significant, the paired 'r' test was performed, in a same manner as done before. The calculated value of t = 6.070, is greater than the table value of t 0.05 at df 2.101. Therefore the differences between the means of sample group (A) and sample group (D) is significant. Hence the transverse strength of the stellon heat cure acrylic resin samples with 'orthogel' soft liner is significantly lower than that of the stellon heat cure acrylic resin samples without 'orthogel' soft liner. This means that the 'orthogel' soft liner decrease the transverse strength of the stellon – heat cure acrylic resin. To check whether the difference between the means of transverse strength of sample group (E) and sample group (F) samples is significant, the paired 't' test was performed.

The calculated value of t= 8.520, is greater than the table value of t 0.05 at df = 2.101.Therefore, the null hypothesis is not accepted and the difference between the mean values of transverse strength of sample group (E) and sample group (F) is significant. Hence the transverse strength of the stellonself cure acrylic resin samples with 'coe-comfort' soft liner is significantly lower than that of the Stellonself cure acrylic resin samples without soft liner.

This means that the coe-comfort soft liner decreases the transverse strength of the stellon-cold cure acrylic resin. To check whether the difference between the means of transverse strength of sample group (E) and sample group (G) samples significant, the paired 't' test was performed.

The calculated value of t = 10.892 is greater than the table value of t 0.05 at df = 2.101. Therefore, the mull hypothes is not accepted and the differences between the mean values of transverse strength of sample group (E) and sample group (G) is significant. Hence the transverse strength of the stellonself cure acrylic resin samples with 'viscogel' soft liner is significantly lower than that of the stellonself cure acrylic resin samples without soft liner. This means that the 'viscogel' soft liner decreases the transverse strength of the stellon – self cure acrylic resin.

To check whether the differences between the means of transverse strength of sample group (E) and sample group (H) is significant, the paired 't' test was performed.

The calculated value of t = 9.4336 is greater than the table value of t = 0.05 at df = 2.101.Therefore the difference between the mean value of transverse strength of sample group (H) is significant.Hence the transverse strength of the Stellonself cure acrylic resin samples with 'orthogel' soft liner is significantly lower than of the stellonself

cure acrylic resin samples without soft liner.This means that the 'orthogel' soft liner decreases the transverse strength of stellonself cure acrylic resin.

To check whether the difference between the means of transverse strength of sample group (I) and sample group (J) is significant, the paired 't' test was performed.

The calculated value of t = 9.4336 is greater than the table value of t = 0.05 at df = 2.101. Therefore null hypothesis is not accepted and the difference between the mean values of transverse strength of sample group (I) and sample (J) is significant. Hence the transverse strength of the Acralyn H-(cross linked) heat cure acrylic resin samples with 'coe-comfort' soft liner is significantly lower than that of the Acralyn H-(cross linked) heat cure acrylic resin samples without soft liner.This means that the 'coe-comfort' soft liner decreases the transverse strength of the Acralyn H-(cross-linked) heat cure acrylic resin.

To check whether the difference between the means of transverse strength of sample group (I) and sample group (K) is significant, the paired 't' test was performed.

The calculated value of t = 9.4336 is greater than the table value of t = 0.05 at df = 2.101. Therefore the mull hypothesis is not accepted and the difference between the mean value of transverse strength of sample group (I) and sample group (K) is significant.Hence the transverse strength of the Acralyn – H (cross linked) heat cure acrylic resin ampless with 'viscogel' soft liner is significantly lower than of the Acralyn – H (cross-linked) heat cure acrylic resin samples without soft liner.This means that the viscogel soft liner decreases the transverse strength of the Acralyn-H (cross –linked) heat cure acrylic resin.

To check whether the difference between the mean values of transverse strength of sample group (I) and sample group (L) is significant the paired 't' test was performed.

The calculated value of t = 7.865 is greater than the table value of t 0.05 at df = 2.101. Therefore the null hypothesis is not accepted. Therefore the difference between the mean values of transverse strength of sample group (I) and sample group (L) is significant. Hence the transverse strength of the Acralyn-H (cross linked) heat cure acrylic resin samples with 'orthogel' soft liner is significantly lower than that of the Acralyn heat cure resin samples without soft liner. This means that 'orthogel' soft liner decreases the transverse strength of the Acralyn –H (cross linked) heat cure acrylic resin.

