

Micro Leakage Assessment of Pit and Fissure Sealant with Previous Fluoride Application: An *in vitro* Study

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Abstract: Adhesion of restorative materials to the tooth structure is significance in dentistry. The aim of this study was to evaluate the micro leakage of pit and fissure sealants following application of 1.23% Acidulate Phosphate Fluoride (APF). Thirty sound non carious human premolar teeth were randomly assigned in two groups (n = 20). Artificial fissure grooves were prepared on the buccal surface of each tooth. In test group 1.23% APF gel was applied for 4 min to thoroughly dried teeth and then teeth etched 15 sec using phosphoric acid gel. Bonding was applied to the fissures and polymerized with a light curing unit and the fissure sealant material (3M, USA) were placed on the fissures. In control group the procedure was the same as test group but with the omission of the fluoride application. All the teeth were thermo cycled 1000 times at 5-55oc with dwell time of 30 sec. Samples were immersed in 2% basic fuchsin solution for 24 h and the teeth were sectioned buccolingually for the middle of the fissure. Dye penetration was evaluated under stereomicroscope. In test group 20% of the specimens and 46.7% of those in the control group shows no dye penetration. The dye had penetrated to the base of the fissure in 26.7% of test group and 20% of controls. Comparing groups by Mann Whitney U-test revealed that the difference between groups was not significant ($p < 0.05$). The results reveal that the use of topical fluoride treatment immediately prior to sealant placement does not increase micro leakage.

Key words: Micro leakage, fluoride, fissure sealant, penetration, treatment, bonding, Iran

INTRODUCTION

Fissure sealants have been widely used from 1960s for control of occlusal caries (Mejare *et al.*, 2003). If the fissures are sealed completely and micro leakage is prevented they act as a physical barrier to various external carious agents thus preventing the onset of caries (Mejare *et al.*, 2003; Shaw, 2000).

Adhesion of restorative materials to tooth structure is one of the greatest problems in dentistry. If the lack of adhesion exists between resin restoration and enamel the micro leakage occurs and it leads to discoloration, secondary caries and marginal breakdown. The method is technique sensitive in which many factors intervene and modify the effects.

On the other hand application of topical fluoride agents in children is well accepted as a clinical preventive procedure.

The use of fluoride prior to sealant placement is controversial for many decades. It has been suggested that application of fluoride prior to tooth etching lowers the tensile bond strength (Low *et al.*, 1975; Sheykholeslam *et al.*, 1972) but other studies have suggested that fluoride does not adversely affect

bond strength of enamel with composites or sealants (Warren *et al.*, 2001; Koh *et al.*, 1995; Takahashi *et al.*, 1980).

Furthermore the application of the sealant material over a fluoride treated surface should provide prolonged contact of the fluoride with the enamel and enhance the uptake (Takahashi *et al.*, 1980).

Another fact to consider is that fluoride applications reduce the surface energy of enamel and it interferes with the wetting of the tooth surface by a liquid adhesive (MacDonald, 2011). To solve these contradictory results further investigations is required.

The aim of this study is to evaluate the micro leakage of pit and fissure sealants following application of 1.23% acidulated phosphate fluoride. It was believed that the findings would have potentially important implications for clinical use of sealants.

MATERIALS AND METHODS

Thirty sound non carious human maxillary and mandibular premolar teeth which were extracted for orthodontic or periodontal reasons were collected. Teeth were brushed and washed then, stored in 0.5%

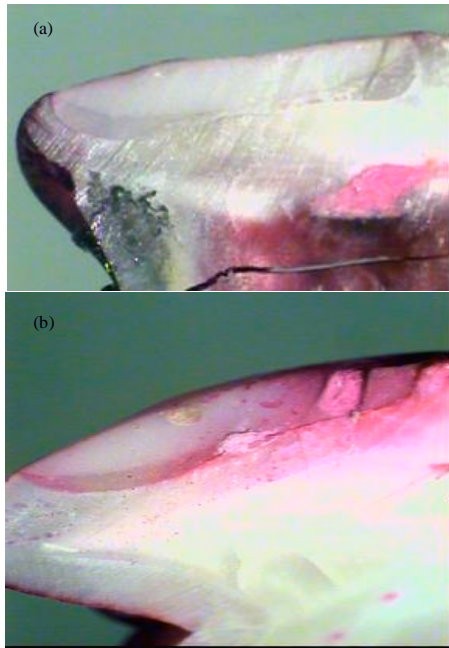


Fig. 1: Dye penetration evaluation under stereomicroscope (a: Grade 0, b: Grade 3)

chloramines solution for 24 h and kept in saline until the beginning the experiment. Two layers of nail polish were applied to coat the teeth approximately 2 mm from the margins of the sealant. Teeth were mounted in a self curing acrylic base by using metallic molds to allow ease in handling. Artificial fissure grooves (Width 1 mm) confined to a depth of 1 mm in enamel were then prepared on the buccal surface of each tooth using a 1/4 round bar (D and Z, Germany) with a high speed hand piece.

