

Comparative evaluation of fluoride releasing hydrophilic pit and fissure sealant with a highly filled nano-hybrid pit and fissure sealant in the prevention of dental caries in children- an in-vitro study.

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Abstract

Purpose: To determine the degree of microleakage of fluoride releasing hydrophilic pit and fissure sealant (Group I) with a highly filled nano-hybrid pit-and-fissure sealant (Group II) using dye penetration method.

Materials and methods: Out of hundred, fifty sound permanent premolar teeth that have been extracted for orthodontic reasons were collected from the outpatient Department of Oral and Maxillofacial Surgery of K. D. Dental College and Hospital, Mathura. Following ultrasonic scaling specimen preparation was done with pumice prophylaxis and acid etching. Teeth were divide into 2 Groups I : fluoride releasing hydrophilic pit and fissure sealant and Group II : highly filled nano-hybrid pit-and-fissure sealant. Both groups were subjected to thermocycling. Samples were immersed in 2% methylene blue dye. Sectioning of samples and microleakage evaluation was done using Image J program.

Results: There was insignificant result among 2 groups using Student 't' test.

Conclusion: Application of Fluoride releasing hydrophilic sealants on moist enamel had less microleakage and dye penetration as compared to highly filled nano-hybrid pit-and-fissure sealant applied on dry enamel. Thus, it can be used in young children, disabled children and public dental health programs.

Keywords: Pit and Fissure Sealants, Microleakage, Hydrophilic Sealant, Nano Hybrid Sealant.

Introduction

The term "pit and fissure sealant" can be described as a "material that is introduced into the occlusal pits and fissures of caries-susceptible teeth, thus forming a micromechanically bonded, protective layer, cutting access of caries-producing bacteria from their source of nutrients." ¹

The effectiveness of the sealant is assessed by its retention and the ability to resist microleakage on the tooth surface. The development of moisture-tolerant resin –based sealant has overcome the shortcomings of traditional sealants, which were hydrophobic. Embrace WetBond™ (Pulpdent, Watertown, MA) is one such product, which claimed to be a hydrophilic, moisture-tolerant resin-based sealant that does not require an additional bonding agent. Upon light curing, the polymerized sealant has been claimed to have the physical properties similar to other commercially available sealants.² Since much of the dental caries prevention is focused during early childhood period where moisture control is difficult, the moisture-tolerant fissure sealant is believed to give a better and alternate option to the glass ionomer cement.³

Therefore, the purpose of this in vitro study was to compare and evaluate the effectiveness of fluoride

releasing hydrophilic pit and fissure sealant with a highly filled nano-hybrid pit-and-fissure sealant in the prevention of dental caries.

Materials And Methodology

This study was reviewed and approved by the Institutional Review Board (IRB) of K. D. Dental College and Hospital, Mathura prior to the commencement of the study. The sample size was drawn after calculating the statistical power, which was 80% for this study. Study samples included extracted 50 permanent premolars teeth having:

Inclusion criteria

- Premolar teeth with deep, narrow, occlusal pit and fissures were selected as specimen.
- Teeth extracted for orthodontic reasons or because of periodontal disease, were used.

Exclusion criteria

- Carious teeth
- Fractured teeth
- Attrited teeth

All teeth were cleaned using ultrasonic scaler (Unicorn, Taiwan) to remove adherent tissue and then polished with fluoride free pumice slurry and rinsed in normal saline. The teeth were then stored in normal saline with thymol crystals (Qualikems Fine Chemicals, India) and the solution was changed periodically to minimize the deterioration.

Grouping and specimen preparation

The teeth were randomly divided into 2 groups of 25 teeth each. Group I : fluoride releasing hydrophilic pit and fissure sealant and Group II : highly filled nano-hybrid pit-and-fissure sealant.