To check whether the difference between the mean value of transverse strength of s ample group (M) and sample group (N) samples is significant the paired 't' test was performed.

The calculated value of t = 2.75 is greater than the table value of t = 0.05 at df 2.101. Therefore the null hypothesis is not accepted. Therefore the difference between the mean values of transverse strength of the sample group (M) and sample group (N) is significant.Hence the transverse strength of Acralyn –R-self cure acrylic resin samples with 'coe-comfort' soft liner is significantly lower than that of the Acralyn-R-self cure acrylic resin samples without soft liner.This means that the 'coe-comfort' soft liner decreases the transverse strength of the Acralyn-R-self cure acrylic resin.

To check whether the difference between the mean values of transverse strength of sample group (M) and sample group (O) is significant, the paired 't' test was performed.The calculated value of t = 1.387 is lower than the table value of t = 0.05 at df 2.101.Therefore the null hypothesis is accepted and the difference between the mean values of transverse strength of the sample group (M) and sample group (O) is not significant.Hence the transverse strength of Acralyn–R-self cure acrylic resin samples with 'viscogel' soft liner is significantly lower than that of the Acralyn-R-self cure acrylic resin samples without soft liner.This means that the 'viscogel' soft liner decreases the transverse strength of the Acralyn-R-self cure acrylic resin significantly.

To check whether the difference between the mean values of transverse strength of sample group (M) and sample group (P) is significant, the paired 't' test was performed.

The calculated value of t = 5.452 is greater than the table value of t = 0.05 at df 2.101. Therefore the null hypothesis is not accepted and the difference between the mean values of transverse strength of the sample group (M) and sample group (P) is not

significant. Hence the transverse strength of Acralyn–R-self cure acrylic resin samples with 'orthogel' soft liner is significantly lower than that of the Acralyn-R-self cure acrylic resin samples without soft liner. This means that the 'orthogel' soft liner decreases the transverse strength of the Acralyn-R-self cure acrylic resin significantly. The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the stellon – heat cure acrylic resin by 22.42%, 37%, 39% respectively. The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the stellon – heat cure acrylic resin by 39.97%, 48.54%, 42.8% respectively. The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the stellon – self cure acrylic resin by 22.42%, 37%, 39% respectively. The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the Acralyn –H (cross linked) – heat cure acrylic resin by 16.62%, 17.02%, 20.72% respectively. The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the Acralyn –R– self cure acrylic resin by 18.09%, 10.64%, 28.09% respectively.

Table 1: Transverse Strength Values Of Stellon-Heat Cure Acrylic Resin Samples Without Soft Liner (A) (Control Group) & With Coe-Comfort(B), Viscogel(C), Orthogel(D), Temporary Soft Liners.

SPECIMEN NO.	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_1) (STELLON WITH HEAT CURED SOFT LINER) (A) Group	$(x_1-x_1)^2$ (STELLON WITH HEAT CURED SOFT LINER) (A) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_2) (COE-COMFORT SOFT LINER)	$(x_2-x_2)^2$ (COE-COMFORT SOFT LINER) (B) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_3) (VISCOGEL SOFT LINER)	$(x_3-x_3)^2$ (VISCOGEL SOFT LINER) (C) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_4) (ORTHOGEL SOFT LINER)	$(x_4-x_4)^2$ (ORTHOGEL SOFT LINER) (D) Group
1.	1422	38416	900	3136	876	10465.29	758	309.75
2.	1383	23716	971	225	810	1317.69	568	30765.16
3.	1303	5476	924	1024	639	18144.09	900	25472.16
4.	1398	28561	1018	3844	758	246.49	663	5990.76
5.	1241	144	976	400	781	53.29	687	2851.56
6.	1407	31684	971	225	786	151.29	758	309.76
7.	971	66564	924	1024	767	44.89	758	309.76
8.	1422	37249	933	484	781	53.29	796	3091.36
9.	758	221841	971	225	758	246.49	758	309.76
10.	985	59356	971	225	781	53.29	758	309.76
	12290	513187	9559	10812	7737	30776.10	7404	69719.80

Table 2: Transverse Strength Values Of Stellon-Self Cure Acrylic Resin Samples Without Soft Liner (E) (Control Group) & With Coe-Comfort(F), Viscogel(G), Orthogel(H), Temporary Soft Liners

