Microleakage of Pit and Fissure Sealants after Using Different Occlusal Surface Preparation Techniques: An *In Vitro* Study

Nibal Mohammed Hoobi, B.D.S., M.Sc. [(1)]

ABSTRACT

Background: The marginal seal is essential for sealant success because penetration of bacteria under the sealant might allow caries onset or progression. The aim of the present study was to estimate and compare the microleakage of pit and fissure sealant after various methods of occlusal surface preparation.
Materials and methods: Thirty non-carious premolars extracted for orthodontic reasons were equally divided into three groups. In group one, occlusal fissures were opened with round carbide bur, in group two, occlusal surfaces of the teeth were cleaned with a dry pointed bristle brush and samples of group three were cleaned with a slurry of fine flour of pumice in water using rubber cup. Then fissures of all teeth were etched using 35% phosphoric acid gel prior to placement of Conseal F (SDI) light cured sealant, the teeth were thermocycled, then they were immersed in 1% methylene blue for 24hours. Each tooth was sectioned bucco-lingually to detect the microleakage.
Results: Different levels of microleakage were observed among various groups, highest level was recorded for brushing group followed by pumice group, while round bur samples showed the least microleakage when compared with other groups. Statistically the difference was not significant between brushing and pumice groups, while it was significant between round bur and other groups
Conclusion: Preparation of occlusal surface with round bur was very effective in reduction of microleakage in comparison with the traditional pumice slurry and bristle brush.
Keywords: Microleakage, fissure sealant, Conseal. (J Bagh Coll Dentistry 2016; 28(3):172-177).

INTRODUCTION

In preventive dentistry, many techniques are available for prevention of caries, such as plaque control, use of fluorides and pit and fissure sealants [(1)].

The exceptional morphology of occlusal pit and fissures renders the mechanical way of debridement unapproachable as an average tooth brush bristles is too big to penetrate most of the fissures [(2)].

Difficult salivary access to these areas minimizing fluoride deposition and remineralization [(3,4)]. Besides the close proximity of fissure base to dentino-enamel junction enhance caries susceptibility of fissures by many times. Accordingly, to prevent initiation of caries in these fissures, the conception of pit and fissure sealants was introduced [(5)].

It is strappingly recommended in fortification against commencement of occlusal caries [(6)]. The cariostatic properties of sealants are ascribed to the physical obstruction of the pit and fissures. This prevents colonization of pits and fissures with new bacteria and also prevents the infiltration of fermentable carbohydrate to any bacteria lingering in the pits and fissures [(7)].

The current sealants can be differentiated based on filler content (filled or unfilled), appearance (clear, tinted, opaque, or color changing), mode of setting initiation (chemical or visible light cure), and fluoride release [(8)].

(1) Lecturer, Department of Pedodontics and Preventive Dentistry, College of Dentistry, University of Baghdad.

The requirements of an ideal material include biocompatibility, low viscosity, low solubility, esthetically acceptable and rationally visible to easere-evaluation [(6)]. The success of pit and fissure sealants over long-time spans depends on an efficient marginal seal, retention and integrity [(9)].

Lack of sealing permits the incidence of microleakage which is the passage of bacteria, fluids, molecules and ions throughout the tooth-material interface, which is able to encourage caries progression beneath the sealants [(10,11)].

This in turn depends not only on the physical, chemical or biological acceptance of the material used as a fissure sealants, but should be depends also upon optimal clinical procedure by the dentist including cleaning and preparing the tooth surface to receive the sealant placement. Remaining substance in the fissure, air trap and fissure geometry itself lead to restraining of sealant penetration, making it essential to have an excellent clinical procedure [(12)].

To improve sealing capability of sealant materials numerous different methods of sealant application were investigated. It was found that the use of bonding agents can reduce the microleakage [(13)].

Some studies indicated that acid etching show significantly less microleakage when compared to laser etching [(14)], other studies concerned with use of air abrasion to improve marginal seal [(15-17)]. Because there is no published Iraqi study available concerning occlusal surface preparation before acid etching and because pit and fissure sealants are fundamental part of preventive dentistry that can play a considerable role in alleviating the oral health status, hence this study was designed to compare in vitro the efficiency of different methods of cleaning and preparing occlusal fissures to accept sealant so as to make them more acceptable and dependable.

MATERIALS AND METHODS

Thirty caries-free first premolars extracted for orthodontic purposes from young age patients ranged from 12-15years old of age. Permission to conduct this study in the college of dentistry-Baghdad University was obtained.

The lack of caries was detected according to the clinical parameters using a sharp explorer and visual examination [7]. The samples were cleaned under tap water and any periodontal tissues attached to the roots of the teeth were removed with periodontal scalar spreceding to their preservation in thymol.

They were randomly divided to three groups of 10 teeth each for receiving fissure sealant Conseal F which chemically based on UDMA (Urethane Dimethacrylate).The groups were as follows:

Group I: opening of fissures with round carbide bur. The fissures were opened with a new round carbide bur (1⁄4) in a high speed hand piece (250,000 rpm) to approximately the width and the depth of the bur diameter (0.5mm).

