

## Comprehensive Evaluation of Effect of Remineralizing Agents on Bond Strength in Between Two Commercially Available Restorative Composite Resins and Enamel in Deciduous Teeth: An Original Research Study

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### Abstract

**Background and Aim:** Tooth remineralization is a reparative procedure, which happens naturally and daily in the oral cavity. This remineralization procedure repairs the vanished enamel and helps in preventing dental caries. Commercially available remineralizing agents also used for these purposes. However, they have been shown to affect the bond strength of composite resins. This study was designed to comprehensively evaluate the effect of remineralizing agents on bond strength in between two commercially available restorative (composite) resins and enamel in deciduous teeth.

**Materials & Methods:** This study was performed in the department of Pedodontics and Preventive dentistry which included forty deciduous maxillary molars. Two commercially available restorative composite resins were used on the buccal surface of enamel. Group one included twenty samples in which Beautifil Flow Plus X was used. Group two included twenty samples in which Filtek™ Z350 XT Universal Restorative was used. All samples were immersed in to Remineralization agent independently. Universal testing machine was used to evaluate the shear bond strength between composite resins and enamel. Readings were noted before and after immersion into Remineralization agent. P value less than 0.05 was considered significant ( $p < 0.05$ ).

**Statistical Analysis and Results:** Statistical analysis was done by statistical software Statistical Package for the Social Sciences (SPSS). The resultant data was sent to suitable statistical tests to achieve p values, mean, standard deviation, standard error and 95% CI.  $P \leq 0.05$  was considered as statistically significant. Out of 40 studied patients, males were 25 and females were 15. All studied patients were separated into four age groups. After immersion into Remineralization agent, highest mean (shear bond strength) was noticed for group 1 samples (15.08). After immersion into Remineralization agent, minimum mean (shear bond strength) was noticed for group 2 samples (12.52).

**Conclusion:** Within the limitations of the study, authors concluded that the tested remineralizing agent literally affects shear bond strength in between studied composite resins and enamel of primary teeth.

**Key Words:** Enamel, Primary Teeth, Remineralizing Agents, Composite Resins, Pedodontics

## I. INTRODUCTION

Most of the aesthetic restorative therapies in dentistry usually involve usage of direct or indirect tooth coloured restorative materials. Most of the related researches in the literature have shown universal popularity of aesthetic tooth colored materials. They are mostly in relation to composite resins.<sup>1,2</sup> Composite resins are most commonly used dental aesthetic material by practitioners. Nevertheless, bonding in between composite resin and dentin have less stability compared to composite resin and enamel bonding.<sup>3,4</sup> This is primarily due to organic constituent of dentinal structure. Bond strength and stability are very important for the long term success of any restorations since bond deprivation leads to loss of adhesion, creation of spaces between the tooth surface and restorative materials. Adhesion to enamel is characteristically gained by etching process.<sup>5,6</sup> This makes an extremely roughened surface which is easily wetted by hydrophobic adhesives. These micro retentive areas are very favourable for resin based materials. The process of remineralization is a natural phenomenon for regular repairing of dental hard tissues. It helps in maintaining structure by regular wear and tear of the hard tissues. Therefore, it has its imperative role in preventing dental caries also.<sup>7,8</sup> In case of diminished remineralization activity, commercially available remineralizing agents can also be used for these purposes. However, they have been shown to affect the bond strength of composite resins. Numerous studies have confirmed that the bond strength between restorative resin and enamel can be enhanced by several ways.<sup>9,10</sup> Regardless of the enamel remineralizing capacity of saliva, most of the times it fails to begin the procedure of remineralization to meet the real time requirements. Remineralization procedure actually involves rising of levels of calcium and phosphate.<sup>4,7,11</sup> Also, the invention of newer enamel remineralization systems has extensively grown in the past decade. Therefore in light of these intermingling facts, this study was attempted to comprehensively evaluate the effect of remineralizing agents on bond strength in between two commercially available restorative (composite) resins and enamel in deciduous teeth.

