Print ISSN: 2321-6379
Online ISSN: 2321-595X

Original Article

Comparative Evaluation of the Tensile Bond Strength between Polyvinyl Siloxane Impression Materials with Two Different Tray Materials using Three Different Tray Adhesives – An *In Vitro* Study

Nithin Thomas Mathews[1], G S Chandu[2], Neeraj Kumar Gupta[3], Mohd. Faisal Khan[3], Ambika Shrivastava Gupta[4], Brajendra Singh Tomar[3], Sonal Tripathi[5], Jyoti Sarathe[1]

[1]Postgraduate Student, Department of Prosthodontics Crown and Bridge and Implantology, Rishiraj College of Dental Sciences and Research Centre, Bhopal, Madhya Pradesh, India, [2]Professor and Head, Department of Prosthodontics Crown and Bridge and Implantology, Rishiraj College of Dental Sciences and Research Centre, Bhopal, Madhya Pradesh, India, [3]Reader, Department of Prosthodontics Crown and Bridge and Implantology, Rishiraj College of Dental Sciences and Research Centre, Bhopal, Madhya Pradesh, India, [4]Professor, Department of Prosthodontics Crown and Bridge and Implantology, Rishiraj College of Dental Sciences and Research Centre, Bhopal, Madhya Pradesh, India, [5]Senior Lecturer, Department of Prosthodontics Crown and Bridge and Implantology, Rishiraj College of Dental Sciences and Research Centre, Bhopal, Madhya Pradesh, India

Abstract

Introduction: A dimensionally accurate impression is a prerequisite before any prosthesis can be manufactured. There is no chemical or mechanical bond between custom tray resin and elastomeric materials has been established. If the impression material gets separated from the impression tray while withdrawing from the oral cavity, it will affect its accuracy. Vinyl polysiloxane impression materials are the most frequently used non-aqueous elastomeric material by dental practitioners. The introduction of various tray adhesives has strengthened the bond between the resin and the impression materials.

Purpose: This study aims to evaluate and compare the tensile bond strength of three different tray adhesives used for polyvinyl siloxane impression materials with two different tray materials.

Materials and Methods: Medium-bodied elastomeric impression material (Coltene Affinis) and two different custom tray materials (DPI, Mumbai, India and Polytray) were used. For each tray material, three different tray adhesives were used (3M ESPE, Dentsply Caulk, and Coltene Affinis). Each of these specimens was then subjected to tensile load using Instron universal testing machine at a cross-head speed of 5 mm/min and the results were compared.

Results: Comparing the auto-polymerized tray resin with different adhesive groups, the 3M adhesive demonstrated a higher tensile bond strength, while Affinis demonstrated the lowest. Dentsply showed the highest tensile bond strength among the visible light cure (VLC) tray material group followed by 3M and Affinis. Dentsply outperformed both groups in terms of tensile bond strength, followed by 3M and Affinis.

Conclusion: The study showed that 3M tray adhesive has higher tensile bond strength with auto-polymerizing tray resin while Dentsply showed the highest tensile bond strength among VLC tray materials.

Key words: Impression, Polyvinyl siloxane impression material, Tensile bond strength, Tray adhesives

INTRODUCTION

Fabrication of any prosthesis requires a dimensionally accurate impression.[1] The use of a custom impression tray enhances the dimensional accuracy of the impression. Die results from a custom tray are more accurate than those from a stock tray.[2] There has been no established chemical bonding between custom tray resin and elastomeric materials, although stock trays often provide mechanical retention for impression materials. However, the accuracy of the impression material can be rendered absolutely useless if it detaches from the impression tray while withdrawing from the oral cavity.[3,4]

The most common non-aqueous elastomeric impression materials used in dentistry are vinyl polysiloxane (VPS)

Access this article online

IJSS

www.ijss-sn.com

Month of Submission : 05-2023
Month of Peer Review : 06-2023
Month of Acceptance : 06-2023
Month of Publishing : 07-2023

Corresponding Author: Dr. G S Chandu, Department of Prosthodontics Crown and Bridge and Implantology, Rishiraj College of Dental Sciences and Research Centre, Bhopal- 462036, Madhya Pradesh, India.

impression materials.[5] Various tray adhesives have been introduced to strengthen the bond between tray and impression materials to prevent the detachment of impression materials.[6]

The adhesives recommended for silicone impression materials are composed of poly (dimethylsiloxane) and ethyl silicate. Poly (dimethylsiloxane) adheres to the silicon material, whereas ethyl silicate forms hydrated silica that bonds with tray material physically, leading to an accurate and consistent impression.