Group II: brushing only. The fissures were cleaned with a dry pointed bristle brush (Buffalo dental manufacturing co., Inc.) using a low speed hand piece for approximately 10 seconds.

Group III: application of pumice slurry.

The fissures were cleaned with a slurry of fine flour of pumice (amorphous aluminum silicate, Patterson dental company Inc.) in water (5g⁄4ml water) using rubber cup in low speed hand piece for approximately 10 seconds. Succeeding to fissure preparation, the fissures were etched using 35% phosphoric acid gel for 30 seconds, the specimens were then rinsed for 10 seconds using air water spray of three way syringe and dried using oil free compressed air with a hand pump air pressure syringe. Following ensuring a frosted appearance of the enamel at the fissure entry, Conseal F pit and fissure sealant was placed on the surface according to manufacturer instructions.

To evade bubbles and air entrapment, a 0.5mm-tip diameter periodontal probe was used to shove the sealant into the fissure and any obvious voids were removed with the tip of the probe. The sealant was, after that, cured for 20 seconds using visible light curing unit. The samples were incubated for 24 hours in distilled water at room temperature [18]. All the samples were then thermocycled by hand between two water baths [19], the temperature of water baths were 5◦C and 55◦C with a dwell time of 30 seconds in each bath [18,20], and the number of cycles in use was 15 cycles [13].

Two layers of acid resistant varnish were applied to all tooth surfaces excepting for 1 mm diameter contiguous the sealant, the apices of the roots were sealed with sticky wax to prevent dye penetration from anywhere except via the sealant-tooth interface.

The teeth were immersed in1%aquous solution of methylene blue dye for 24 hours; subsequently they were washed to remove the surplus dye [21].

The varnish and sticky wax were scraped off and samples were implanted in acrylic blocks up to cement-enamel junction. Approximately 1.5 mm-thick sections were made longitudinally with a water cooled diamond disk in buccolingual direction. The sections were then kept dry and examined for microleakage using motic microscope with digital camera [18].

The extent of microleakage was scored by single specialist observer using a ranked scale method [22].

Microleakage scores

Score criteria

0: no dye penetration

1: dye penetration into the occlusal third of the enamel-sealant interface

2: dye penetration into the middle third of the interface

3: dye penetration into the apical third of the interface

The data were analyzed using SPSS (version 20). The (ANOVA) test and LSD test were performed. The significance level (P-value) was set at 0.05.

RESULTS

The dye penetration represent the microleakage which was presented by scores for all groups .The frequency of scores for each group was shown in Figure 1. According to these results the highest frequency of score 0 was within group 1(bur group) and the lowest frequency of such score was with group 2(brushing only group).The highest microleakage score 3 was recorded in group 3 (conventional pumice prophylaxis group) only.

Table (1) presents the arithmetic mean and standard deviation of microleakage scores. The lowest mean of microleakage was for bur group which is 0.2, then pumice with 0.9, while the highest mean appeared in brushing group which was 1.

ANOVA was used to compare between various groups for microleakage as illustrated in Table 2, the three different groups showed significant difference between them since P< 0.05.

Least significant difference (LSD) test was needed to show where the significance had occurred between groups as shown in Table 3.The result demonstrated that microleakage score was lower significantly for bur group than brushing and pumice groups ,while the difference between brushing group and pumice group was not significant. The dye penetration and microleakage scores were determined by microscope examination, and some photographs were taken and presented in Figures 2, 3, 4 and 5.

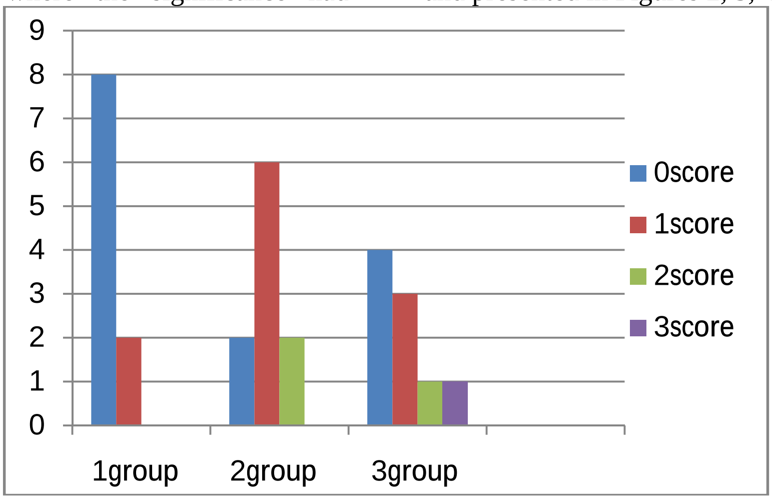

Figure 1: The frequency of dye penetration score for each group

Table 1: Mean and standard deviation of the microleakage scores for all groups

Groups	No.	Mean	±SD
Bur group	10	0.2	0.421
Brushing group	10	1.0	0.666
Pumice group	10	0.9	0.999

Table 2:ANOVA test among different groups

	Sum of Squares	Df	Mean Square	F-value	P-value
Between Groups	3.8	2	1.9	3.538	0.04*
Within Groups	14.5	27	0.537		
Total	18.3	29			

***Significant (P <0.05)**

Table 3: Least significant difference (LSD) between each two groups

Group 1	Group 2	Mean difference	Sig.
Bur group	**Brushing group**	0.8	0.021*
	Pumice group	0.7	0.042*
Pumice group	**Brushing group**	0.1	N.S.

