

Evaluation of the Effects of Enameloplasty and Air Abrasion on Sealant Micro-Leakage

Aliasghar Soleymani¹, Zahra Bahrololoomi², Shahrzad Javadinejadi³, Parisa Salehi⁴

¹Assistant Professor, Department of Pediatric dentistry, Faculty of Dentistry, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

²Associate Professor Department of Pediatric dentistry, Faculty of Dentistry, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

³Assistant Professor Department of Pediatric Dentistry, Islamic Azad University, Khorasgan, Esfahan, Iran

⁴Dentist

Abstract

Objective: Micro-leakage, one of the major reasons for recurrent decays, may lead to uncontrollable flow of liquids, pulp inflammation and peri-apical pathology. The purpose of this in vitro study was to evaluate micro-leakage of pit and fissure sealants after using three different pit and fissure preparation techniques: 1) acid etching, 2) fissure enameloplasty and acid etching, and 3) air abrasion and acid etching.

Materials and Methods: Sixty-nine extracted sound molars and premolars were randomly divided into three groups (23 samples in each group). Teeth were prepared using one of three occlusal surface treatments. Then the sealant was applied on the occlusal fissures of all teeth. The teeth were thermocycled and stored in normal saline. All teeth were sealed apically and coated with nail varnish and then were immersed in a 2% solution of methylen blue. Two buccolingual sections were made. The surfaces were scored 0 to 3 for the extent of micro-leakage using a stereomicroscope. Data were analyzed by Kruskal- wallis and Dunn procedure.

Results: Enameloplasty and acid etching were significantly different regarding micro-leakage ($P= 0.016$), but no significant difference in micro-leakage was observed between air abrasion and the other methods.

Conclusion: Enameloplasty followed by acid etching produced significantly less micro-leakage than the acid etching technique. Air abrasion acid etching was better than the acid etching technique in reducing micro-leakage too.

Key Words: Fissure Sealants; Air Abrasion; Dental

✉ Corresponding author:
Z. Bahrololoomi, Department
of Pediatric dentistry, Faculty
of Dentistry, Shahid Sadoughi
University of Medical Sciences,
Yazd, Iran

zbahrololoomi@ssu.ac.ir

Received: 5 March 2014
Accepted: 7 August 2014

Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran (2014; Vol. 11, No. 6)

INTRODUCTION

One of the most important aspects of prevention in dentistry is caries prevention [1]. Micro-leakage is one of the major reasons for recurrent decays, pulp inflammation and ne-

crosis. The most important complication of micro-leakage is uncontrollable flow of liquids that may lead to pulp inflammation and peri-apical pathology [1, 2]. Pits and fissures in the first new-erupted permanent molars especially

among children are highly vulnerable to caries. Fissure sealants are extensively used for sealing on fissures. The effect of sealants in decreasing the incidence of caries depends on their entanglement and soundness of the interface between the enamel and sealant [1].

The sealant penetrates into the microscopic pores of enamel during etching. Its penetration into the etched enamel produces resin tags, which provide the mechanical method for sealant bonding [3]. Therefore long-term clinical success of fissure sealant use is closely related to the success in how to put it in its place [4].

There are different methods of fissure preparation before sealant use in order to increase sealant bonding and decrease micro-leakage, including prophylaxis by pumice powder, preparation with round bur 1/4, and air abrasion. Due to the high ability of air abrasion for removing debris from the depth of the fissure, this method is recommended before fissure sealant use [1].

Different studies have shown different effects of air abrasion on binding and micro-leakage of fissure sealants. Brockman et al. could not find any difference in sealant efficacy after preparation by pumice and air abrasion [5], but Brocklehurst et al. showed a higher depth of penetration for the air abrasion method [6]. Zyskind et al. showed the importance of acid etching for prevention of micro-leakage, but the study failed to show a significant difference between the two methods of air abrasion with etching and air abrasion with etch and scotch bond [7]. Hatibovil et al. showed that air abrasion and acid etching is the most efficacious preparation method before using fissure sealants [8].

Some studies have shown that air abrasion is an effective method [9- 12]. Knoblock did not find a significant difference between air abrasion and acid etching with air abrasion alone [13]. Srinivasan et al. showed that pumice and etch is the best method of preparation [14]. Ansari showed that pumice powder could significantly lower the micro-leakage [15].