Less attention has been paid to the attachment of impression materials to polymethyl methacrylate (PMMA) and visible light cure (VLC) trays. Switching adhesives for two VPS impression materials resulted in stronger bonds, according to one study. Another researcher discovered that switching adhesives between two additional silicon materials increased the bond between impression material and tray significantly.[7,8] Tray adhesive has usually been recommended to be applied on the custom resin tray, not only for the inside of the custom tray but also to the surface of the border molding materials of the tray borders, before placing the elastomeric impression material on to the tray.

The authors concluded that the material-adhesive combination provided by the manufacturer may not be the best. Drying times have been suggested ranging from 4 min to 72 h. Samman and Fletcher discovered that the ideal drying time for silicone material was 10 min.[9] Despite the commercial availability of universal adhesives, researchers have yet to reveal bond strength data for such products with VPS impression material and tray materials. Manufacturer-recommended tray adhesives as well as universal tray adhesives are now available. Since its introduction, many clinicians have begun to use universal tray adhesive, but studies on its efficacy are lacking. The objective of this study is to evaluate the tensile bond strength of three different tray adhesive, applied between VPS material and two tray materials.

MATERIALS AND METHODS

One medium body elastomeric impression material (Affinis), two tray materials (autopolymerizing PMMA and VLC), and three tray adhesives (Affinis, Dentsply Caulk, 3M) were used.

Total 180 specimens were fabricated. Ninety were fabricated with auto polymerizing PMMA (DPI, Mumbai, India) and rest 90 were fabricated with visible light polymerizing acrylic resin (Polytray). The study was carried out in three steps:

Fabrication of Master Die

A standard stainless steel cylindrical die of the dimension of 20 × 20 mm was custom fabricated using milling technique and it was polished.

A cylindrical plastic die of the dimension of 20 × 20 mm was custom fabricated using 20 mL dispovan syringe.

Preparation of Test Specimens

a. Ninety specimens of autopolymerizing PMMA (DPI, Mumbai, India) were fabricated using stainless steel die and after loading of PMMA excess material was flushed out using glass plates, then a stainless steel eye hook was submerged into one end of cylinder and these specimens were kept overnight for complete polymerization.
b. Ninety visible light polymerizing acrylic resin (Polytray) were kept in curing unit (Eurolight UV chamber) with a stainless steel eyehook submerged on one end of cylinder for 10 min to polymerize into hard block.

The surface opposite to the eye hook attachment surface that is the testing surface 20 mm is hardened with 320 grid silicon carbide paper on a polishing machine (30,000 rpm) to standardize the surface roughness for the adhesion with tray adhesive.

An abbreviation for the specific brand of adhesive example "3M" for 3M adhesive, "A" for Coltene Affinis and "D" for Dentsply Caulk were written on the surface of PMMA specimen except testing surface for the future identification 20 mL Syringe (dispovan) cylinder of dimension 20 mm in diameter and 20 mm in length will be used to contain the impression material and multiple holes were made to retain impression material within the cylinder with the help of straight fissure bur (FG#58 SSWhite) of diameter 0.8 mm.

Fabrication of UTM attachment

A metallic eye hook was submerged into each specimen (PMMA & VLC) opposite to the testing surface and served as a point of attachment for the upper arm of the UTM with the help of a stainless steel eye hook. Metal rod of diameter 2 mm was inserted across the syringe cylinder and was close to free end of cylinder for attachment of S-shaped eye hook and that was inserted to the lower end of UTM.

PMMA (90 specimens) and VLC (90 specimens) were divided into three sub-groups (30 in each group), as per the use of tray adhesive and were named accordingly, that is, 3M, Affinis and Dentsply Caulk. Each sample of tray material were coated on the testing surface with different tray adhesives, respectively, and left for 10 min for the solvent to evaporate according to the manufacturer's specifications. The perforated hollow cylinder was placed in

contact with the testing surface of specimen in the testing machine. The impression material was dispensed onto the testing surface through the other free end of cylinder until the cylinder fills completely and held in position until the material set completely.

Testing of Samples

Each specimen is attached to the UTM with a stainless steel eye hook on one side and on the testing side a metal rod with a S-shaped hook is placed in its respective position. A cross-head speed of 5 mm/min, using a 2500-kg load cell set at full-scale load and gradually pulled apart until the impression material is separated from the specimen's testing surface. The values obtained will be divided by the area of adhesion of the cylinder with the specimen and the tensile bond strength will be calculated in megapascals (MPa) by the formula

$$\text{Tensile bond strength } \left(N/mm^2\right) = \frac{\text{Maximum load } (N)}{\text{Section area of cylinder } \left(mm^2\right)}$$

RESULTS

The data obtained were subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS Version 23; Chicago Inc., IL, USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons.

