ORIGINAL RESEARCH

Comparison of Bond Strength of Pit And Fissure Sealant in Permanent and Deciduous Molars

Sajeev R¹, Nayak AU², Reddy V³, Ramesh V⁴, Bindu MJ⁵

ABSTRACT: **Introduction:** Pit and fissure sealants are a safe and effective way to prevent dental caries. Non Rinse Conditioner has the advantage of being able to be applied and then removed with a simple burst of compressed air, without the need for washing thus reduces the working time and reduces the risk of contamination of enamel. **Aim and Objective:** The purpose of the present study was to compare the shear bond strength of pit and fissure sealant on enamel using a non-rinse conditioner and a conventional acid etch technique. **Materials and methods:** 12 premolars and 12 deciduous molars were selected. Group 1 (P1): Gelatin capsules were packed with Pit and fissure sealant applied on premolar after using Non rinse conditioner, Prime and Bond. Group 2 (P2): Gelatin capsules were packed with Pit and fissure sealant applied on premolar after using Acid etching, Prime and Bond. Group 3 (D1): Gelatin capsules were packed with Pit and fissure sealant applied on deciduous molars after using Non rinse conditioner, Prime and Bond. Group 4 (D2): Gelatin capsules were packed with Pit and fissure sealant applied on deciduous molars after using Acid etching, Prime and Bond. **Results:** Statistical analysis reveals that conventional acid etching technique shows statistically higher shear bond strength than non-rinse conditioner both in primary and permanent teeth. ($p < 0.001$) **Conclusion:** The shear bond strength of the pit & fissure sealant using the Conventional acid etch technique showed the highest shear bond strength than the use of Non-rinsed conditioner in both deciduous and permanent teeth groups.

Keywords: Pit and fissure sealant, acid etchant, prime and bond, non – rinse conditioner

Prevention of dental caries continues to be an oral health priority that calls for an individualized treatment approach^[1]. The occlusal surfaces consists approximately 13% of enamel at the surface is at risk for caries due to the fissure anatomy which favors the plaque retention and maturation, in young permanent teeth^[2]. The pits and fissures of the first and second molars are susceptible for caries even after their eruption and the incidence is estimated to be greater during the first four years after their eruption. Thus, it is

important for us to seal these pits and fissures by blocking them with a material which micro mechanically bonds to the tooth structure and forms a barrier for cariogenic bacteria^[3]. To enhance this type of bonding for the resin based sealants, acid etchant is used for the sealant

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placement and polymerization. Also, pit and fissure sealant should be of low viscosity which will be able to flow into the deepest site of the pits and fissures. Therefore, micromechanical retention is required^[4].

The development of pit and fissure sealants were thus based on the discovery of the etching of enamel which increased the retention of resin restorative material and improved the marginal integrity considerably. The Acid etchant used is 30%-40% of orthophosphoric acid, when applied have to be rinsed and dried. This type of rinse conditioner can be unpleasant when working with uncooperative children^[5,6].

Currently Non-Rinse Conditioner (Dentsply) come into the market which consists of maleic acid and itaconic acids. This etchant has the advantage of being able to be applied and then removed with a simple burst of compressed air, without the need for washing. This procedure may be of great importance in the practice of clinical pediatric dentistry, since it shortens the work time and thus reduces the risk of contaminated dental enamel, especially when conducted in the relative isolation of the operative field.

The purpose of the present study was to compare the shear bond strength of pit and fissure sealant on enamel using a non-rinse conditioner and a conventional acid etch technique.

Materials and Methods:

The present study was carried out in the Department of Pedodontics and Preventive Dentistry, Rajah Muthiah Dental College and Hospital to evaluate the shear bond strength of the sealants to previously cleansed and dried enamel surface of the premolars. The study was also aimed at evaluating the influence of bonding agent

on the shear bond strength of sealant.

Twelve non-carious premolar teeth that were recently extracted for orthodontic purposes and twelve extracted non-carious deciduous molar teeth, which were over retained, were selected for the study. All the teeth were stored in distilled water until the start of the study.

