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Evaluating the Effect of APF Treatment on the Microleakage of Pit and Fissure Sealants and Comparing with a Control Group - An Invitro Study (Original Research)

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Abstract: ***Use of Pit and Fissure sealants in early caries prevention had played a pivotal role over the years. Sealant application results in mechanical bonding of resin material to an acid etched enamel surface. This results in sealing the pits and fissures of teeth and thereby preventing caries. Use of APF on teeth had already proved to be successful in reducing demineralization and improving remineralization. The purpose of this invitro study was to evaluate the effects of APF gel on the microleakage of Pit and fissure sealants of a group of teeth and to compare with a control group. A total of forty recently extracted premolar teeth for orthodontic treatment were collected from various dental clinics of Calicut city. The teeth were randomly divided into 2 groups of 20 each. One was APF group and the other was control group. The Study used a dye penetration method and assessment under stereomicroscope.***

Keywords: pit and fissure sealants, caries prevention, APF gel, microleakage, enamel bonding

1.Introduction

Pit and fissure sealants play an important role among the preventive measures used to reduce the incidence of dental caries. These materials form a physical barrier for protecting the occlusal surface, a zone most susceptible to caries in young child Sealants had undergone a series of modifications since their acceptance by American Dental Association in 1971. Properties of an ideal fissure sealant include retention, biocompatibility, resistance to abrasion and wear. But marginal integrity and microleakage are crucial factors in evaluating their clinical success. Microleakage is the clinically undetectable passage of fluids, bacteria, molecules and ions between the sealing material and tooth. Use of APF have already proved to be successful in reducing demineralization and improving remineralisation. This study evaluates the effectiveness of APF gel when compared with control group in the microleakage of resin sealants.

Aims and Objectives:

To evaluate the effect of APF gel when compared with the control group on microleakage of resin sealants.

2.Materials and Methods

The purpose of this invitro study was to evaluate and compare the effects of APF gel with that of control group on the microleakage of Pit and fissure sealants. A total of forty recently extracted premolar teeth were collected. The teeth were randomly divided into 2 groups of 20 each.

The materials and methods used for the study have been described under following headings.

1. Selection of Material
2. Armamentarium
3. Pit & Fissure preparation
4. Sealant Application
5. Thermocycling
6. Dye penetration study
7. Evaluation method

1. Selection of material

a) **3M ESPE-Climpro sealants**

- Meets ISO 6874 (Dental resin-based pit and fissure sealant)
- Meets ANSI /ADA Spec 39
- BIS - GMA /TEGDMA resin composition
- Unfilled
- Unique Color change feature

b)3M ESPE -Scotch bond-ETCHANT

- 35 % Phosphoric acid

c) Anti Cavity Topical APF Gel (Pascal's)

- 1.23% W/W (+ 0.12%) Fluoride ion from NaF

d) The Synthetic Saliva used in this study was prepared according to following criteria.

5g carboxymethyl cellulose was added to a solution consisting of 250 ml water, 100ml 0.053% tricalcium phosphate in 0.01 N HCL, and 100ml of a mixture containing 15 g sorbitol, 0.6 g KCL, 0.42g NaCl and 0.026 g MgCl2.6H2O. After dissolution of the polymer at room temperature and adjustment of the pH to 7 with 0.05 M NaOH, sufficient water and 5 ml of 0.2 M sodium phosphate (pH 7) were added to make a volume of 500ml. A pH of 7+--0.1 was verified electrometrically and the mixture was sterilized in autoclave.

2. Armamentarium

Hydrogen peroxide 6%, Impression compound, Ethylene blue (Dye) 10 % Finger nail polish. Air water syringe, Explorer, 2 x 2 gauze squares, Cotton pellets, Forceps cotton pliers, Dappen dish with pumice, Acid etch syringe, Excavator, Sealant applicator with dispensing tip, Light cure LED unit, Burs-tapering fissure, Prophylaxis brush, Hand piece NSK - micro motor Stereomicroscope (OLYMPUS - colorplus).