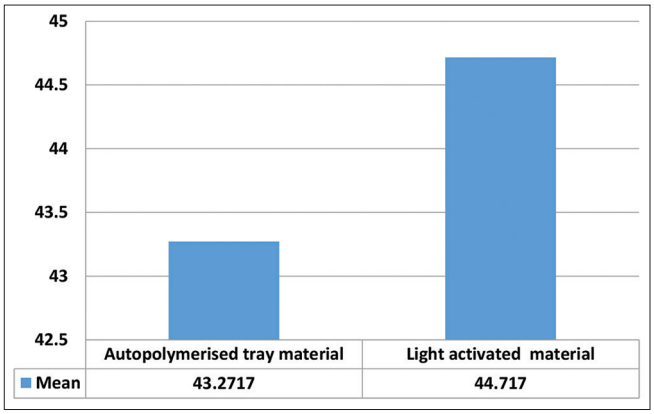
Kolmogorov–Smirnov and Shapiro–Wilk tests were performed to determine the normality of the data for the two major groups and their subgroups of adhesives to check for tensile bond strength. Both the tests showed no significant differences and hence confirmed that the data obtained were normally distributed.

Variables were compared using mean values and standard deviation. The mean for different readings for tensile between each group for autopolymerized tray material and light cured tray material was tested using independent "t"-test. Comparison between groups was done by applying one-way analysis of variance. $P < 0.05$ was considered to be statistically significant.

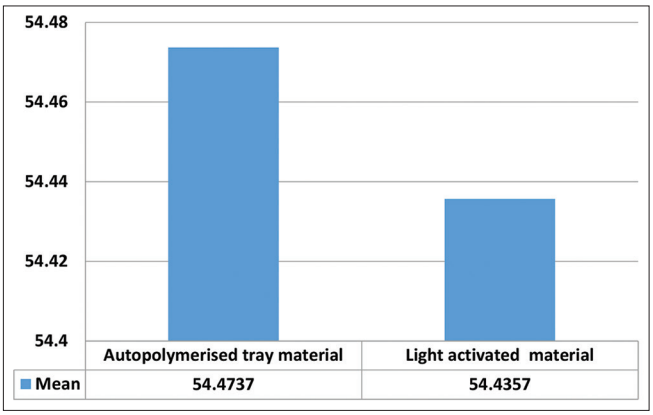
When Group A was analyzed between autopolymerized tray material and light-cured tray material for tensile bond strength, no significant difference was noted between them at $P = 0.443$, as shown in Table 1 and Graph 1.

Light-cured tray material in Group B adhesive type exhibited greater tensile bond strength than autopolymerized type which was significant at $P = 0.000$.

Group C samples showed no significant difference between tensile bond strength of autopolymerized tray material and light-cured tray material, at $P = 0.982$, as shown in Table 2 and Graph 2.



Graph 1: Comparative evaluation of group A (Affinis tray adhesive) between autopolymerized tray material and light-cured tray material



Graph 2: Comparative evaluation of group C (3M tray adhesive) between autopolymerized tray material and light-cured tray material

Table 1: Comparative evaluation of group A (Affinis tray adhesive) between autopolymerized tray material and light cured tray material

Groups	*n*	Mean	SD	Standard error mean	Mean difference
Autopolymerized tray material	30	43.2717	9.62026	1.75641	−1.44533
Light-cured material	30	44.7170	3.53399	0.64522	
"t" statistic			−0.772		
Df			58		
P-value			0.443 (NS)		

*Significant; NS: Not significant

Table 2: Comparative evaluation of group C (3M tray adhesive) between autopolymerized tray material and light-cured tray material

Groups	*n*	Mean	SD	Standard error mean	Mean difference
Autopolymerized tray material	30	54.4737	3.85440	0.70371	0.03800
Light-cured tray material	30	54.4357	8.26184	1.50840	
"t" statistic			0.023		
df			58		
P-value			0.982 (NS)		

*Significant; NS: Not significant

Table 3: Comparative assessment of autopolymerized tray material between groups

Groups	*n*	Mean	SD	Standard error
Affinis	30	43.2717	9.62026	1.75641
Dentsply	30	45.6543	7.28123	1.32936
3M Tray	30	54.4737	3.85440	0.70371
ANOVA/"F" statistic			19.537	
df			2	
P-value			0.000*	

