



## RESEARCH ARTICLE

### EFFECT OF DRYING TIMES OF TRAY ADHESIVES ON TENSILE BOND STRENGTH BETWEEN AUTOPOLYMERIZING RESIN AND POLYVINYL SILOXANE IMPRESSION MATERIAL

Chiramana Sandeep, \*Katragadda Mythili, Muvva Suresh Babu, Anne Gopinadh, Kadiyala Krishna Kishore, Jyothula Ravi Rakesh Dev, Srujana Zakkula, Phani Krishna, G. and Narendra Kedasi

Sibar Institute of Dental Sciences, Guntur, Andhra Pradesh, Katragadda Mythili, Dno-7-55, Atluri Venkateswara Rao Street, Kamayya Thopu, Vijayawada, Pin-520007

#### ARTICLE INFO

##### Article History:

Received 22<sup>nd</sup> April, 2016  
Received in revised form  
05<sup>th</sup> May, 2016  
Accepted 10<sup>th</sup> June, 2016  
Published online 31<sup>st</sup> July, 2016

##### Key words:

Drying time, Elastomeric impression material, Tensile bond strength, Tray adhesive.

#### ABSTRACT

**Aim & Objectives:** To determine the tensile bond strength of different tray adhesives which were allowed to dry for various intervals of time between auto polymerizing resin and polyvinylsiloxane impression material.

**Materials and Methods:** A total of 56 samples were prepared for this study. Out of the total 56 samples, a single coat of Coltene tray adhesive and Medicept tray adhesive was applied for 28 samples each, following which tray adhesive was allowed to dry for four different time intervals. (0 min, 20 min, 40 min, 60 min).

**Results:** The results were analyzed using ANOVA one way test, Scheffe test and unpaired 't' test. Results showed that a minimum of 20 minutes drying time is necessary for acceptable bond strength.

**Conclusion:** Within the limitations of this study, it can be concluded that a minimum of 20 minutes drying time is necessary for acceptable bond strength. Coltene tray adhesive showed superior result than with Medicept tray adhesive.

Copyright©2016, Chiramana Sandeep et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Citation:** Chiramana Sandeep, Katragadda Mythili, Muvva Suresh Babu et al. 2016. "Effect of drying times of tray adhesives on tensile bond strength between autopolymerizing resin and polyvinylsiloxane impression material", *International Journal of Current Research*, 8, (07), 35210-35213.

## INTRODUCTION

### "Behind the complicated details of the world stand the simplicities"

Fitness precision of a prosthetic device is one salient factor that contributes to the long term success of a prosthetic treatment. However a prosthetic restoration typically entails and involves many clinical and laboratory procedures. It should thus be highlighted that the sum /of insignificant failures and errors at each step can detrimentally lead to a misfit. In this connection dental impression materials play an important role as their primary function is to produce an accurate replica of the oral tissues. (Mauro et al., 2007) A detailed and dimensionally accurate impression is required for the fabrication of any prosthesis. Accurate registration of oral structures requires (1) an accurate impression material, (2) an accurate impression

tray to support the material and (3) a means of bonding or attaching the impression material to the tray. (Abdulla and Talic, 2003) Numerous sources of inaccuracy can develop during impression making, among which are selection of type, size and rigidity of tray, the application of tray adhesive, impression technique and manipulation of impression material. (Bindra and Heath, 1997) To be able to withstand the forces generated during the removal of set impressions from the oral cavity, there must be sufficient adhesion between the impression material and tray. During tray removal, a combination of stresses develops between the impression material / adhesive / tray assembly. (Marafie et al., 2008) These stresses tend to pull the impression material away from the tray. If the tray is removed perpendicularly to the occlusal plane, tensile and shear stresses dominate in the palatal area. (Chai et al., 1991) Each class of elastomeric impression material has its own specific adhesive. Use of specific adhesive and delivery system advocated by the manufacturer of the impression material is not necessary for obtaining maximal retentive strength of the impression to the tray. To date application of adhesive solution on custom tray surface seems

#### \*Corresponding author: Katragadda Mythili,

Sibar Institute of Dental Sciences, Guntur, Andhra Pradesh, Katragadda Mythili, Dno-7-55, Atluri Venkateswara Rao Street, Kamayya Thopu, Vijayawada, Pin-520007

to be most effective in achieving the needed bond strength. However due to consideration and priority for shortened chair side time, many prosthodontist's tend to ignore or disregard the adhesive drying time recommended by the manufacturer. Further, use of adhesive solutions has not been quantified. With clinical effectiveness in mind, this study was designed to investigate the appropriate drying time of tray adhesives by evaluating tensile bonding strength between polyvinylsiloxane impression materials and resin tray, for various drying time intervals.

