ORIGINAL RESEARCH

The Shear Bond Strength of Resin Sealants Used on Topical Fluoride Treated Teeth Surfaces – An Invitro Study

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ABSTRACT

Introduction: Topical application of fluoride on enamel surfaces has been reported to reduce the bond strength of sealants.To compare the Shear Bond Strength of two resin sealants applied on topical fluoride treated teeth surfaces.

Methods and Material: 40 buccal halves of permanent third molars were embedded in cold cure acrylic resin and were randomly assigned into 2 groups (n=20), according to the sealant applied: (I) ClinproTM sealant (3M-ESPE) and (II) Delton FS (Dentsply). Each group was divided into 2 subgroups (n=10), Subgroup A: Conventional technique, Subgroup B: Conventional technique preceded by fluoride application with 1.23%APF gel (Pascal International, Inc.). Shear bond strength was tested for these samples and were statistically analyzed using the unpaired t test.

Results: Means (kg/cm2) were: Group IA: 25.26, Group IB: 14.69, Group II A: 16.95, Group II B: 13.65. There was a statistically significant difference ($p<0.05$) between both the sealants group IA & II A, where Clinpro provided higher bond strength than Delton. There was also a statistically significant difference between Conventional technique & topical fluoride application & Group I A& IB.

Conclusions: Clinpro sealant yielded better bonding performance than Delton in conventional group. Topical fluoride application undermined the adhesion and resulted in lower bond strengths only in Clinpro sealant group. But the shear bond strength values are within clinically acceptable limits, hence, it can be concluded that topical fluoride application has no effect on the bond strength of sealants.

Keywords: Shear bond strength, Pit & fissure sealant, Topical fluoride.

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INTRODUCTION

Dental caries is the most common chronic human disease. Although only 12.5 percent of all tooth surfaces are occlusal, these surfaces are shown to develop more than two thirds of the total caries experienced by children.[1] Since dentistry's primary objective today is prevention rather than cure, various preventive measures have been undertaken for the prevention of dental caries which includes oral hygiene procedures, dietary modifications, systemic and topical fluoride applications, pit and fissure sealants and so on.[2] Among these fluoridation is considered as the most economical and practical solution, but the constraint being it is effective only against smooth surface caries and not against pit and fissure carious lesions.[3,4,5] Recent studies reviewed the combinations of preventive methods and concluded that the most promising combination program is the use of fluoride with fissure sealing.[6,8,9] Practical advantages for the same include, if sealant is placed immediately after topical fluoride application, even if the sealant is lost, the tooth will receive benefit from the topical fluoride applied & will be more resistant to caries than the case where in topical fluoride was not applied. It also provides for prolonged contact of fluoride with enamel and enhances the uptake. It also provides protection of smooth surface areas. Another rationale is that, etched enamel surfaces if left uncovered by sealant can undergo demineralisation and may lead to caries. This can also be avoided by the combination strategy.

The added advantage of topical fluoride application separately when compared to fluoride releasing sealants available in the market today is that it protects the smooth surfaces of the teeth also which are usually left uncovered by the sealant application alone.

Few studies have reported that the topical application of fluoride to enamel surfaces deteriorates the bond strength of sealants. Such studies are very few in number and inconclusive. Hence the aim of our current study is to compare the shear bond strength of two resin sealants commonly available in the market today (Clinpro™ sealant (3M-ESPE) and Delton FS (Dentsply)) applied immediately after topical fluoride treatment.

MATERIAL AND METHOD

Forty human sound permanent third molars extracted in a 6 month period, stored in physiologic saline were used in this study. Each tooth was cleaned with a scaler and a bristle brush and was embedded in cold cure acrylic resin blocks (1 inch diameter & 1 inch height) so that buccal surface was perpendicular to the long axis of resin blocks. The tooth structure from all the specimens was removed mesiodistally on buccal surface with tapered fissure bur attached to slow speed contra angle hand piece (NSK NAC model: 00091063) to produce a flat surface parallel to long axis of tooth. In order to get uniform flat surface and fresh smear layer, dentin surfaces are ground wet with 400-grit silicon carbide paper and rinsed with saline and dried and then stored in distilled water.

Forty Teeth were randomly divided into 2 equal groups (Group I & II) based on which sealant they will receive, Group I (n=20) Clinpro, Group II (n=20) Delton sealant.

These groups were further divided into 2 subgroups based on different sealant application techniques.

Subgroup A (n=10) Conventional technique

Pumice prophylaxis, followed by rinsing for 15s, drying for 10s, acid etching for 30s with 37%phosphoric acid gel (Etching Gel, 3M/ESPE, St Paul, Minn) followed by rinsing & drying for 15s.

Subgroup B (n=10) Conventional technique preceded by fluoride application

1.23%APF gel (Pascal International, Inc.) is applied on enamel surface for 4 min, rinsing, drying, followed by conventional technique.

In Group I, Clinpro TM fissure sealant (3M-ESPE) and in Group II, Delton FS Sealant (Dentsply) was applied to etched enamel using a cylindrical plastic tube (4.2mm in diameter and 2mm in height) perpendicular to buccal surface and cured with Light curing equipment type (3M ESPE) LED type for 40s. Plastic matrix was then removed. The specimens were stored in distilled water for 72 hours at room temperature.