*Significant; NS: Not significant

Table 4: *Post hoc*/pairwise comparison for autopolymerized tray material between groups

Pairs	Mean difference	Standard error	*P*-value
Affinis versus Dentsply	−2.38267	1.88810	0.631 9NS)
Affinis versus 3M	−11.20200*	1.88810	0.000*
Dentsply versus 3M	−8.81933*	1.88810	0.000*

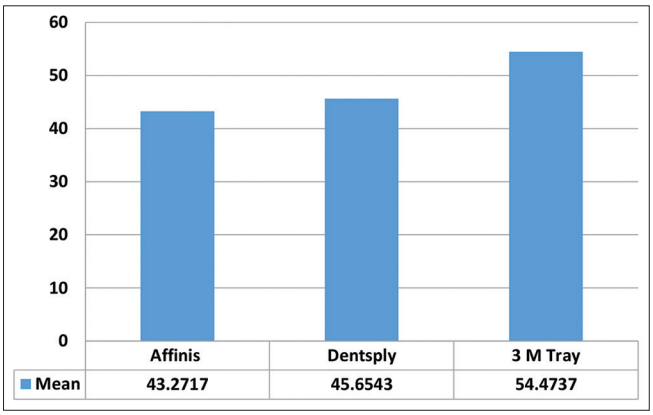
*Significant; NS: Not significant

When evaluating for between different groups for autopolymerized adhesive, 3M adhesive demonstrated greater tensile bond strength with a mean of 54.4737 ± 3.85440, and the least was exhibited by Affinis, which was significant statistically at $P = 0.000$, as shown in Table 3 and Graph 3.

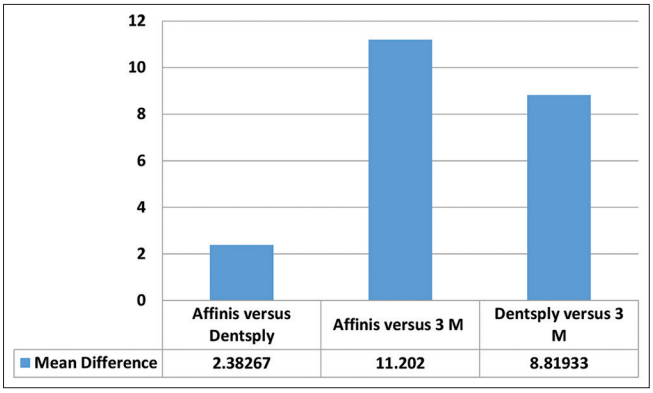
Between pair analysis reviewed that, the greatest mean difference was noted between Affinis versus 3M at 11.20200 significant at $P = 0.000$. Dentsply versus 3M also showed significant difference which was significant, as shown in Table 4 and Graph 4.

In case of light-cured tray material assessment between groups, Dentsply showed the greatest tensile bond strength at 63.9267 ± 9.68044 followed by 3M and Affinis, which was significant at $P = 0.000$, as shown in Table 5 and Graph 5.

Turkeys *post hoc* analysis showed that the greatest mean difference in tensile bond strength was noticed between Affinis versus Dentsply at 19.20967, significant at $P = 0.000$. Affinis versus 3M and Dentsply versus 3M also showed significant differences, as shown in Table 6 and Graph 6.



Graph 3: Comparative assessment of autopolymerized tray material between groups



Graph 4: *Post hoc*/pairwise comparison for autopolymerized tray material between groups

On comparing the tensile bond strength between groups, Dentsply exhibited the greatest tensile bond strength with a mean of 56.2810 ± 12.33113 followed by 3M and Affinis, which was statistically significant at $P = 0.000$, as shown in Table 7 and Graph 7.

Overall group comparison showed that Affinis versus Dentsply had the greatest mean difference at 12.28667 significant at $P = 0.000$. Affinis versus 3M was also significant at $P = 0.000$. Dentsply versus 3M was not significant at $P = 0.810$, as shown in Table 8 and Graph 8.