The occlusal surface of teeth in Group I was washed with oil free compressed air and was etched with 37% Phosphoric acid (Frost, AMMDENT, India) for 15 seconds. The etchant was then washed and the occlusal

fissures were thoroughly rinsed with distilled water and dried with sponge pellets to achieve a slightly moist status with no visible water. In Group I (fluoride releasing hydrophilic pit and fissure sealant) was applied using the applicator tips provided by the manufacturer and light-cured for 20 seconds on all the teeth.

The occlusal surface of teeth in Group II (highly filled nano-hybrid) were washed with oil free compressed air until the etched surface appeared as matte frosty white for teeth in Group II. Later it was etched with 37% Phosphoric acid (Frost, AMMDENT, India) for 15 seconds. The etchant was then washed with water and the surface were air dried. A layer of a highly filled nano-hybrid pit and fissure sealant was applied using the applicator tips provided by the manufacturer and light-cured for 20-30 seconds for all the teeth in Group II with a halogen light curing unit at 500mW/cm² Curing Light. All the test samples were subjected to thermocycling of 500 cycles at 5°C and 55°C prior to the estimation of microleakage.

Immersion of the samples in the dye: 2 grams of Methylene blue dye powder (RANBAXY, India) was dissolved in 1 litre distilled water and Phosphate/Biphosphate(H₂PO₄⁻/ HPO₄²⁻) buffer tablets (Sigma – Aldrich, India) with a pH of 7.0 were later added to the stock solution to maintain the final pH at 7.0. The samples were immersed in the prepared 2% Methylene Blue Dye for 24 hours at room temperature. After 24 hours, the samples were washed under running tap water for 15 minutes to remove the excess dye.

Microleakage evaluation using Dye Penetration

Method: The samples from Group I and Group II were sectioned from the centre of the tooth in a bucco lingual direction parallel to the long axis of the tooth using slow speed double sided diamond disc (Shofu, Japan) under copious irrigation. Two sections made of each specimen

were observed under a stereoscopic microscope at a magnification of 40 X after calibration to a millimetre ruler. The amount of microleakage were calculated by Image J tool program.

Statistical Analysis Used

Student 't' test will reveal statistically significant difference in mean microleakage among the two groups I and II under study.

Result

The mean microleakage score in Group I and Group II is 0.27 ± 0.26 mm and 0.33 ± 0.25 mm respectively. The above results signifies that Group I is having less mean microleakage than Group II. But the difference between the 2 groups is insignificant since 'P' value is 0.238. Refer(table 1 and 2),(Graph 1)

Discussion

Pit-and-fissure sealants are among preventive strategies to decrease occlusal caries onset and/ or progression. The marginal sealing ability is important for sealant success. Thus we have done the present study to evaluate the microleakage.

In this study the use of pumice prophylaxis followed by acid etching was done since it is adopted by most dentists for application of sealants and is also recommended by the manufacturers.

Dental materials in the oral cavity are steadily exposed to heat and functional stress. Daily temperature fluctuation in the oral environment can result in gap formation and bacterial penetration through sealant/enamel interface. Techniques of thermal cycling and cycling under loading are frequently used. Therefore, in the present study we have done thermocycling as the aging methods to determine the extent of microleakage.

The use of organic dyes as tracers is the most common method for microleakage assessment in vitro. It is inexpensive, non-toxic and detects even small amounts of

leakage. Also dye penetration method is considered more accurate because the dye particle diameters are less than those of bacteria and they are of the same size as the bacterial endotoxins. ⁴ Thus, dye penetration method was used to study microleakage for the specimens which were stored in methylene blue for 24 hours.

This study compares microleakage between hydrophilic, self priming, self adhesive, fluoride releasing, less technique sensitive with Resin Acid – Integrated Network [R.A.I.N.] to the resin-based nano hybrid Grandio Seal.

An in vitro study by Kane B et al ⁵ showed Embrace to have superior adaptation and penetration than conventional fluoride releasing sealant. According to Marimuthoo et al ³ moisture tolerant sealant (Embrace Wetbond), a filled resin is comparable to an unfilled conventional resin based sealant in relation to the proportion of microleakage. Khogli et al ⁶ too found no significant difference in microleakage proportions between hydrophilic and conventional sealants.