## MATERIALS AND METHODS

In the following study, a tray material holder and impression material holder were fabricated to simulate the impression tray containing the impression material. (Dixon, 1994)

- Initially a square die stone block of 3.8cm was prepared. This stone block was duplicated in silicone material to obtain the mold space for tray material holder.
- Then another square die stone block of similar measurements was fabricated and upon this small projections of die stone of 2mm in thickness, were formed on all four corners of the surface to ensure an even thickness of impression material for testing.
- This die stone block was duplicated with silicone (UniSil-Flow, Germany, Batch no:1876) and the mold space for impression material holder was obtained.
- A total of fifty six specimen assemblies were fabricated using autopolymerizing resin (DPI-RR acrylic repair material, Mumbai Batch number: 7132).

Acrylic resin was mixed according to manufacturer instructions and rolled to a uniform thickness, the silicone mold was pressed on to the surface of rolled resin and the material was trimmed to the size of the mold using a sharp scalpel.

- A hook (19 guaze, Konark company, Mumbai batch no:6533) was incorporated in the tray material holder so that an eye bolt could be threaded to it for attachment during tensile testing.
- Out of total 56 specimens, 28 specimens were categorized as Group A and 28 specimens were categorized as Group B.
- Coltene tray adhesive (Batch no:D55645, Coltene, Switzerland) was applied to all the Group A specimens. The tray adhesive was then allowed to dry to four different time intervals. For each time interval seven specimens were tested.
  - 0min- Sub Group A1
  - 20min- Sub Group A2
  - 40min- Sub Group A3
  - 60min- Sub Group A4
- Medicept tray adhesive (Batch no:RA12P, Medicept, USA) was applied to all the Group B specimens. The tray adhesive was then allowed to dry to four different time intervals. For each time interval seven specimens were tested.
  - 0min- Sub Group B1
  - 20min- Sub Group B2

- 40min- Sub Group B3
- 60min- Sub Group B4
- Impression material (Regular body, Reprisil, Dentsply, Batch no:121102) was hand mixed with a spatula and applied to specimen holder.
- The tray material and mixed impression material were placed in even contact with each other and allowed to set for 10 minutes.
- Each material was placed in a testing machine, a tensile force was applied and the force necessary to separate the impression material side from tray material side of each specimen was recorded.

The values of all the samples were noted, evaluated and analyzed.

## RESULTS

The present study was conducted to evaluate the effect of drying times of tray adhesives on tensile bond strength between autopolymerizing resin and polyvinyl siloxane impression material.

**Table 1. Intra (within) groups comparison between groups A1 to A4**

		Multiple Comparisons				
		Scheffe's test			95% Confidence Interval	
(I)	Mean Difference (I-J)	Std. Error	P value	Lower Bound	Upper Bound	
A1	A2	-71.97	26.65	0.090 NS	-152.040	8.100
	A3	-87.88	26.65	0.027 S	-167.950	-7.810
	A4	-54.39	26.65	0.270 NS	-134.460	25.670
A2	A1	71.97	26.65	0.090 NS	-8.100	152.040
	A3	-15.91	26.65	0.948 NS	-95.980	64.160
	A4	17.58	26.65	0.932 NS	-62.490	97.640
A3	A1	87.88	26.65	0.027 S	7.810	167.950
	A2	15.91	26.65	0.948 NS	-64.160	95.980
	A4	33.49	26.65	0.668 NS	-46.580	113.550
A4	A1	54.39	26.65	0.270 NS	-25.670	134.460
	A2	-17.58	26.65	0.932 NS	-97.640	62.490
	A3	-33.49	26.65	0.668 NS	-113.550	46.580

Statistical Analysis: This table depicts the Scheffe test for Group A. The test is statistically significant as the P value is <0.05.