Table 5: Comparative assessment of light-cured tray material between groups

Groups	*n*	Mean	SD	Standard error
Affinis	30	44.7170	3.53399	0.64522
Dentsply	30	63.9267	9.68044	1.76740
3M Tray	30	54.9138	5.29882	1.08162
ANOVA/"F" statistic			60.237	
df			2	
P-value			0.000*	

*Significant; NS: Not significant

Table 6: *Post hoc*/pairwise comparison for light-cured tray material between groups

Pairs	Mean difference	Standard error	*P*-value
Affinis versus Dentsply	−19.20967*	1.75109	0.000*
Affinis versus 3M	−10.19675*	1.85731	0.000*
Dentsply versus 3M	9.01292*	1.85731	0.000*

*Significant; NS: Not significant

Table 7: Comparative assessment of tensile bond strength between groups (group A, B, and C) – including both autopolymerized and light-cured tray materials

Groups	*n*	Mean	SD	Standard error
Affinis	60	43.9943	7.22220	0.93238
Dentsply	60	56.2810	12.33113	1.59194
3M Tray	60	54.4547	6.39165	0.82516
ANOVA/"F" statistic			32.283	
df			2	
P-value			0.000*	

*Significant; NS: Not significant

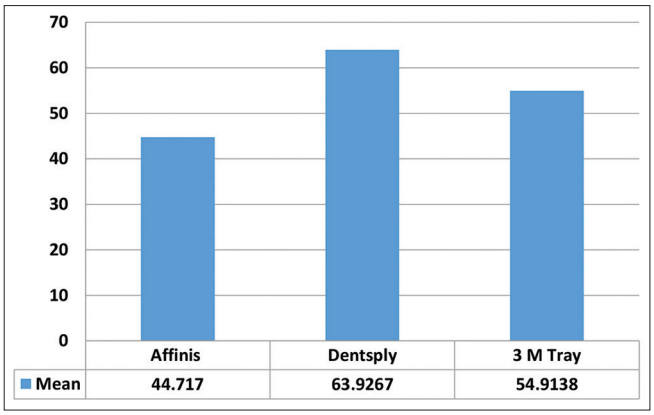
Table 8: *Post hoc*/pairwise comparison for tensile bond strength between groups (group A, B, and C) – including both autopolymerized and light-cured tray materials

Pairs	Mean difference	Standard error	*P*-value
Affinis versus Dentsply	−12.28667*	1.65015	0.000*
Affinis versus 3M	−10.46033*	1.65015	0.000*
Dentsply versus 3M	1.82633	1.65015	0.810 (NS)

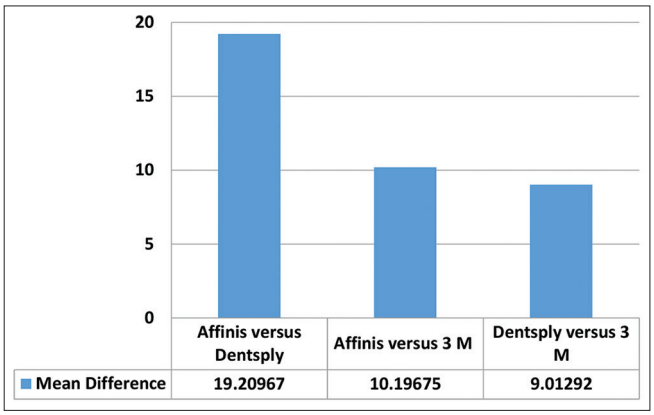
*Significant; NS: Not significant

DISCUSSION

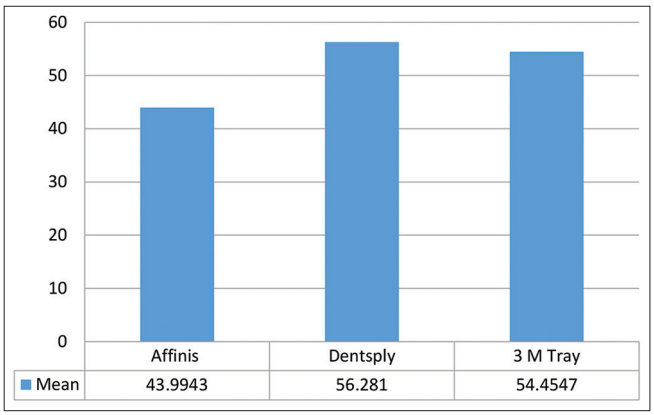
Impressions are an essential component of prosthodontics due to their superior properties, elastomeric impression materials are the preferred impression materials in dentistry including improved reproduction of surface detail VPS that is the most advanced impression material available in prosthodontics, but even these materials cannot provide an accurate reproduction of the tissues if the impression materials disengage from the tray, resulting in a distorted impression and poor final restorations made from such impressions.[10]