SPECIMEN NO.	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_1) (STELLON WITH COLD CURE SOFT LINER) (E) Group	$(x_1-x_1)^2$ (STELLON WITH COLD CURE SOFT LINER) (E) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_2) (COE-COMFORT SOFT LINER)	$(x_2-x_2)^2$ (COE-COMFORT SOFT LINER) (F) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_3) (VISCOGEL SOFT LINER)	$(x_3-x_3)^2$ (VISCOGEL SOFT LINER) (G) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_4) (ORTHOGEL SOFT LINER)	$(x_4-x_4)^2$ (ORTHOGEL SOFT LINER) (H) Group
1.	1241	44142.01	682	3994.24	521	88.36	658	4691.25
2.	1189	24995.61	677	3387.24	507	547.56	639	2450.25
3.	948	6872.41	644	635.04	554	556.96	592	6.25
4.	1061	906.01	658	1538.64	502	806.56	639	2450.25
5.	995	1288.81	644	635.04	545	213.16	545	1980.25
6.	1213	33160.41	677	3387.24	592	3794.56	559	930.25
7.	924	11427.61	549	4872.04	568	1413.76	573	272.25
8.	819	44901.61	568	2580.64	521	88.36	592	6.25
9.	924	11427.61	540	6209.44	497	1115.56	568	462.25
10.	995	1288.81	549	4872.04	497	1115.56	510	3540.25
	10309	180410.9	6188	32111.60	5304	9740.40	5895	16790.25

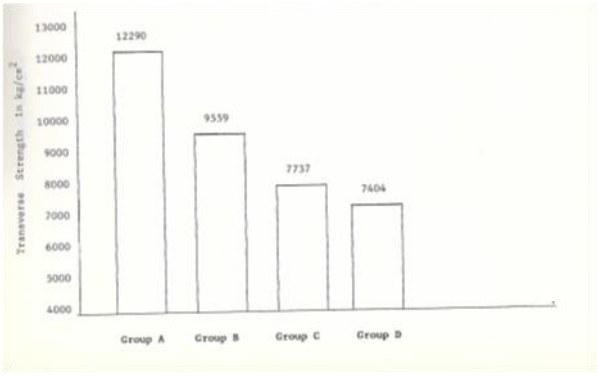
Table 3: Transverse Strength Values Of Acralyn-H-(Crosslinked) Heat Cure Acrylic Resin Samples Without Soft Liner (I) (Control Group)& With Coe-Comfort(J), Viscogel(K), Orthogel(L), Temporary Soft Liners.

SPECIMEN NO.	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_1) (ACRALYN-H WITH HEAT CURED SOFT LINER)	$(x_1-x_1)^2$ (ACRALYN-H WITH HEAT CURED SOFT LINER) (I) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_2) (COE-COMFORT SOFT LINER)	$(x_2-x_2)^2$ (COE-COMFORT SOFT LINER) (J) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_3) (VISCOGEL SOFT LINER)	$(x_3-x_3)^2$ (VISCOGEL SOFT LINER) (K) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_4) (ORTHOGEL SOFT LINER)	$(x_4-x_4)^2$ (ORTHOGEL SOFT LINER) (L) Group
1.	1241	14232.49	1137	7.84	1180	2631.69	1137	3433.96
2.	1445	7174.09	1004	16952.04	1185	3169.69	971	11534.76
3.	1422	3806.89	1146	139.24	1137	68.89	1090	134.46
4.	1312	2332.89	1194	3576.04	758	137418.49	1019	3528.36
5.	1422	3806.89	1128	38.44	1132	10.89	1066	153.76
6.	1407	2180.89	976	25027.24	1161	1043.29	971	11534.76
7.	1445	7174.09	1213	6209.44	1255	15951.69	1156	6021.76
8.	1422	3806.89	1161	718.24	1338	43806.49	1137	3433.96
9.	1255	11088.09	1208	5446.44	1208	6288.49	1128	2460.16
10.	1252	16460.89	1175	1664.64	933	38298.49	1109	4936.36
	13603	72064.10	11342	59779.60	11287	248688.10	10784	43172.40

Table 4: Transverse Strength Values Of Acralyn-H-(Crosslinked) Self Cure Acrylic Resin Samples Without Soft Liner (M) (Control Group)& With Coe-Comfort(N), Viscogel(O), Orthogel(P), Temporary Soft Liners.