3. Pit and Fissure preparation

The teeth were stored in synthetic saliva for 1 week before being treated. Superficial cleaning of the sealing surface was carried out with a low speed rotary brushing instrument and hydrogen peroxide to remove the traces of plaque with water irrigation and subsequent drying.

Occlusal surface were polished with a low speed hand piece and a brush along with pumice. An explorer was used to clean debris from the pit and fissures. Teeth were then rinsed and dried.

4. Sealant Application

First group (APF): Conventional acid etching done for 30 seconds followed by sealant application which was then stored in synthetic saliva for 24 hours then followed by APF gel application for 4 minutes and then stored in synthetic saliva for 24 hours.

Second group (Control)): Conventional acid etching done for 30 seconds followed by sealant application which was then stored in synthetic saliva for 24 hours.

5. Thermocycling:

The specimens were forced to undergo manual thermocycling in two different bath maintained at 50C & 550C. The dwell time of 10 seconds in each bath for a total of 250 cycles. The time interval between each bath was 5 seconds.

6. Dye penetration Study:

Tooth apices were sealed with impression compound. Finger nail polish applied on the crown and root surfaces of the teeth so that one millimeter peripheral margin of sealant remain exposed. The specimen were then immersed in 10% Methylene blue dye for 24 hours. The specimens were rinsed in water to remove the dye covering the outer surface of sealant and nail polish removed. Tooth were sectioned longitudinally in bucco-lingual direction through the center of the sealant using diamond disc to be viewed under stereomicroscope to assess the degree of amount of dye penetration at sealant tooth interface.

7. Evaluation

Microleakage was scored according to the following criteria:

0-No dye penetration
1-Dye penetration up to one third of fissure total height
2-Dye penetration between one third and two thirds of fissure total height.
3-Dye penetration between two thirds and total height of fissure

8. Observation and results:

The study assessed and compared the microleakage values of pit and fissure sealants that were treated by APF with that of control group where there was no treatment.

The microleakage was computed on a scale of 0-3 for the pit and fissure. The data was analyzed at the sealant fissure junction using Chi square test and evaluated for significance

As evidenced from the Table 1 some samples showed some amount of microleakage in both groups.

In Table 2 comparative evaluation of APF values and Control group values using Chi square test is given. It was not significant ($p > 0.05$).

3.Discussion

Today sealants are regarded as a safe and effective measure in dental health care for the prevention of caries related to the pits and ssures. They were developed in early 1970s for occlusal caries prevention. Sealants are mostly resin materials that are placed on the pits, grooves and ssures of molars and premolars by means of acid etching technique.

Topical fluorides have been used as a caries preventive agent in dental practice over 30 years. One among them is Acidulated phosphate fluoride, containing 1.23% available fluoride in 0.1 M phosphoric acid. In a study Delbem AC, Cury JA (2002) found that APF gel formed more fluoride in enamel than neutral gel and it was more efficient in reducing demineralization [1] In another study conducted by Jiang Bianz Tai BJ (2007) in China of biannual professional application of APF in primary teeth showed effective reduction of caries.2

The sealants used in the present study were Bis GMA based organic resins. One of the major factors influencing the longevity of any restoration is the microleakage of tooth restoration interface.3 The integrity of tooth sealer interface is depended on a number of factors such mechanical and chemical properties of the material, anatomy of pits and Fissures, thermal conditions of oral cavity etc.

Microleakage of materials are tested invitro by various laboratory tests like the dyes, radioactive isotopes, bacteria, air pressure etc. Assessing microleakage using

dyes have stood the test of time and continues to be a simple, reliable, economical and convenient method. The dye used for the study was methylene blue

The specimen used for the study was freshly extracted premolars for orthodontic treatment without caries. . The teeth were stored in synthetic saliva for 1 week before sealant application. Conventional acid etching done for 30 seconds followed by sealant application which was then stored in synthetic saliva for 24 hours then followed by APF gel application for 4 minutes and then stored in synthetic saliva for 24 hours. In control group there was only sealant application.