Graph 5: Comparative assessment of light-cured tray material between groups

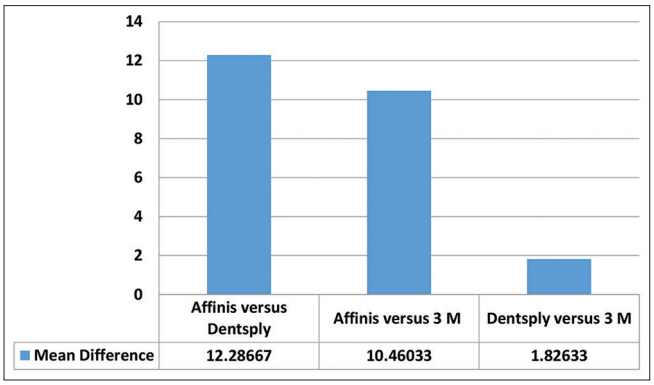


Graph 6: *Post hoc*/pairwise comparison for light-cured tray material between groups



Graph 7: Comparative assessment of tensile bond strength between groups (group A, B, and C) – including both autopolymerised and light-cured tray materials

The use of impression tray adhesive to keep the elastomeric impression material in place has definite advantages. Davis *et al.* looked into the bonding properties of elastomeric tray adhesive.[11,2] They concluded that because the bonding is insufficient and the material goes into the undercut, a significant amount of force is required to pull the material away. The surface preparation of the custom tray,



Graph 8: *Post hoc*/pairwise comparison for tensile bond strength between groups (Group A, B, and C) – including both autopolymerized and light-cured tray materials

particularly with silicone carbide paper, had a significant impact on retention by increasing the bond strength of the impression material with the adhesive.[3]

Applying a tray adhesive is a routine procedure because it controls the direction of polymerization shrinkage of the material toward the custom tray side. The impression adhesives used for silicone impression materials contain polydimethylsiloxane or a similar reactive silicone, as well as ethyl silicate. Polymethylsiloxane adhesive bonds to the silicone impression material, whereas ethylsilicate forms a hydrated silica that physically bonds to the impression tray material. The volatile solvent, ethyl acetate, reacts with the autopolymerizing tray material to form microporosites on the tray material, allowing the adhesive to physically and mechanically bond with it.[6]

The previous research suggested that the material adhesive combination supplied by the manufacturer might not be the best. Universal adhesives are now replacing the manufacturer's adhesive.[1] It has been discovered that paint-on adhesive on medium body VPS is effective.[12]

Considering this, the study is being conducted to compare the effectiveness of three different tray adhesives (3M ESPE, Coltene Affinis, and Dentsply Caulk) with the commonly available medium consistency VPS impression material (Affinis) with the three different tray adhesives using the custom autopolymerizing tray resin and VLC.

Other researchers have reported tensile strength values for VPS elastomeric impression materials ranging from 0.2 to 2.1 MPa depending on tray impression materials used.[13]

The adhesives were recommended for use in all trays, including those with perforations that aid in mechanical retention. Rapid removal of the impression from the mouth increased the retention between the tray and the impression materials. Furthermore, as the flexibility of the impression materials increased, the retention between the tray and the impression material decreased.[12]

Several studies in the past have investigated the tensile bond strength of different tray materials to VPS impression material using different tray adhesives.

Tensile bond strength of auto polymerizing tray materials and VLC acrylic resin tray material to medium body addition silicone impression material after application of three different tray adhesives on tray materials is evaluated in this study.

Ashwini *et al.*,[14] three medium-body viscosity VPS (3M, Dentsply, and Affinis) treated with own adhesives and universal adhesives (Zhermack and GC) were used in this study to compare the tensile bond strength to the two tray materials (autopolymerizing resin and VLC resin).

1. When compared to the adhesive that the manufacturer recommends, universal tray adhesives among group A (autopolymerizing resin tray material) showed greater strength
2. In comparison to the manufacturer-recommended adhesive and universal adhesive GC, universal tray adhesive (Zhermack) from group B (VLC resin tray material) demonstrated greater strength
3. Group B (VLC resin tray material) outperformed the other two groups in terms of bond strength when using the universal tray adhesive

Kumar *et al.*[15] stated no discernible variation in adhesive strength as a function of tray material was found within the constraints of the experimental conditions of this *in vitro* study. In comparison to the adhesives provided by the maker of the impression materials, GC revealed the highest tensile bond strength across all combinations. 3M showed the highest tensile strength out of the three impression materials tested. The 3M impression material with GC adhesive was found to be the most superior when different impression materials' effects on tensile strength were compared. Therefore, it is crucial for the success of the prosthodontic procedure and the end result in our clinical practice to understand the adhesive strength of different impression materials with specific adhesives.

Saha *et al.*[16] concluded that tray adhesives for silicone rubber impression material are effective for impression modeling plastics for border molding within the scope of the study to evaluate the tensile bond strength of autopolymerizing tray materials and medium body addition silicone impression material after the application of three different tray adhesives on tray materials. 3M had the highest tensile bond strength, followed by Dentsply and Coltene tray adhesive.