SPECIMEN NO.	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_1) (ACRALYN-H WITH COLD CURE	$(x_1-x_1)^2$ (ACRALYN-H WITH COLD CURE SOFT LINER)	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_2) (COE-COMFORT SOFT	$(x_2-x_2)^2$ (COE-COMFORT SOFT LINER) (N) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_3) (VISCOGEL SOFT LINER)	$(x_3-x_3)^2$ (VISCOGEL SOFT LINER) (O) Group	TRANSVERSE STRENGTH = $\frac{3pL\ kg}{2bd^2\ cm^2}$ (x_4) (ORTHOGEL SOFT LINER)	$(x_4-x_4)^2$ (ORTHOGEL SOFT LINER) (P) Group

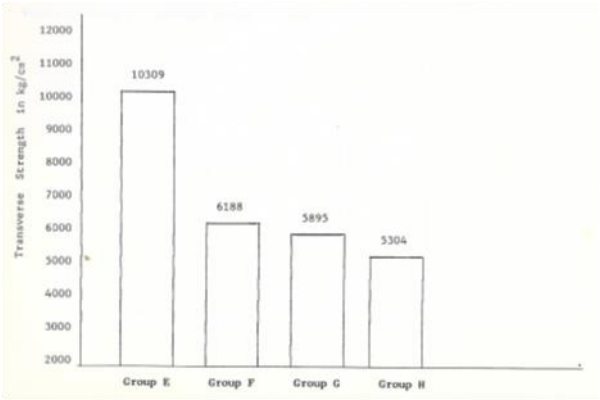
	SOFT LINER)	(M) Group	LINER)					
1.	753	16281.76	805	7005.69	782	24.01	701	5610.01
2.	948	4542.76	971	62350.09	1066	77896.81	725	9781.21
3.	1042	26049.96	720	1.69	819	1030.41	696	4886.01
4.	739	20050.56	975	5554.49	606	32724.81	649	524.41
5.	805	5715.36	720	1.69	758	835.21	663	1361.61
6.	938	3294.76	824	10547.29	663	15351.21	625	1.21
7.	857	556.96	663	3398.89	450	113501.6	568	3375.61
8.	1080	39760.36	440	79129.69	924	18796.41	535	8299.21
9.	796	7157.16	663	3398.89	948	25953.21	426	40040.01
10.	848	1062.76	450	79129.69	853	4369.21	673	2199.61
	8806	134872.40	7213	300518.10	7869	272582.90	6261	76378.90



Graph 1: Graph showing average transverse strength values of Stellon Heat cured acrylic resin specimens without soft liner (Group A), with soft liners Coe Comfort (Group B), Viscogel (Group C), Orthogel (Group D) respectively.

DISCUSSION

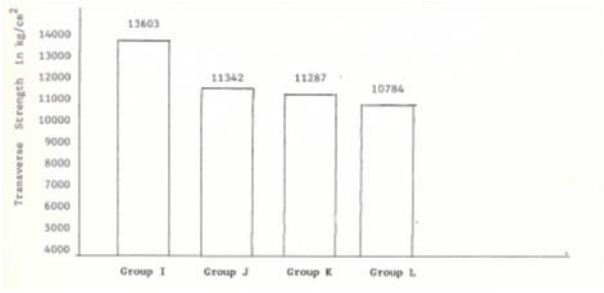
The failure of acrylic resin dentures depends on a large number of factors. One such factor of clinical significance is the fatigue failure.Flexural strength or transverse strength when tested by three point transverse bend test induces tensile stresses and compressive stresses.Artificial dentures are commonly subjected to flexures during mastication. This flexing often results in fatigue failure. Fatigue failure can happen in well-fitting dentures. It occurs even when a well



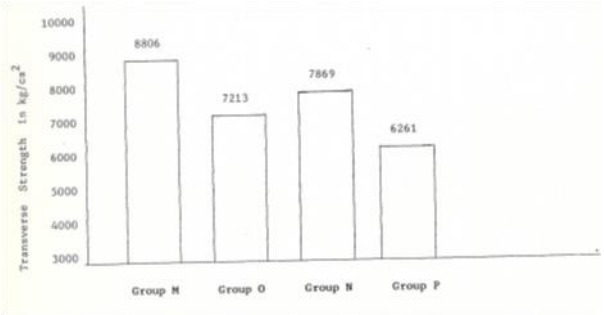
Graph 2: Graph showing average transverse strength values of Stellon cold cured acrylic resin specimens without soft liner (Group E), with soft liners Coe Comfort (Group F), Viscogel (Group G), Orthogel (Group H) respectively.

fit upper denture occluding against natural lower teeth and in virtually all dentures with soft liners.Kelly (1967)[6] stated that flexure fatigue is the chief cause of failure of polymethyl methacrylate denture bases. He also showed that the heat cure resins were much more resistant to flexure fatigue than the self cure resin.