## II. MATERIALS & METHODS

This study was designed, planned and conducted in the department of Pedodontics and Preventive dentistry of the institute. Sample selection included forty deciduous maxillary molars. These teeth were collected from forty different paediatric patients. Randomized sampling was employed for this procedure. All sample teeth were collected at the time of their natural shedding. Undoubtedly, informed consent from parents was obtained to use the exfoliated primary teeth in the study. Teeth with crack, congenital enamel defect, decayed or restored were excluded from the study during sample selection procedure. A mandatory inclusion criterion was teeth with intact and unaffected enamel. Sample teeth were uncontaminated carefully to make it free from all microorganisms. Two commercially available restorative composite resins were used on the buccal surface of enamel. These composite resins restorations were of fixed predetermined dimensions in all samples. Based on the type of composite resins, samples were studied in two groups. Group one included twenty samples in which Beautifil Flow Plus X (SHOFU INC., Higashiyama-ku, Kyoto, Japan) was used. Group two included twenty samples wherein Filtek™ Z350 XT Universal Restorative (3M India Ltd, Bangalore, Karnataka, India) was used. Standard etching a priming procedures were followed as per manufacturer instructions. For evaluating effect of Remineralization agent on shear bond strength, samples were immersed in to Remineralization agent individually. Each sample was kept for two minutes and taken out. Uncle Harry's Remineralization Kit for Tooth Enamel was used (Uncle Harry's Natural Products). In intra oral environment, remineralization agent protects tooth enamel by

neutralizing acids and microorganisms, providing calcium, magnesium, and phosphorus for strengthening teeth, and promoting an alkaline pH of the mouth. Universal testing machine (Instron, Canton, MA, USA) was used to evaluate the shear bond strength between composite resins and enamel. Readings were noted before immersion into Remineralization agent and after immersion into Remineralization agent. Specimens were placed individually and a crosshead speed of 0.5 mm/min was used. Crosshead speeds of 0.5 to 5.0 mm/min allow better stress distribution inside the restored tooth. The confidentiality and other human rights of the patients along with their freedom of expression were not revealed. Data was entered into spread sheet and transferred for assessment. Inferences thus received was compiled in table and subjected to basic statistical analysis. P value less than 0.05 was considered significant ( $p < 0.05$ ).

### III. STATISTICAL ANALYSIS AND RESULTS

In this study, all evident findings and details were collected in judiciously. All data was sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The processed records was subjected to appropriate statistical tests to obtain p values, mean, standard deviation, chi-square test, standard error and 95% CI. Table 1 and Graph 1 illustrated that out of 40 studied patients, males were 25 and females were 15. All studied patients were separated into four age groups. 11 patients were noticed in the age of 9/<9 years. P value was not significant here. 11 patients were recognized in the age of 10 years. P value was not significant for this age group. Total 12 patients were noticed in the age of 11 years. P value was highly significant for this age group (0.02). Total 6 patients were noticed in the age of 12 years. P value was very significant for this age group (0.01). Table 2 showed basic statistical representation [for group I and II]. After immersion into Remineralization agent, highest mean (shear bond strength) was noticed for group 1 samples (15.08, Beautifil Flow Plus X). After immersion into Remineralization agent, minimum mean (shear bond strength) was noticed for group 2 samples (12.52, Filtek™ Z350 XT Universal Restorative). Table 3 is showing level of significance evaluation by pearson chi-square test [for group I and II]. Group one sampled illustrated highly significant p value (0.01). Table 4 demonstrated comparison of Mean (shear bond strength) among two study groups using one-way ANOVA [for group I and II]. Here, comparisons were attempted for between group, within group and cumulative. The overall p value was very significant (0.002).

**Table 1:** Age & gender wise distribution of patients

Age Group (Yrs)	Male	Female	Total	P value
9/<9	5	6	11	0.50
10	7	4	11	0.80
11	9	3	12	0.02 <sup>*</sup>
12	4	2	6	0.01 <sup>*</sup>
Total	25	15	40	<sup>*</sup> Significant

**Table 2:** Fundamental statistical representation [for group I and II]

Group	n	Mean	Mean	Std.	Std.	95% CI
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		(shear bond strength before immersion)	(shear bond strength after immersion)	Deviation	Error	
I	20	14.68	15.08	0.736	0.633	1.03
II	20	12.02	12.52	0.342	0.322	1.83