Gray showed that etched enamel bond is stronger than the air-abraded one [16]. According to Yazici et al., air abrasion and acid etching is better than air abrasion alone after 12-24 months [17].

In this study, we aimed to compare the effect of three methods including etching, enameloplasty and air abrasion on fissure sealing.

MATERIALS AND METHODS

This was an experimental in vitro study. Sixty-nine third molar and premolar teeth that had been extracted for orthodontic treatment without any caries or crack were collected during a 3-month period. They were kept in distilled water in room temperature. Prior to the study, the occlusal surfaces of the teeth were cleansed with water/pumice slurry using brushes at low speed. Samples were randomly divided into three groups (23 samples in each group).

Occlusal surfaces in the first group (control) were then etched with phosphoric acid 37%. After 20 seconds they were washed and dried again. Then Clinpro unfilled fissure sealant (3M, St Paul, USA) was placed on the teeth. Fissure sealant was cured by a halogen light cure unit (Caltolux, coltene, USA) with light intensity of 500mW/cm² for 40 seconds. Then the samples were put in distilled water. Samples in the second group (enameloplasty) were gently prepared by a round carbide bur 1/4 (SSWhite) in high speed. Then the teeth were dried and etched and fissure sealed similar to the first group.

Samples in the third group (air abrasion) were air abraded (Prophy-Mate, NSK) for 20 seconds. Then the teeth were dried and etched and fissure sealed similar to the first group. All samples were thermocycled between 5±2 and 55±2 degrees centigrade (Vafaei, Iran).

The surfaces of the specimens were coated with two layers of nail varnish except for one millimeter around the sealant. The specimens were stored in methylene blue 2% for 24 hours, rinsed and then sectioned buccolingual-

ly to assess dye penetration under 4X magnification of a stereomicroscope (Sten SV 11-Zeiss, Germany). Three observers separately measured the micro-leakage from the three surfaces (mesial, distal and one of the two middle surfaces). The largest score was recorded. The scoring was done according to a ranked scale: 0, no penetration of dye; 1, dye penetration limited to the outside half of the sealant; 2, leakage up to the inner half of the sealant; 3, dye penetration extending to the underlying fissure. Data were analyzed by SPSS (ver. 16) using Kruskal- Wallis and Dunn procedure.

RESULTS

In this study, 69 samples were assessed in three groups. Table 1 summarizes the results of dye penetration in each group. Dunn procedure showed a statistically significant difference between enameloplasty and control groups regarding micro-leakage ($p = 0.016$). But this analysis failed to show a significant difference between air abrasion and control groups ($p = 0.118$) and between air abrasion and enameloplasty groups ($p = 0.279$) (level of significance was $p < 0.0166$).

DISCUSSION

Using fissure sealant is an effective method for prevention of caries on the occlusal surface. Sealant bonding and soundness of the interface between the enamel and sealant can predict the effect of sealant on caries prevention.

Different methods are used for cleansing tooth surface before etching that may help better penetration of the sealant. Before etching of the enamel and sealant use, it is necessary to be sure that the tooth surface and fissures are free from plaques and debris that may intervene with etching and sealant use. Verterhus et al. used air polishing and found that this method improved fissure cleanliness, although it did not affect the penetration of the sealant to the base of the pits [18]. Air entrapment is one explanation for this failure. Le Bell used another more invasive method, i.e. mechanically enlarging the pits and fissures with bur, which led to better sealant retention. This technique removed the outermost layer of the enamel as well [19].

In the present study, we evaluated the efficacy of two cleansing methods; air abrasion and enameloplasty. For micro-leakage assessment, we used dyeing with methylene blue, an available, reproducible, inexpensive and non-toxic method. Different kinds of burs have been used in previous studies. For enameloplasty, we used a round carbide bur (SS white), which is specifically designed for recontouring the fissures.

This bur helps access decay without removing considerable amounts of the enamel [20]. This study showed that micro-leakage was lower in the samples prepared by enameloplasty comparing the air abrasion and control group, although the difference was only statistically significant when we compared enameloplasty with the control group.