***Significant (P<0.05)**

Figure 2: Photograph viewof ground sectionshows clear enamel without dye penetration (score 0)

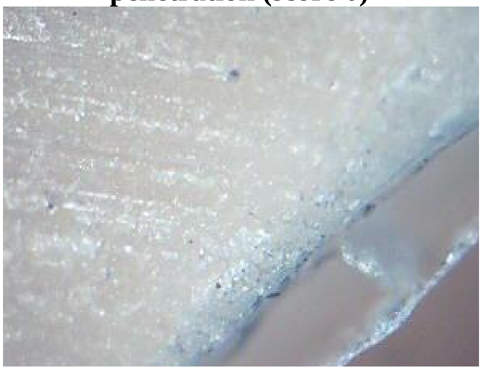

Figure 3: Photograph view of ground section shows occlusal one third of dye penetration (score1)

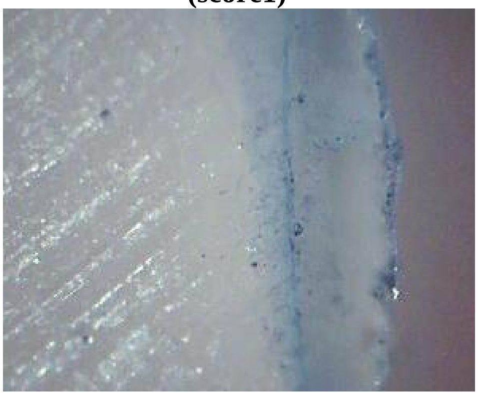

Figure 4: Photograph view of ground section shows dye penetration into middle third of the interface (score 2)

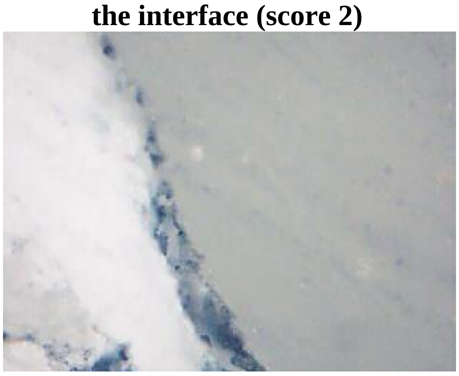

Figure 5: Photograph view of ground section shows apical penetration of the dye (score3)

DISCUSSION

The degree of the occlusal caries reduction by fissure sealant depends on its ability to remain strongly adherent to the tooth and produce a tight seal at the tooth-sealant interface. That can be achieved by diverse enamel surface preparation techniques [23,24].

Conseal F fissure sealant which is resin based, fluoride releasing and light curable was elected in this research because it has low shrinkage capability, the filler load is seven percent only to bestow low viscosity value and facilitate better penetrability into pits and fissures and it is commercially available in Iraq, so we can apply the result of this study for the benefit of the patients [25].

The in vitro nature of the study permitted the control of numerous variables that could not be controlled under in vivo condition and to carry out thermocycling which simulate stress caused by thermal difference [13,26].

All the tested groups in this study presented some extent of microleakage and this approved with previous studies [3,27], this is for the reason that complete penetration of sealant into complicated fissure system is intricate due to many reasons, one of them is the phenomenon of closed end capillaries or isolated capillaries. Some lateral fissures arise from the main fissures also fail to be full with sealants in addition to other variables like fissure morphology and preparation method of the fissures [1,28].

The major finding of this study was that the bur preparation gave less microleakage and finest result. Several causes can be proposed to explain this results, fissures were widened and deepened, organic materials and plaque were removed [29], offer more surface area to hold the sealant and a constant plug of sealant is obtained which present more wear resistance [30].

Enamel fissures penetration of the sealants is enhanced when fissures are enlarged by bur and acid etching used [3]. Enlargement of fissures produce difficulty for implanting a steady microflora and creating a closed system for the development of caries. Consequent sealant placement decreases the number of viable bacteria up to hundred percent 100% [31].

The significant difference between both brushing and pumice, and bur preparation can be explained by that the remaining debris and pellicle may not be removed from the base of the fissures, prevent enamel conditioning and decrease the resin penetration [32-35].

Cleaning and preparation in these procedures is restricted to the cuspal inclined planes only and not to the bottom of the fissures [34]. The width of the bristles is too large to go through the orifice of most fissures [36]. Pumice particles become wedged impacted into the fissures, become incorporated into the sealants, thus changing its micromechanical bond, resulting in greater microleakage [33,34,37].

Following proper technique of sealant application can increase the micromechanical interlocking between the resin and the enamel and this in turn will diminish the microleakage and improve the efficiency of sealant in preventing dental caries.

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