From the above results, the following conclusions can be carried out:

1. In the Group A specimens, the tensile bond strength between autopolymerizing resin and polyvinylsiloxane impression material is good for Group A3 specimens which were being allowed to dry for 40 minutes. In the Group B specimens, the tensile bond strength between autopolymerizing resin and polyvinylsiloxane impression material is good for Group B2 specimens which were being allowed to dry for 20 minutes. In the comparison of Group A and Group B samples, Group A samples shows significantly superior tensile bond strength when compared to Group B. From the results we can conclude that it is better to wait for a minimal time of 20 minutes for the impression material to be loaded after the application of tray adhesive.

Table 2. Intra (Within) groups comparison between groups B1 to B4

Multiple Comparisons						
Scheffe						
(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	P value	95% Confidence Interval	
					Lower Bound	Upper Bound
B1	B2	-19.92	10.93	0.366 NS	-52.755	12.916
	B3	-12.29	10.93	0.739 NS	-45.122	20.548
	B4	7.58	10.93	0.922 NS	-25.255	40.416
B2	B1	19.92	10.93	0.366 NS	-12.916	52.755
	B3	7.63	10.93	0.920 NS	-25.203	40.468
	B4	27.50	10.93	0.125 NS	-5.335	60.335
B3	B1	12.29	10.93	0.739 NS	-20.548	45.122
	B2	-7.63	10.93	0.920 NS	-40.468	25.203
	B4	19.87	10.93	0.368 NS	-12.968	52.703
B4	B1	-7.58	10.93	0.922 NS	-40.416	25.255
	B2	-27.50	10.93	0.125 NS	-60.335	5.335
	B3	-19.87	10.93	0.368 NS	-52.703	12.968

Table 3. Mean comparison of Groups A1-B1, A2-B2, A3-B3, A4-B4, and A-B

TIME	GROUPS	Mean	SD	difference	t value
0 Minutes	A1	73.24	65.69	17.19±47.85	0.517
	B1	56.05	17.84		Not significant
20 Minutes	A2	145.21	33.04	69.24±15.30	0.000
	B2	75.97	17.74		Significant
40 Minutes	A3	161.12	33.37	92.78±6.02	0.000
	B3	68.34	27.35		Significant
60 Minutes	A4	127.63	58.50	79.16±41.44	0.005
	B4	48.47	17.06		Significant
(0 Minutes - 60 Minutes)	A	126.80	22.09	64.60±10.43	0.000
	B	62.20	11.66		Significant

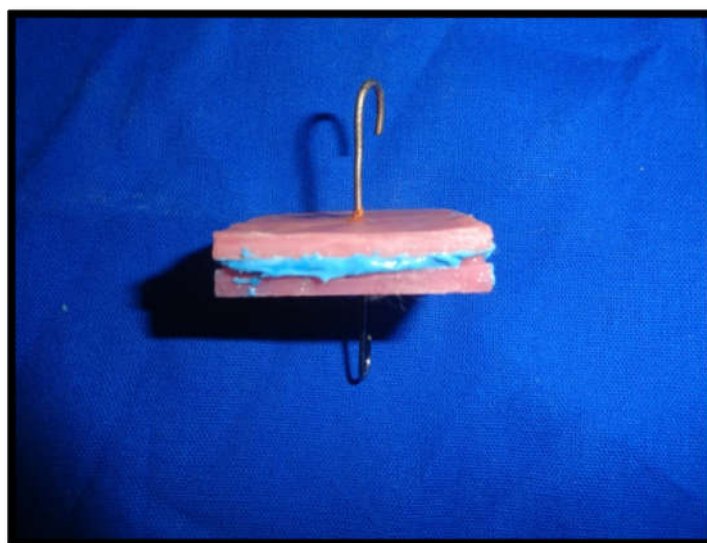


Fig. Acrylic sample assembly

**DISCUSSION**

Instructions on the drying time for the adhesive are also variable; most authorities suggest allowing it to dry on the tray before making the impression. Most of the dentists follow the manufacturer’s instructions, but problems are often encountered where clinical circumstances dictate departure from standard operating procedures. Occasionally, the material may have to be painted on the tray just prior to mixing the

rubber base impression material. In other circumstances, the tray may be painted for use, but then left overnight or even longer prior to making the impression. (Hogans and Agar, 1992) However, in many dental practices the custom tray is simply tried in the patient’s mouth and dried the tray adhesive by either leaving it undisturbed in the air or with air spray. It is possible that the bond strength of the adhesive may not be diminished, if the adhesive is not allowed sufficient time to dry and react with the surface of tray material. (Dixon *et al.*, 1993)