Table 1. Dvne Penetration Score for All Groups

Groups	Dye Penetration Score (n, %)				Median
	0	1	2	3	
Enameloplasty	18 (78.3)	4 (17.4)	0 (0)	1 (4.3)	0
Air Abrasion	15 (65.2)	4 (17.4)	3 (13)	1 (4.3)	0
Control	11 (47.8)	4 (17.4)	1 (4.3)	7 (30.4)	1

Therefore, according to the results of this study, enameloplasty was better than air abrasion for micro-leakage control, which is consistent with the results of some previous studies [12, 13, 20- 23], although there were differences between our study and other studies; e.g. Geiger used carbide and diamond burs, but we only used carbide burs [21]. Pope used aluminium oxide as the abrasive powder, but we used sodium bicarbonate [22]. In a study conducted by Khanna et al., an increase in the area of fissure sealant after enameloplasty was found. It is possible that the increase in surface area provides a thicker sealant layer than the conventional sealant application that may lead to protection against wear [20]. Shapira et al. observed that mechanical preparation could create a wider and deeper fissure that may lead to better retention of the sealant [24]. Our study was inconsistent with some other studies [7, 10, 14, 24, 25] due to the different methods used in the studies. Zyskind et al. did not find a significant difference between carbide bur and air abrasion and etching methods [7]. Hatibovic et al. compared filled and unfilled sealants [8]. They found ultraseal-filled sealant as the most effective sealant for the prevention of micro-leakage, although they used aluminum oxide as the powder for air abrasion and we used sodium bicarbonate. Lupi Pregurier et al. studied only the occlusal surface of the distal half of the teeth [25]. Mazzoleni and Bevilaqua found air abrasion and etching as the best method, although they used different sealants [10, 27]. This study was the result of a student thesis in dentistry in Shahid Sadoughi University of Medical Sciences.

CONCLUSION

This study showed that enameloplasty causes less micro-leakage and is less expensive than air abrasion, so it is recommended to use this method before fissure sealant use. We suggest more in vivo studies should be conducted about this issue.

REFERENCES

- 1- MC Donald RE, Avery DR. Dentistry for the child and adolescent. 8th ed. Philadelphia: Mosby; 2011. p. 355-60.
- 2- Cortes O, Garcia C, Perez L, Perez D. Marginal microleakage around enamel and cementum surfaces of two compomers. J Clin Pediatr Dent. 1998 Summer; 22(4):307-10.
- 3- Pinkham J, Casamassimo P, Mctigue D, Fiedls H, Nowak A. Pediatric dentistry: infancy through adolescence. 4th ed. Philadelphia: Saunders; 2005. p. 539-52.
- 4- Barroso JM, Lessa FC, Palma Dibb RG, Torres CP, Pecora J, Borasatto MC. Shear bond strength of pit-and-fissure sealants to saliva-contaminated and non-contaminated enamel. J Dent Child (Chic). 2005 Sep-Dec;72(3):95-9.
- 5- Brockmann SL, Scott RL, Eick JD. A scanning electron microscopic study of the effect of air-polishing on the enamel sealant surfaces. Quintessence Int. 1990 Mar;21(3):201-6.
- 6- Brocklehurst PR, Joshi RI, Northeast SE. The effect of air-polishing occlusal surfaces on the penetration of fissures by a sealant. Int J Paediatr Dent. 1992 Dec;13(2):222-6.
- 7- Zyskind D, Zyskind K, Hirschfield Z, Fuks AB. Effect of etching on leakage of sealants placed after air abrasion. Pediatr Dent. 1998 Jan-Feb;20(1):25-7.
- 8- Hatibovic-Kofman S, Butler SA, Sadek H. Microleakage of three sealants following conventional, bur and air abrasion preparation of pits and fissures. Int J Paediatr Dent. 2001 Nov;11(6):409-16.
- 9- Blackwood JA, Dillery DC, Roberts MW, Swift EJ Jr. Evaluation of pumice, fissure enamel oplasty and air abrasion on sealant microleakage. Pediatr Dent. 2002 May-Jun;24(3):199-203.
- 10- Mazzoleni S, De Francesco M, Perazzolo D, Favero L, Bressan E, Ferro R, et al. Comparative evaluation of different techniques of surface preparation to occlusal sealing. Eur J Paediatr Dent. 2007 Sep;8(3):119-23.