Stafford et al (1978)[7] stated that the polymers used in the construction of the denture



Graph 3: Graph showing average transverse strength values of Acralyn-H (Cross linked) Heat cured acrylic resin specimens without soft liner (Group I), with soft liners Coe Comfort (Group J), Viscogel (Group K), Orthogel (Group L) respectively.



Graph 4: Graph showing average transverse strength values of Acralyn -R cold cured acrylic resin specimens without soft liner (Group M), with soft liners Coe Comfort (Group O), Viscogel (Group N), Orthogel (Group P) respectively.

bases are subjected to loading by the masticatory apparatus during function. Thus it is important that there should be no change in the dimension during chewing. This study was therefore done to evaluate the effect of commonly used temporary soft liner, 'Coe-comfort', 'Viscogel', 'Orthogel' on the transverse strength of the commonly used denture base resins 'Stellon' heat cure acrylic resin, 'Stellon' cold cure acrylic resin, 'Acrylic-H' (cross-linked) heat cure acrylic resin and ' Acralyn-R' cold cureacylic resin.The results of this study revealed some useful information. The observation shows that the temporary soft liners decreases the transverse strength of the acrylic resins. The (cross linked) heat cure acrylic resin is less affected as compared to non –crosslinkedheat andself cure acrylic resins.

Cross linking affects the physical properties of a polymer .Increasing the number of cross-links ,increases the glass transition temperature. Glass transition temperature is the temperature above which the polymer changes from a hard ,more or less brittle material to a soft rubbery sage. Cross linked polymers are harder, more resistant to the action of solvents than non crosslinked materials.[8] The temporary soft liners are supplied in the form of powder and liquid. The powder contains poly methaylmethacylate and liquid contains solvents such as Ethyl alcohol and plasticizers such as Butylthalate,Butylglycolate.[8].

The plasticizer such as Butylthalate have an effect on both the glass transition temoerature and modulus of elasticity of some polymers. They are able to penetrate between the randomly oriented chains of polymer. As a result the molecules of polymer gets apart, and the forces between them becomes less. They soften the material and make it more flexible by lowering its glass transition temperature. Thus soft liners decreases the strength of the acrylic resins[9].

The results of the study are as per the reaction stated between soft liners and polymer. The plasticizer present in the liquid of Butylpthalate reduces the transverse strength of the non cross linked acrylic resins more as compared to the cross linked acrylic resins. Our results are in accordance with the following studies done by various authors.Sweeney et al (1954)[10] stated that the transverse strength and transverse deflection of resins vary with temperature, rate of loading, moisture content and testing environment.

Craig (1961)[11] showed that the addition of resilient liners to methyl methacrylate denture base, reduced the transverse strength of the methyl methacrylate denture base resins. Braner and white (1959)[12] studied the effect of self cure soft liners on the transverse strength of denture base resin (heat cure resin). The samples were stored in distill water

at 37ºC for 48 hours. He found that the self cure soft liners reduced the transverse strength of the heat cure denture base resin.

Elick and Craig (1962)[13] studied the effect of the soft liners on the transverse strength of the base material and concluded that heat cure liner had no harmful effect on the transverse strength of the acrylic resin base and the self cure liner reduced the transverse strength of the acrylic resin base by approximately 25%.Davis et al (1988)[14] studied the effect of temporary self liners on the transverse strength of the heat cure and cold cure resins and showed than the soft resilient liners decreases the transverse strength of the self cure acrylic resins more than the heat cure resins.The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the Stellon – heat cure acrylic resin by 22.42%, 37%, 39% respectively.

The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the Stellon – self cure acrylic resin by 39.97%, 48.54%, 42.8% respectively.The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the Acralyn –H (cross linked) – heat cure acrylic resin by 16.62%, 17.02%, 20.72% respectively.The temporary soft liners 'coe – comfort', 'viscogel', 'orthogel' reduced the transverse strength of the Acralyn –R– self cure acrylic resin by 18.09%, 10.64%, 28.09% respectively.