The teeth were divided in to two groups using simple randomization method. In test group 1.23% APF gel (Sultan, USA) was applied for 4 min to thoroughly dried teeth and then teeth etched 15 sec using 37% phosphoric acid gel (3M, USA), washed 30 sec and dried for 15 sec. A layer of bonding agent (N Bond, Germany) was applied to the fissures and dried gently for 5 sec with compressed air and polymerized with a light curing unit.

Sealant (3M, ESPE, USA) was applied and light cured according to the instructions of the manufacture and the margins of sealants were then checked for any failure of sealant application. In control group the procedure was the same as test group but with the omission of the fluoride application. All the teeth were thermo cycled 1000 times at 5-55oc with dwell time of 30 sec. Samples were immersed in 2% basic fuchsin solution for 24 h and then washed. The teeth were sectioned buccolingually for the middle of the fissure using a disk mounted on a slow speed hand piece. One blinded examiner was evaluated

the dye penetration (Fig. 1a and b) according to the bellows criteria under stereomicroscope (Zervou *et al.*, 2000):

- 0 = No dye penetration
- 1 = Dye penetration restricted to the outer half of the sealant
- 2 = Dye penetration extending to the inner half of the sealant
- 3 = Dye penetration extending to the underlying fissure

The results were statistically evaluated and the comparisons of the groups were performed using Mann Whitney U-test and a value of $p < 0.05$ was considered significant.

RESULTS AND DISCUSSION

The percentage of teeth that showed micro leakage in each group is shown in Table 1. In test group 3 (20%) of the specimens and 7 (46.7%) of those in the control group shows no dye penetration. The dye had penetrated to the base of the fissure in 4 (26.7%) of test group and 3 (20%) of controls.

Comparing groups by Mann Whitney U test revealed that the difference between groups was not significant ($p < 0.05$).

One of the most important factors for success of pit and fissure sealant treatments is the integrity of tooth sealant material interface.

Although, micro leakage can be expected on all restorative materials however, various materials and preparation techniques have been suggested to decrease or even prevent micro leakage. It's clear that the repeated use of fluorides is one of most important roles for prevention of dental caries.

Acidulated Phosphate Fluoride (APF) solution includes acids for the etching of the enamel and the consequent enhancement of the fluoride uptake (Lee *et al.*, 2010).

The results of this study supports that use of fluoride prior to sealant placement does not increased micro leakage. These finding confirms previous studies (Warren *et al.*, 2001; Takahashi *et al.*, 1980; Garcia-Goday *et al.*, 1991). On the other hand Low *et al.* (1975) reported that APF applied prior to tooth etching lowered the tensile bond strength and they strongly recommended that clinical procedures which involve etching of the enamel should not be preceded by the topical application of APF solutions.

Table 1: Micro leakage values in two groups

Flouride	Leak				Total
	0.00	1.00	2.00	3.00	
Yes					
Count	3.0	2.0	6.0	4.0	15.0
Within flouride (%)	20.0	13.3	40.0	26.7	100.0
No					
Count	7.0	3.0	2.0	3.0	15.0
Within flouride (%)	46.7	20.0	13.3	20.0	100.0
Total					
Count	10.0	5.0	8.0	7.0	30.0
Within flouride (%)	33.3	16.7	26.7	23.3	100.0

In this manner Sheykholeslam *et al.* (1972) indicated that topical treatment of ground etched enamel with fluoride, prior to application of self curing resin adhesives resulted in significant reduction in bond strength. It should be point out that in the mentioned studies they have used the ultraviolet light activated resins and this kind of resins are no longer used. It seems that the developments have occurred in the sealant materials during the time and they may shows better clinical properties.

To prevent the influence of the anatomical structure of the fissures and complex morphology of occlusal pits which affects the clinical success of the sealant (Eronat *et al.*, 2003) in this study artificial fissure grooves were prepared on the buccal surface of teeth. Some studies indicated using of bonding agents after etching process is unnecessary and does not affect their clinical effectiveness (Boksman *et al.*, 1993), on the other hand there are other studies which support that bonding agents provides adequate bond strength and retention for resin sealants (MacDonald, 2011) so, in this study the researchers have used bonding agent which was thoroughly air dried across the surface to avoid a thick layer of adhesive residue.

In this study micro leakage was investigated using a dye leakage model with basic fuchsin. This technique has been used in many studies to evaluating micro leakage. It has been believed that if a material responds positively to *in vitro* dye tests it is likely to respond even better clinically because the dye is more easily diffused than bacteria and their by products (Toman *et al.*, 2007). There are advantages to placing a sealant after a topical fluoride treatment in clinical practice. If the sealant becomes totally or partially lost tooth structure underneath sealants would have benefit of fluoride.

Tandon and Mathew (1997) stated that acid etched enamel treated with APF remineralized at a more rapid rate also patients having received a fluoride therapy at same visit would not need to be rescheduled for sealant placement.

CONCLUSION

The results reveal that the use of topical fluoride treatment immediately prior to sealant placement does not increase micro leakage and there was no apparent different permeability of fissure sealants with or without previous fluoride application.

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