- 11- Moslemi M, Erfanparast L, Fekrazad R, Tadayon N, Dadjo H, Shadkar MM, et al. The effect of Er, Cr: YSGG laser and air abrasion on shear bond strength of a fissure sealant to enamel. *J Am Dent Assoc.* 2010 Feb;141(2):157-61.
- 12- Sancakli HS, Erdemir U, Yildiz E. Effect of Er: YAG laser and air abrasion on the microleakage of a resin- based fissure sealant material. *Photomed Laser Surg.* 2011 Jul;29(7):485-92.
- 13- Knobloch LA, Meyer T, Kerby RE, Johnston W. Microleakage and bond strength of sealant to primary enamel comparing air abrasion and acid etch techniques. *Pediatr Dent.* 2005 Nov-Dec;27(6):463-9.
- 14- Srinivasan V, Deery C, Nugent Z. In-vitro microleakage of repaired fissure sealants; a randomized controlled trial. *Int J Paediatr Dent.* 2005 Jan;15(1);51-60.
- 15- Ansari G, Oloomi K, Eslami B. Mikro-leakage assessment of pit and fissure sealant with and without the use of pumice prophylaxis. *Int J Paediatr Dent.* 2004 Jul;14(4):272-8.
- 16- Gray GB, Carey GP, Jagger DC. An in vitro investigation of a comparison of bond strengths of composite to etched and air-abraded human enamel surfaces. *J Prosthodont.* 2006 Jan-Feb;15(1):2-8.
- 17- Yazici AR, Kiremitçi A, Celik C, Ozgünaltay G, Dayangaç B. A two-year clinical evaluation of pit and fissure sealants placed with and without air abrasion pretreatment in teenagers. *J Am Dent Assoc.* 2006 Oct;137(10):1401-5.
- 18- Verterhus G, Raadal M. The efficiency of cleaning fissures with an air-polishing system. *Acta Odontol Scand.* 1988 Apr;46:113-7.
- 19- Le Bell Y, Forsten L. Sealing of preventively enlarged fissures. *Act Odontol Scand.* 1980;38:101-4.
- 20- Khanna R, Pandey RK, Singh N, Agarwal A. A comparison of enameloplasty sealant technique with conventional sealant technique: A scanning electron microscope study. *J Indian Soc Pedod Prev Dent.* 2009 Jul-Sep;27(3):158-63.
- 21- Geiger SB, Gulayer S, Weiss EI. Improving fissure sealant quality: mechanical preparation and filling level. *J Dent.* 2000 Aug;28(6):407-12.
- 22- Pope BD, Garcia-Godoy F, Summitt JB, Chan DD. Effectiveness of occlusal fissure cleansing methods and sealant micromorphology. *ASDC J Dent Child.* 1996 May-Jun;63(3):175-80.
- 23- Manhart JJ, Huth KC, Chen HY, Hickel RR. Influence of the pretreatment of occlusal pits and fissures on the retention of a fissure sealant. *Am J Dent.* 2004 Feb;17(1):12-8.
- 24- Shapira J, Eidelman E. The influence of mechanical preparation of enamel prior to etching, on the retention of sealants. *J Pedod.* 1984 Spring;8(3):272-7.
- 25- Baygin O, Kormaz FM, Tuzuner T, Tannirer M. The effect of different enamel surface treatments on the microleakage of fissure sealants. *Lasers Med Sci.* 2012 Jan;27(1):153-60.
- 26- Lupi-Pregurier L, Muller-Bolla M, Bertrand MF, Fradet T, Bolla M. Microleakage of a pit- and- fissure sealant: effect of air abrasion compared with classical enamel preparations. *J Adhes Dent.* 2004 Spring;6(1):43-8.
- 27- Bevilacqua L, Cadenaro M, Sossi A, Biasotto M, Di Lenarda R. Influence of air abrasion and etching on enamel and adaptation of a dental sealant. *Eur. J Paediatr Dent.* 2007 Mar;8(1):25-30.