CONCLUSION

From the results of the study the following conclusions have been drawn.

1. The temporary soft liners reduced the transverse strength of the Stellon- heat cure acrylic resin and Stellon- self cure acrylic resin. The transverse strength of the Stellon- self cure acrylic resin was reduced more as compared to Stellon heat cure acrylic resin. This means that heat cure acrylic resins gets less affected as compared to self cure acrylic resin, by addition of soft liners.

2. The temporary soft liners reduced the transverse strength of the Acralyn-H(Cross linked) –heat cure acrylic resin and self cure acrylic resin. The transverse strength of the Acralyn -H self cure acrylic resin was reduced more as compared to Acralyn -H heat cure acrylic resin. This means that the heat cure acrylic resin gets less affected as compared to self cure acrylic resin, by addition of soft liners.

3. The temporary soft liners reduced the transverse strength of the Stellon –heat cure acrylic resin more as compared to Acralyn –H(Cross linked) heat cure acrylic resin. This means that the Acraylin -H heat cure resin gets less affected as compared to Stellon – heat cure acrylic resin, by addition of soft liners.

4. The temporary soft liners reduced the transverse strength of the Stellon –self cure acrylic resin more as compared to Acralyn –H(Cross linked) self cure acrylic resin. This means that the Acraylin -H self cure acrylic resin gets less affected as compared to Stellon – heat cure acrylic resin, by addition of soft liners.

5. The Coe-comfort temporary soft liner reduced the transverse strength of the Acralyn –H &Stellon –heat and self cure acrylic resin less as compared to Viscogel&Orthogel. The Viscogel temporary soft liner.reduced the transverse strength less as compared to Orthogel. The Orthogel temporary soft liner reduced the transverse strength more as compared to Viscogel&Orthogel.

SUMMARY

The transverse strength of the heat cureand selfcure acrylic resins were evaluated and compared with the heat cure and self cure acrylic resins lined with 'Coe-comfort' 'Viscogel' and 'Orthogel' temporary soft liners.The transverse strength of the stellon-heat cure acrylic resin was reduced by 32%, of the stellon-self cure acrylic resin by 43%, by the addition of the soft liners.The transverse strength of the Acralyn-H (cross linked) acrylic resin was reduced by 18%, of the Acralyn-R – self cure acrylic resin by 20%, by the addition of the soft liners. From this study it is learned that, whenever there is a need of soft liners ,we should use heat cure cross linked acrylic resins, as the resistance to fracture will be more as compared to non cross linked heat cure and self cure acrylic resins.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Peyton F.A.; History of resins in Dentistry. D.C.N.A. 1975 : 19 : 211
2. Matthews E.; Soft resin lining for dentures.Br,Dent.J.1945:78:140.
3. Regli C.P. Kydd W.L.; Preliminary study of the lateral deformation of metal base denture in relation to plastics base dentures. J.P.D. 1953: 3: 326.
4. Barber Ronald.; Preliminary test of some of the newer denture materials. J.A.D.A. 1934: 21 : 1969.
5. Smith D.C.;The acrylic denture mechanical evaluation of midline fracture.Br,Dent,J.1961:10;257.
6. Kelly Ellsworth.; Fatigue failure in denture bare polymers. J.P.D. 1969: 21 : 257
7. Stafford G.D. Robin.; Creep and hardness testing of some denture base polymers. J . P. D. 1978 : 39 : 6
8. Philips R.W. ;Skinner's science of dental Materials, Pg. No. 28, Eighth Edition, W.B. Sannders company.
9. McCabe J.F. Applied dental materials,seventh edition,pg.102,Blackwell scientific publication.
10. Sweeney W.T;.A transverse testing machine for denture resins. . J.A.D.A. 1954: 49 : 174.
11. Craig R.G.; Properties of resilient denture liners Gibbon Paul J.A.D.A. 1961 : 63 : 382 Denture reliners-direct, haed,self curing resins.
12. Braner M.G. White E. E; Denture reliners-direct, hard, self-curing resins, J.A.D.A. 1959 : 59 : 270
13. EickJ.D.,Craig R.M. Properties of resilient denture liners in simulated mouth conditions. J.P.D.1962:12:1043
14. Davis D.M. Plasticising effects of temporary soft lining materials on polymerized acrylic resins. J.P.D.1988:60:463.