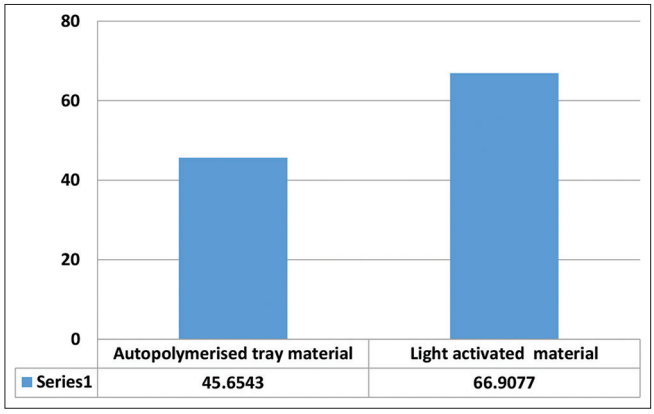
When Group A was analyzed between autopolymerized tray material and light-cured tray material for tensile bond strength, no significant difference was noted between them at $P = 0.443$, as shown in Table 1 and Graph 1.

Light-cured tray material in Group B adhesive type exhibited greater tensile bond strength than autopolymerized type which was significant at $P = 0.000$, as shown in Table 9 and Graph 9.

Group C samples showed no significant difference between tensile bond strength of autopolymerized tray material and light cured tray material, at $P = 0.982$, as shown in Table 2 and Graph 2.

When evaluating for between different groups for autopolymerized adhesive, 3M adhesive demonstrated greater tensile bond strength with a mean of 54.4737 ± 3.85440 and the least was exhibited by Affinis, which was significant statistically at $P = 0.000$, as shown in Table 3 and Graph 3.

Between pair analysis reviewed that, the greatest mean difference was noted between Affinis versus 3M at 11.20200 significant at $P = 0.000$. Dentsply versus 3M also showed significant difference which was significant, as shown in Table 4 and Graph 4.



Graph 9: Comparative evaluation of group a (Affinis tray adhesive) between autopolymerized tray material and light-cured tray material

In case of light-cured tray material assessment between groups, Dentsply showed the greatest tensile bond strength at 63.9267 ± 9.68044 followed by 3M and Affinis, which was significant at $P = 0.000$, as shown in Table 5 and Graph 5.

Turkeys *post hoc* analysis showed that the greatest mean difference in tensile bond strength was noticed between Affinis versus Dentsply at 19.20967, significant at $P = 0.000$. Affinis versus 3M and Dentsply versus 3M also showed significant differences, as shown in Table 6 and Graph 6.

On comparing the tensile bond strength between groups, Dentsply exhibited the greatest tensile bond strength with a mean of 56.2810 ± 12.33113 followed by 3M and Affinis, which was statistically significant at $P = 0.000$, as shown in Table 7 and Graph 7.

Overall group comparison showed that Affinis versus Dentsply had the greatest mean difference at 12.28667 significant at $P = 0.000$. Affinis versus 3M was also significant at $P = 0.000$. Dentsply versus 3M was not significant at $P = 0.810$, as shown in Table 8 and Graph 8.

The adhesives recommended for silicone impression materials are composed of poly (dimethylsiloxane) and ethyl silicate. Poly(dimethylsiloxane) adheres to the silicon material, whereas ethyl silicate forms hydrated silica that bonds with tray material physically leading to an accurate and consistent impression.

The molecular networks in polyvinyl siloxane react with the recently made adhesive's composition, which includes methyl acetate as a solvent and a joint monomer that bonds with both the impression material and the tray material. This allows the adhesive to chemically bond with both the elastomeric impression material and the acrylic tray material.[17] It is claimed that these reactive adhesives can effectively retain the impression material without the need for mechanical retention. A more dependable method of retaining the impression material to the tray can be achieved if these adhesives offer better impression retention to the tray than conventional adhesives do.

Table 9: Comparative evaluation of group B (Dentsply tray adhesive) between autopolymerized tray material and light-cured tray material

Groups	*n*	Mean	SD	Standard error mean	Mean difference
Autopolymerized tray material	30	45.6543	7.28123	1.32936	−21.25333
Light-cured tray material	30	66.9077	4.76450	0.86987	
"t" statistic				−13.378	
Df				58	
P-value				0.000*	

*Significant; NS: Not significant

CONCLUSION

According to the study's findings, tray adhesives for silicone rubber impression materials are useful for molding impressions into plastics for border work, as long as the study's objectives are met, which were to assess the tensile bond strength between auto-polymerizing tray materials and VLC tray materials and medium-body silicone impression materials following the application of three different tray adhesives on tray materials.