The selected deciduous and permanent teeth were divided into two groups of 12 teeth each as follows^[7].

Non-rinse conditioning group (NRCTM).

NRCTM + Prime and Bond^{NT} + Clinpro (3M)

P1 - Permanent (6 teeth)

D1 - Deciduous (6 teeth)

Conventional acid etching group (RC).

Acid etchant + Prime and Bond^{NT} + Clinpro (3M)

P2 - Permanent (6 teeth)

D2 - Deciduous (6 teeth)

Each subgroup consisted six premolar and six deciduous molar, to be evaluated for the shear bond strength of pit and fissure sealant to enamel. The sealants were packed into a gelatin capsule of 4mm diameter and 5mm height, serving as a matrix. The sealants were then bonded to the smooth enamel surface of the sample. The following was the technique to be followed for each group.

Group A: (P1, D1)

NRCTM was applied with a disposable brush and left undisturbed for 20 seconds as per the manufacturer's instructions. The excess of NRCTM was removed by blowing gently with an air syringe. Prime and Bond^{NT} (Dentsply) was applied with a fresh brush and left undisturbed for 20 seconds as per the instructions of manufacturer. The gelatin capsule was packed with Clinpro [3M] and bonded to the treated enamel surface of the premolars and light cured. The samples were then

polymerized from the top of sample with the light source held as close as possible, for 40 seconds and then irradiated at the junction of the cylinder and the enamel for another 10 seconds from all sides of the matrix.

Group B: (P2, D2)

34% Phosphoric acid was applied on the enamel surface for 20 seconds, rinsed and dried as per instructions of manufacturer. Prime and Bond^{NT} (Dentsply) was then applied with a fresh brush and left undisturbed for 20 seconds. The excess was removed by blowing gently again with an air syringe. Then the gelatin capsules were packed with Clinpro (3M) and bonded to the treated enamel surface of the premolars and light cured. The samples were then polymerized from top of the sample with the light source held as close as

possible, for 40 seconds and then irradiated at the junction of the cylinder and the enamel for another 10 seconds from all sides of the matrix. Then the samples were immersed in distilled water for 7 days. After 7 days, the shear bond strength testing was carried out using Universal testing machine. (Make: FIE, India, Model: Unitek 94100)(Fig1) The load required to fracture the specimen was determined and noted in kg and was then converted to Mega Pascals (MPa) and statistical analysis was done using ANOVA.

$$\text{Shear bond strength} = \frac{\text{kg} \times 9.8 \text{ (N)}}{\text{Crosssectionalarea}}$$

$$\text{Cross sectional area} = \pi d^2 / 4 = 19.625 \text{ mm}^2 \text{ surface area}$$

$$d = \text{internal diameter of the gelatin capsule}$$

The load at which fracture occurred was noted in kg

The teeth, which were subjected to shear bond

Fig– 1: Specimen Undergoing Shear Bond Strength Testing

Fig– 2: Specimen showing adhesive fracture

Fig– 3: Specimen showing cohesive fracture

strength, were sectioned through the centre, smoothened using Arkansas stone and viewed under light reflecting microscope (10x). The mode of fracture of specimen was determined as being adhesive or cohesive, based on the presence or absence of the restorative material on the sheared tooth surface.(fig 2&3)

Results

In this study, conventional acid etching technique for primary teeth showssignificantly higher shear

bond strength than non-rinse conditioner both in primary and permanent teeth. P2 (11.61Mpa)& D2 (14.64 Mpa) (p-0.4526) shows higher shear bond strength than P1(8.37 Mpa)& D1(8.383 Mpa)(p-0.9956). Where the p value is <0.001(Table 1 to 4).