The results of this study compare favorably with those of other studies. Davis *et al.* found a gradual increase in bond strength from 5, 15 to 30 minutes with polysulfide rubber. The largest recorded gain was from 5 minutes to 15 minutes, and gains after that were considered to be minimal. In this clinical study conducted the results showed a significant increase of bond strength of Coltene tray adhesive when compared to Medicept tray adhesive and the 40 min adhesive drying time exhibited highest mean adhesive bond strength for Coltene tray adhesive and 20 min drying time for Medicept tray adhesive. Another study used one brand of polyvinylsiloxane (Mirror 3) and found bond strengths at 15 minutes somewhat higher than the values recorded in this study. These results may be related to minor differences in the material, the adhesive, the size of the resin samples and the rate of force application. (Cho, Donovan, 1995) From the data presented in this study, there does not seem to be any substantial disadvantage to applying the adhesive a considerable time before making the impression.

### Conclusion

Within the limitations of this study, it can be concluded that

- (1) There is significant increase of mean adhesive tensile bond strength of Coltene tray adhesive when compared to Medicept tray adhesive.
- (2) 40 min adhesive drying time exhibited highest mean adhesive bond strength for Coltene tray adhesive and 20 min drying time for Medicept tray adhesive.
- (3) A minimal drying time of 20min is necessary to obtain good tensile bond strength for both adhesives used in the study.

In addition to this more research work needs to be carried out in a larger number of samples and with more materials and more drying times.

### REFERENCES

Abdulla MA. And Talic YF. 2003. The effect of custom tray material type and fabrication techniques on tensile bond strength of impression material adhesive systems. *Journal of Oral Rehabilitation*, 30:312-7.

- Bindra B. and Heath JR. 1997. Adhesion of elastomeric impression materials to trays. *Journal of Oral Rehabilitation*, 24:63-9
- Chai JY, Jameson LM, Moser B, IHesby RA. 1991. Adhesive properties of several impression material systems: Part I. *Journal of Prosthetic Dentistry*, 6S:201-20.
- Cho, Donovan; 1995. Tensile bond strength of polyvinyl siloxane impressions bonded to a custom tray as a function of drying time: Part I. *Journal of Prosthetic Dentistry*, 73(5):419-23.
- Dixon DL, Breeding LC, Bosser MJ, Nafso AJ. 1993. The effect of custom tray material type and surface treatment on the tensile bond strength of an impression material/adhesive system. *International Journal of Prosthodontics*, 6:303-6.
- Dixon, Breeding, 1994. The effect of custom tray material type and adhesive drying time on the tensile bond strength of an impression material/ adhesive system. *International Journal of Prosthodontics*, 7(2):129-33.
- Hogans WR. and Agar R. 1992. The bond strength of elastomer tray adhesives to thermoplastic and acrylic resin tray materials. *J Prosthet Dent*, 67:541-3
- Marafie. Y, Looney. S. Nelson, S, Chan.D, Browning.W, Ruuggeberg. F. 2008. Retention strength of impression materials to a tray material using different adhesive methods: An Invitro study. *Journal of Prosthetic Dentistry*, 100,432-40.
- Mauro, Y, Nishigawa G, Oka M, Minagi S, Irie M and Suzuki K. 2007. Tensile bond strength between custom tray and elastomeric impression material. *Dental Materials Journal*, 26(3), 323-8.
- Morneburg, T. 1991. The bonding properties of various silicone impression materials at standardized surfaces using adhesives. *Deutsch Stomatology.*, 41(8):306-8.

\*\*\*\*\*