The specimens were then air dried and the Shear Bond Strength (SBS) was evaluated using a universal testing machine (Instron Model FA-50). A shear force was applied to the base of the bonded sealant cylinder parallel to the buccal surface of the tooth at a cross head speed of 0.5mm/min until debonding occurred.

The Shear bond strength (SBS) was calculated by dividing the obtained load by surface area of attachment and expressed in kg/cm2.

$$\text{SBS (kg/cm}^2\text{)} = \frac{\text{Obtained load (kg)}}{\text{Surface area of attachment (cm}^2\text{) } \{A=\pi r^2\}}$$

Bond strengths were then statistically analysed using unpaired t test

RESULTS

The mean Shear Bond Strength (SBS) values of the two sealants are displayed in Table 1.Means (kg/cm2) and standard deviations were: Group IA: 25.26 ± 6.99, Group IB: 14.69± 2.10. Group II A: 16.95±4.86 Group II B: 13.65±2.12. There was a statistically significant difference ($P<0.05$) between both the sealants group I A& II A, where Clinpro provided higher bond strength. There was no statistical significance between two groups IB and II B. There was a statistically significant difference between conventional technique and topical fluoride application in Group I A& IB. The Shear Bond Strength is found to decrease after topical fluoride application in Clinpro group. There was no statistical significance between Groups II A& II B, Delton group.

DISCUSSION

Majority of the previous studies have shown that fluoride is negatively associated with resin bonding.[2,4,6,7] This is because, fluorides react with the enamel, forming calcium fluoride and fluoroapatite, which act as slow releasing agents, enhancing remineralization of enamel and making it more resistant to acid dissolu-

GROUPS (SEALANTS)	SUBGROUPS (TECHNIQUES)	(Shear bond strength) SBS MEAN	SD	RANGE
I	A	25.26	6.99	20.10-44.39
	B	14.69	2.10	10.89- 17.79
II	A	16.95	4.86	9.33- 25.73
	B	13.65	2.12	11.26- 17.46

Table 1 : The mean Shear Bond Strength (SBS) (kg/cm^2) and Standard deviation values of the two sealants to tooth surface in the two groups.

tion. However, the formation of reaction products (mainly calcium fluoride) has been reported to reduce resin bond strength to enamel.[11] For this reason, it is not recommended to place sealants immediately after topical fluoride application and for regular dental care, sealant placement is done either before fluoride application or postponed for another visit after flouride application.[8]

In our present study, the effects of topical fluoride application on the shear bond strength of resin sealants were compared. There was a statistically significant difference between conventional technique and topical fluoride application & in Group I A& IB. The Shear Bond Strength is found to decrease after topical fluoride application in Group I. Although there was no statistical significance between Groups II A&II B, the mean bond strength values for topical fluoride applied teeth were lower. When the application of topical fluoride is compared with the conventional technique, the former resulted in decreased strengths than the latter, but the difference is not much pronounced. Thus the results of the present study showed that application of topical fluoride gel prior to acid etching adversely affected the Shear Bond Strength of ClinproTM sealant of 3M- ESPE company, but the SBS of Delton FS sealant were not affected. But the shear bond strength values are within clinically acceptable limits.

Other studies published by Garcia Godoy, Bishara, Thornton JB, Koh et al have shown that even incorporating small amounts of fluoride to phosphoric acid agents, or applying fluoride after acid etching before placing the resin, did not significantly influence the bond strength of resin composite to enamel which is in agreement with our current study.[11-15] But contradictory to this, a study conducted by LeódidoGda to evaluate the Shear Bond Strength of brackets after pre-treatment with different fluoride solutions, concluded that the pre-treatment of enamel with flouride prior to fixing orthodontic brackets reduces the shear bond strength values which is contradictory to our study.[17,18]

The present study also compared the Shear Bond Strengths of two different sealants, Delton and Clinpro fissure sealant which are commonly available in the dental market today. There was a statistically significant difference ($P<0.05$) between both the sealants Group I A& II A, where Clinpro provided higher bond strength. But although there was no statistical significance between two groups IB & II B, mean bond strength values for Clinpro was higher. Since the values of shear bond strength are within acceptable clinical limits, Clinpro sealant cannot be considered superior to Delton and both these sealants are effective clinically. Studies conducted by Perdigão, Fernandes KS et al concluded that Clinpro sealant resulted in increased bond strengths than Delton.[19,20,21]

These results suggest that new materials should not be readily incorporated into daily practice right after they are released into the market. These require a large number of invitro, in vivo and clinical trials to test for their effectiveness before its use.[22]

The lack of reported studies using the same methodology and materials tested in the present study is a limitation to stating a reliable comparison with outcomes of previous investigations.

CONCLUSION

When conventional technique was performed Clinpro fissure sealant provided higher bond strength than Delton FS fissure sealant.In topical fluoride application group, there was no difference in bond strength between Clinpro and Delton sealant. Topical fluoride application undermined the sealant bond strength in Clinpro group. Topical fluoride application didnot affect the sealant bond strength in Delton group.But the shear bond strength values are within clinically acceptable limits, hence, within the limitations of the current study, it can be concluded that topical fluoride application has no effect on the bond strength of sealants.

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