Discussion:

In the present study, conventional acid etching technique shows statistically higher shear bond strength than non-rinse conditioner both in

Sample No	P1(MPa) : NRC+Prime &Bond+ Clinpro	P2(MPa) : Acid etching+ Prime&Bond +Clinpro
1	9.0800	7.8100
2	11.010	12.110
3	8.2900	12.730
4	9.3100	14.050
5	5.5400	10.120
6	7.000	12.850

Table 1: Shear bond strength values of pit and fissure sealant in permanent teeth (MPa)

Sample No	D1(MPa) : NRC+Prime &Bond+ Clinpro	D2(MPa) : Acid etching+ Prime&Bond +Clinpro
1	7.4300	13.640
2	5.9200	13.350
3	10.840	12.140
4	10.480	11.370
5	7.990	18.550
6	7.640	18.810

Table 2: Shear bond strength values of pit and fissure sealant in deciduous teeth (MPa)

Variable	Mean (MPa)	Sample size	Group variance
P1	8.372	6	3.650
P2	11.61	6	5.131
D1	8.383	6	3.623
D2	14.64	6	10.47

Table 3: Shows the mean shear bond strength of each groups

primary and permanent teeth. P₂ (11.61Mpa)& D₂ (14.64 Mpa) shows higher shear bond strength than P₁(8.37 Mpa)& D₁(8.383 Mpa). This result was similar to the results obtained Anna B. Fuks (2002)^[7]and Fava (2003)^[8].

Fava et al (2003)^[8]explained that phosphoric acid has a pH equal to 0.6 while Maleic acid which contained the NRCTM has a pH of 1.4. Thus, the higher pH of the acid component in NRCTM may not be sufficient to condition the surface enamel as effectively as phosphoric acid. Moreover, the application of Phosphoric acid for 20 seconds causes the preferential dissolution of center of the prism classified as Type I in accordance with Silverstone et al (1975)^[10,11]both in deciduous molars and in permanent teeth. Whereas, with NRCTM for 20 seconds preferentially removes prism periphery material, characteristic of the Type II pattern. The retentive type 1 and type 2 etch patterns were not present in any of the NRC treatment regimens. However, in the context of significant than the depth of resin penetration. This contributes to the adequate adhesion of the sealants to the enamel surface which makes the difference in shear bond strength between conventional acid etching and non rinse conditioner^[4,9,12,13].

Although the shear bond strength of conventional acid etching was found to be higher than the non-rinse conditioner, clinically the use of a non-rinse conditioning agent can be advantageous. It

requires fewer and more reduced operational steps resulting in saving time for preventive and / or restorative procedures. It is particularly desirable in the treatment of children. It also diminishes the risk of technical error by reduced number of operational steps.

Non-rinse conditioner with clinpro(3M) showed lower bond strength value than clinpro(3M) with phosphoric acid and rinsing. However, as we are unaware of the lowest value for the retention of sealants, the clinical significance of these findings has to be tested. In this study, the sheared specimens were also assessed for the mode of fracture by using light reflecting microscope (10x objective).

All the samples (P₁, D₁) involving the NRCTM showed adhesive failure to the teeth in contrast to the conventional acid etching groups (P₂, D₂), which showed more of a cohesive failure.

Conclusion:

The following conclusions were drawn from the present study.

The shear bond strength of the pit & fissure sealant using the Conventional acid etch technique showed the higher shear bond strength than the use of Non-rinsed conditioner in both deciduous and permanent teeth groups.

There was no significant difference in the shear bond strength of sealant in the Non rinsed conditioner between the deciduous and permanent teeth.

Group	Adhesive	Cohesive
P1(MPa) : NRC+Prime &Bond+ Clinpro	3	3
P2(MPa) : Acid etching+ Prime&Bond +Clinpro	2	4
D1(MPa) : NRC+Prime &Bond+ Clinpro	3	3
D2(MPa) : Acid etching+ Prime&Bond +Clinpro	1	5

Table 4: Types of bond failures of the specimen at the restoration tooth interface

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How to cite this article:

Sajeev R, Nayak AU, Reddy V, Ramesh V, Bindu MJ. Comparison of Bond Strength of Pit And Fissure Sealant in Permanent and Deciduous Molars. Journal of Scientific Dentistry 2014;4(1):3-8

Source of Support: Nil, Conflict of Interest: None declared