The results of present study revealed that hydrophilic sealant under moist surface condition exhibited less microleakage. Hydrophilic sealant (Group I) is with filler content of 36.6% equivalent to a flowable composite while nano hybrid (Group II) is with 70% filler content. This is in accordance to Mehrabkhani M et al ⁷ who in his study while comparing low filler particle to a high filler particle sealants found, low filler particle to be better when compared to high filler particle with regards to microleakage. Gillet D et al ⁸ in his study found no difference in microleakage using flowable composite and hybrid composite which is similar to this study. However observations are in contrast to Singh S, Pandey RK ⁹ who found greater microleakage for flowable composites compared to nano composites.

Grandio Seal showed greater microleakage probably due to its greater filler content (which means inverse relation with polymerization shrinkage) and more viscosity, thus it cannot easily flow in the pits and fissures.

Gawali PN et al ¹⁰ in their study revealed hydrophilic sealant under moist condition exhibited least microleakage when compared to hydrophobic sealants, the results of which are comparable to present study.

In the study Cooley RL et al ¹¹ who had used FluroShield (50% filler particles by weight) showed more microleakage but microleakage was not clinically significant considering its ability to release fluoride. Same can be applied to Embrace Wetbond which too has fluoride releasing ability having mean microleakage 0.27mm. In addition to the fluoride releasing ability Embrace Wetbond is Bisphenol A (BPA) free i.e. Bis-GMA which has potential health hazards.

Table 1: Comparison of the mean microleakage, standard deviation, minimum score and maximum score between Group I (Embrace Wetbond) and Group II (Grandio Seal).

Variable	Group	N	Mean	S.D.	Minimum	Maximum
Scores	Group I	50	0.27	0.26	0.02	0.97
	Group II	50	0.33	0.25	0.04	1.23

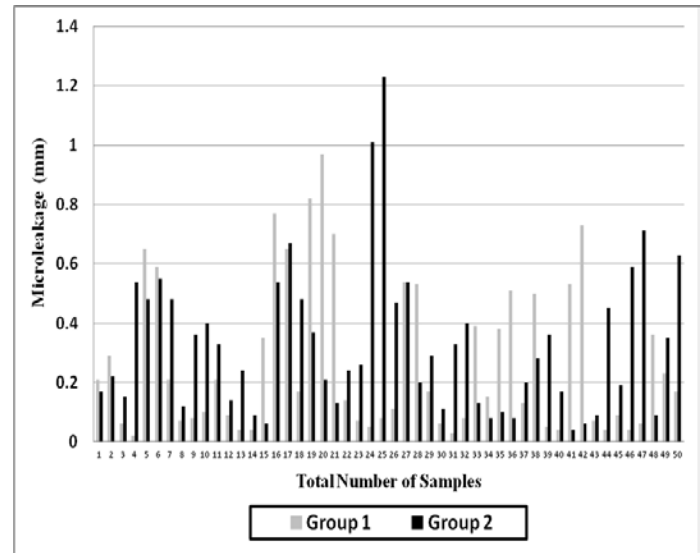
Table 2: Comparison between Group I (Embrace Wetbond) and Group II (Grandio Seal) for mean percentage of dye penetration during the study.

	t	P	Inferences
Group I v/s Group II	1.888	0.238	Ns

t = value of student's test;

P = 'P' is the probability of chance error

Graph 1: Represents the microleakage and dye penetration scores in Group I (Embrace Wetbond) and Group II (Grandio Seal) in 50 specimens in each group.



Conclusion

The hydrophilic sealant is superior to hydrophobic sealant when micro leakage is evaluated. Nevertheless, results of the present study should not be interpreted as higher tolerance of hydrophilic pit and fissure sealant to salivary contamination until more support is provided by in vivo studies.

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