Thermocycling was done manually on the tooth specimen after sealant application to simulate oral environments with a temperature variation between 50C and 550C for 250 cycles with dwell time of 10 seconds and a time interval of 5 seconds between baths. Apices of the teeth were sealed with impression compound and 2 coats of nail polish were applied on the root and crown so that with 1mm of peripheral margin of the tooth remain exposed and prevents microleakage other than the area of sealant application. This procedure has been widely adopted by various investigators in previous studies, Woody and Davis (1992).4 In the study most of the samples showed some sort of dye penetration. There is no specific standards regarding the number of samples taken in a group for the study. In assessing the microleakage of sealants the results obtained in this study are restricted to the condition invitro and should be further substantiated by the clinical trials.

4.Summary and Conclusion

From the results obtained it was observed that:

a. Sealant applied fissures showed some degree of dye penetration
b. No significant dye penetration was observed.
c. Even though the comparison of APF scores and control scores were statistically insignificant, APF showed less microleakage.

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Tooth Specimen

Figure 1: Group I (APF)

Figure 2: Group II (CONTROL)

Materials

Figure 3

Figure 4

Figure 5

Armamentarium

Figure 6

Stereo Microscope

Specimens after Coating with Nail Polish

Figure 7: Group I (APF)

Figure 8: Group II (Control)

Table I: Microleakage scores of two groups

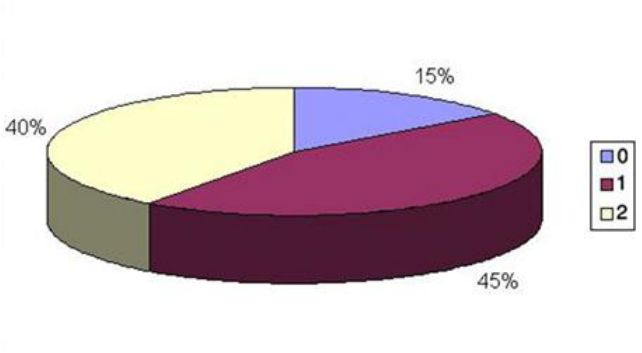
SL. NO	APF	Control
1	2	2
2	1	1
3	1	1
4	0	1
5	2	1
6	2	2
7	1	2
8	1	1
9	2	2
10	0	1
11	1	2
12	2	2
13	1	1
14	2	1
15	1	1
16	1	1
17	2	2
18	0	1
19	2	1
20	1	2

Table II: Comparative evaluation of APF and Control

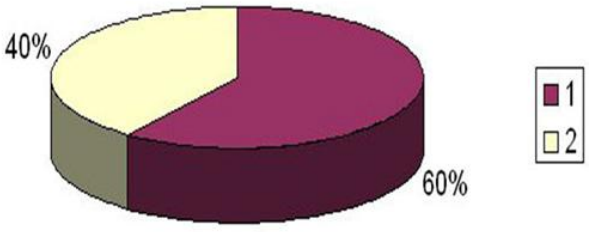
Crosstabulation

		CONTROL		
		1.00	2.00	Total
APF	.00	3	0	3
	1.00	6	3	9
	2.00	3	5	8
Total		12	8	20

Chi-square=3.854 p-value=.146



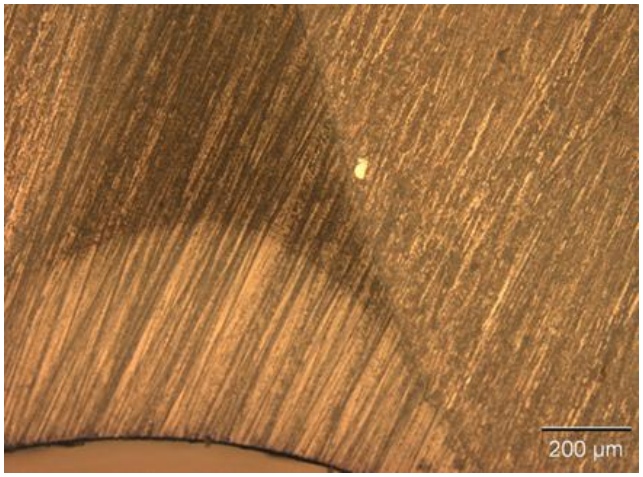
Graph I: Distribution of Scores in Percentage for APF