**Table 3:** Level of significance evaluation by pearson chi-square test [for group I and II]

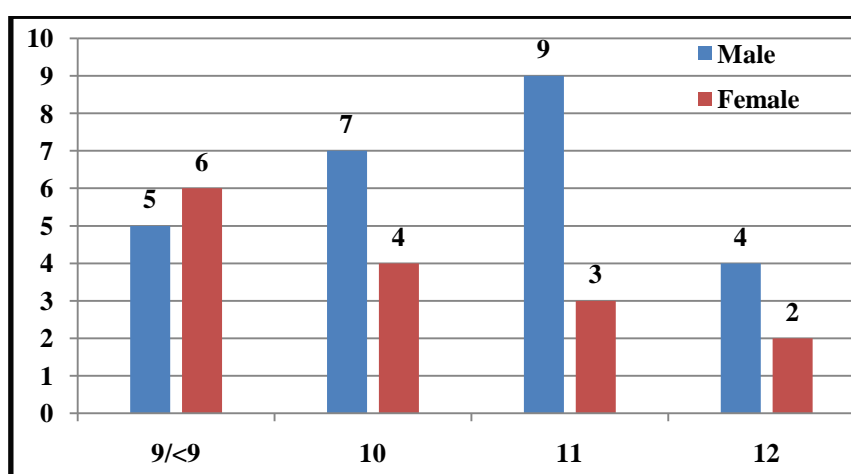
Group	Pearson Chi-Square Value	df	Level of Significance (p value)
I	1.839	2.0	0.01*
II	1.202	1.0	0.20

\*p&lt;0.05 significant

**Table 4:** Comparison of Mean (shear bond strength) among two study groups using one-way ANOVA [for group I and II]

Parameters	Degree of Freedom	Sum of Squares $\Sigma$	Mean Sum of Squares $m\Sigma$	F	Level of Significance (p value)
Between Groups	21	24.039	1.03	1.020	0.002*
Within Groups	12	10.038	0.425	-	
Cumulative	218.87	12.326	-	-	

\*p&lt;0.05 significant

**Graph 1:** Age & gender wise allocation of patients

#### IV. DISCUSSION

Researchers are hunting since many decades for inventing ideal tooth coloured restorative material that offer optimal function and aesthetics. However, till date we don't have perfect material to meet these requirements ideally.<sup>12</sup> Composite resin has resolved his dilemma to a certain extent. Dental practitioners are also using other tooth coloured material for miscellaneous purposes. The ideology of bonding to tooth structure has led to major changes surface preparation.<sup>13,14</sup> These preparations are primarily directed towards conservation of healthy and natural tooth structure. In spite of the considerable improvements of adhesion mechanisms, the bonding area remains the weakest region of composite restoration. Traditionally, composite resin is the most frequently used restorative material in private practices because of its high aesthetics. However, composite resin is also having one major issue of bond failure.<sup>15,16</sup> Because of this dilemma, composite resins are being used very cautiously in prone situations. It is therefore very imperative to recognize the exact cause of bond breakage. A range of bonding systems has been introduced to meet these issues. Literature has well evidenced that reliable bonding can be achieved by ideal and efficient etching.<sup>17,18</sup> Total etch system works by eliminating smear layer and creation of collagen fibril layer. Abdelmegid and associates have studied the effect of three remineralizing agents on the shear bond strengths of two composite resins.<sup>4</sup> They concluded that the three tested remineralizing agents affect shear bond strength of the tested resin-composites to enamel of primary teeth. These days, the resin composites have achieved high recognition among the pedodontists because of mechanical properties and behaviour qualities.<sup>19,20</sup> Enamel remineralization process is a usual repair mechanism to re-establish the minerals again in dental hard tissues particularly in enamel. Enamel remineralization usually happens in neutral pH conditions.<sup>21</sup> Numerous types of remineralizing agents and remineralizing techniques have been discussed and many of them are being used clinically, with considerably unsurprising results.

#### V. CONCLUSION

Authors have presented few very significant conclusions from this study. Within the limitations of the study, authors concluded that the tested remineralizing agent literally affects shear bond strength in between studied composite resins and enamel of primary teeth. However, these changes are not very evident. After immersion into remineralization agent, maximum mean shear bond strength was noticed with Beautifil Flow Plus X). Similarly, minimum mean shear bond strength was noticed with Filtek™ Z350 XT Universal Restorative. Comparison of shear bond strengths among groups revealed highly significant implications. Our study outcomes should be taken as suggestive while applying clinically. Nonetheless, authors anticipate few other authentic studies to be conducted with larger sample size and wider parameters.

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