Comparing the autopolymerized tray resin with different adhesive groups, the 3M adhesive demonstrated a higher tensile bond strength with a mean of 54.4737 ± 3.85440, while Affinis demonstrated the lowest, with a statistically significant difference of $P = 0.000$.

Dentsply showed the highest tensile bond strength among the visible light cure tray material groups at 63.9267 ± 9.68044, followed by 3M and Affinis. At $P = 0.000$, this outcome was significant.

With a mean of 56.2810 ± 12.33113, Dentsply outperformed both groups in terms of tensile bond strength, followed by 3M and Affinis. At $P = 0.000$, this outcome was statistically significant.

REFERENCES

1. Donovan TE, Chee WW. A review of contemporary impression materials and techniques. Dent Clin North Am 2004;48:vi-vii, 445-70.
2. Payne JA, Pereira BP. Bond strength of two nonaqueous elastomeric impression materials bonded to two thermoplastic resin tray materials. J Prosthet Dent 1995;74:563-8.
3. Nicholson JW, Porter KH, Dolan T. Strength of tray adhesives for elastomeric impression materials. Oper Dent 1985;10:12-6.
4. Johnson GH, Craig RG. Accuracy of addition silicones as a function of technique. Prosthet Dent 1986;55:197-203.
5. Frazier KB, Mjör IA. The teaching of all-ceramic restorations in North American dental schools: Materials and techniques employed. J Esthet Dent 1997;9:86-93.
6. Phillips RW, Skinners EW. Skinner's Science of Dental Materials. Vol. 8. Philadelphia, PA: W.B. Saunders Co.; 1982. p. 150.
7. Sulong MZ, Setchell DJ. Properties of the tray adhesive of an addition polymerizing silicone to impression tray materials. J Prosthet Dent 1991;66:743-7.
8. Sandrik JL, Vacco JL. Tensile and bond strength of putty-wash elastomeric impression materials. J Prosthet Dent 1983;50:358-61.
9. Samman JM, Fletcher A. A study of impression tray adhesives. Quintessence Int 1985;16:305-9.
10. Ona M, Takahashi H, Sato M, Igarashi Y, Wakabayashi N. Effect of reactive adhesives on the tensile bond strength of polyvinyl siloxane impression materials to methyl methacrylate tray material. Dent Mater J 2010;29:336-40.
11. Nishigawa G, Sato T, Suenaga K, Minagi S. Efficacy of tray adhesives for the adhesion of elastomer rubber impression materials to impression modeling plastics for border molding. J Prosthet Dent 1998;79:140-4.
12. Davis GB, Moser JB, Brinsden GI. The bonding properties of elastomer tray adhesives. J Prosthet Dent 1976;36:278-85.
13. Peregrina A, Land MF, Wandling C, Johnston WM. The effect of different adhesives on vinyl polysiloxane bond strength to two tray materials. J Prosthet Dent 2005;94:209-13.
14. Ashwini BL, Manjunath S, Mathew KX. The bond strength of different tray adhesives on vinyl polysiloxane to two tray materials: An *in vitro* study. J Indian Prosthodont Soc 2014;14:29-37.
15. Kumar S, Gandhi UV, Banerjee S. An *in vitro* study of the bond strength of five adhesives used for vinyl polysiloxane impression materials and tray materials. J Indian Prosthodont Soc 2014;14:61-6.
16. Saha MK, Gupta S, Desai P, Jain S, Wadhwani T. An comparative evaluation of tensile bond strength of polyvinyl siloxane impression material to tray material using three different tray adhesive: An *in vitro* study. Int J Appl Dent Sci 2019;5:293-6.
17. Yi MH, Shim JS, Lee KW, Chung MK. Drying time of tray adhesive for adequate tensile bond strength between polyvinylsiloxane impression and tray resin material. J Adv Prosthodont 2009;1:63-7.

How to cite this article: Mathews NT, Chandu GS, Gupta NK, Khan MF, Gupta AS, Tomar BS, Tripathi S, Sarathe J. Comparative Evaluation of the Tensile Bond Strength between Polyvinyl Siloxane Impression Materials with Two Different Tray Materials using Three Different Tray Adhesives – An *In Vitro* Study. Int J Sci Stud 2023;11(4):58-65.

Source of Support: Nil, **Conflicts of Interest:** None declared.