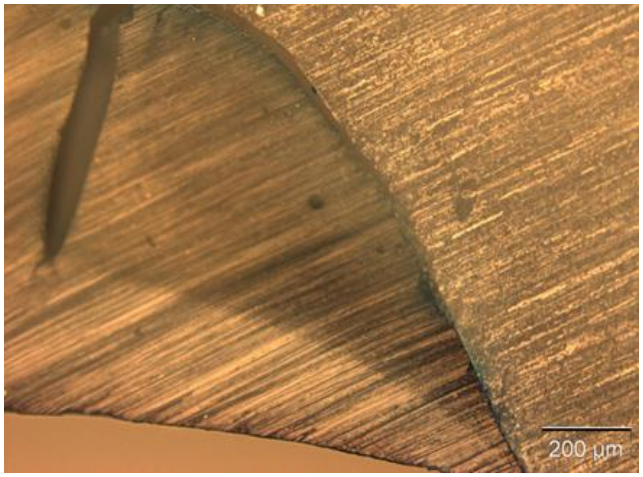
Graph II: Distribution of Scores in Percentage for Control

Micro Leakage at Sealant-Fissure

Interface for APF (Magnification 10X)



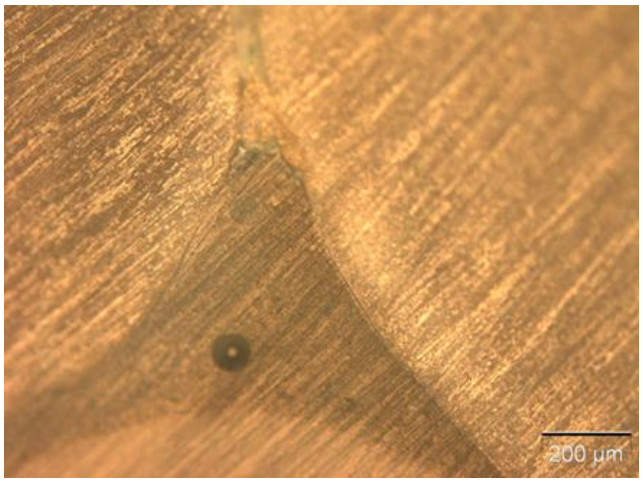
(a)



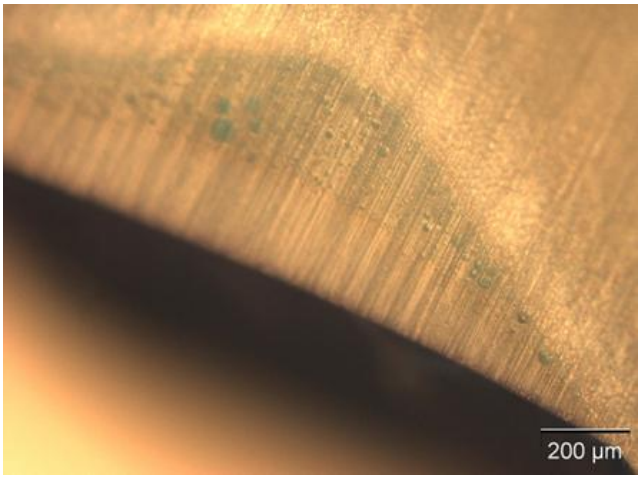
(b)

Micro Leakage at Sealant-Fissure

Interface for Control (Magnification 10X)



(a)



(b)