Journal of Advanced Medical and Dental Sciences Research
@Society of Scientific Research and Studies

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr ICV 2018= 82.06

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

A stereomicroscopic evaluation of commercially available pit & fissure sealants for coronal microleakage

Rishi Suryavanshi[1], Harsha Vardhan Choudhary[2], Shobha Tandon[3], Neerja Singh[4], Ahsan Abdullah[5]

[1]Lecturer, Department of Pedodontics And Preventive Dentistry, Purvanchal Institute of Dental Science Gorakhpur Uttar Pradesh;
[2]Senior Resident, Department of Dentistry, Darbhanga Medical College and Hospital Laheriasarie Darbhanga;
[3]Professor and Ex-Head Of Department of Pedodontics And Preventive Dentistry Babu Banarsi Das College Of Dental Science Lucknow Uttar Pradesh;
[4]Professor and Head Of Department of Pedodontics And Preventive Dentistry Babu Banarsi Das College Of Dental Science Lucknow Uttar Pradesh;
[5]Associate Professor, Department of Pedodontics And Preventive Dentistry Career Post Graduate institute of Dental Science Lucknow Uttar Pradesh, India

***ABSTRACT*:**
Purpose: The purpose of thisstudy was to evaluate the microleakage and depth of penetration of four recently available pit & fissure sealants. **Methods:** Fourty sound extracted human molars were randomly divided into 4 groups(N=I0). After sealant placement, the teeth were stored in simulated saliva for 7 days and thermocycled (500 cycles; 5°C, 37°C and 55°C), isolated, immersed in 5% methylene blue dye for 24 hrs,subsequently embedded in acrylic resin and sectioned longitudinally in a buccolingual direction The sections were analyzed for leakage using an stereomicroscope. Microleakage was assessed using a dye penetration scoring system (scare=0-3) and also measured in millimetres. **Result:** All materials exhibited a similar pattern of penetration into the pits and fissures, and no statistically significant difference between the study groups was found. ($p>0.05$). Microleakage was found to be highest for the flowable giomer, and least for the Gic Fuji VII. **Conclusion:** Under the conditions used in this in vitro study the flowable giomer, showed higher microleakage depth while micro leakage of Gic Fuji VII was comparatively better.

Received: 13 March, 2019 Revised: 10 July 2019 Accepted: 11 July 2019

Corresponding author: Dr. Harsha Vardhan Choudhary, Senior Resident, Department of Dentistry, Darbhanga Medical College and Hospital Laheriasarie Darbhanga;

This article may be cited as: Suryavanshi R, Choudhary HV, Tandon S, Singh N, Abdullah A. A stereomicroscopic evaluation of commercially available pit & fissure sealants for coronal microleakage. J Adv Med Dent Scie Res 2019;7(8): 153-157.

INTRODUCTION

Pit and fissures are anatomical manifestations of fusion of developmental lobes during odontogenesis. Pits are small, pinpoint depressions commonly found at the end of groove's cross sections whilefissures are formed during the development of grooves where the enamel in the area is not fully fused. Nagano (1960)[1] classified occlusal fissures into five types on the basis of fissure morphology: V, U, Y, I, IK types. The complex morphology of occlusal pits and fissures makes them an ideal site for retention of bacteria and food remnants.

Pit & Fissure Sealants are resin-based materials which form a micromechanically retained physically protective layer when introduced into the pits and fissures of young permanent/caries-susceptible teeth, and prevent demineralization of enamel by blocking the interaction of cariogenic bacteria and their nutrient substrates[2].

Despite an array of ideal properties required for correct handling, placement & retention of these sealants, their clinical efficacy is directly related to marginal adaptation followed by retention. Microleakage or marginal leakage may be defined as the ingress of oral fluids into the space between the tooth and restorative material[3]. The assessment of dye penetration coronally has been the most indispensible in vitro method of examining the adaptation of a pit & fissure sealant to tooth enamel walls.[4].Recently many new sealants have come to the market but very few of them have scientific studies support. Their physical characteristics and efficiency of technical application are still not yet evaluated.

Therefore the present study is an attempt to evaluate marginal integrity and depth of penetration of four commercially available pit & fissure sealants by stereomicroscopy using both qualitative and quantitative analysis .This may in turn act as a guide for pedodontists to decide which commercially available product is most suitable in children for pit & fissure sealing.

METHODS

The study consisted of 40extracted sound human young permanent third molar teeth. These sampls were surface debrid and cleaned with rubber cup and slurry of pumice, then teeth were divided into four groups with 10 samples in each group. No invasive technique (enameloplasty) was performed before sealing the teeth using the four commercially available sealants assigned to each group as follows :

Table-1

Product	Manufacturer	Group
Clinpro	3M, ESPE	Group AControl Group
Beautifil flow	Shofu	Group B
GIC fuji VII	G C Corporation	Group C
Tetric N flow	Ivoclar vivadent	Group D

The specimens were subjected to thermocycling for 500 cycles at temperatures of 5°C, 37°C and 55°C with dwell time of 15 seconds in controlled water bath. To simulate oral conditions, the sealed teeth were immersed in simulated saliva in plastic containers for 7 days in an incubator at 37°C.

The apices of all the teeth were sealed with autopolymerizing acrylic resin and the teeth were coated with two layers of nail polish , leaving exposed a 1.5-mm window around the sealant margins and immersed in 5% methylene blue dye for 24 hours. Subsequently the teeth were sectioned, in a buccolingual direction, and viewed under a stereomicroscope at 10 X magnification. Both Qualitative and quantitative analysis were done to evaluate microleakage. For qualitative analysis Ordinal rating scores were given for marginal dye penetration according to criteria given by Ovrebo and Raadal (1990)[5]to score dye penetration.

For quantitative analysis linear measurement of dye penetration within the fissure system was noted, from an occlusal surface of the crown towards the dentine enamel junction and micro leakage was evaluated using photomagnification method (Aranda et al 2005)[6].

To determine the depth of penetration of the materials on the occlusal surface, the distance between the most superficial and the deepest points on the occlusal central groove was calculated and expressed as the fissure's total depth. The measurement corresponding to the length of the fissure filled with the sealing material was divided by the measurement corresponding to its total depth to obtain the percentage of sealing of the central fissure using photomagnification method.

With help of CorelDRAW Graphics suite X3 program, the photographs from tooth sections were calibrated to analyse lengths in mm.Data obtained by the above methods were tabulated andstatistically analyzed using SPSS for Windows release version 15.0 (SPSS, Chicago, IL, USA). Kruskall Wallis and Mann Whitney U test were applied at the level of significance of p <0.05.

RESULTS:

Intergroup comparison on applying Mann-Whitney u test revealed Statistically significant difference between mean microleakage of Group B and Group C on evaluation by Scoring criteria (Figure1).

Statistically significant differences were found on applying Mann-Whitney u test between mean microleakage of Groups A and B, Groups B and C and Groups B and D on evaluation by photomagnification method (Figure 2). For two different scores, overlapping microleakage measurements were observed indicating that there might be subjective error in microleakage scoring. Overall, there was a strong correlation between microleakage score and microleakage measurements (Figure 3)

Mean percentage sealant penetration in different groups ranged from 76.44±11.54 to 83.32±9.66. The minimum percentage penetration in a sample was calculated as 53.69 in a specimen of Group B whereas maximum percentage sealant penetration was observed too as 97.44 in one of the samples of Group B itself. Statistically, no significant differences were observed for any of the inter groups comparisons when Mann-Whitney u test was applied (Figure 4).

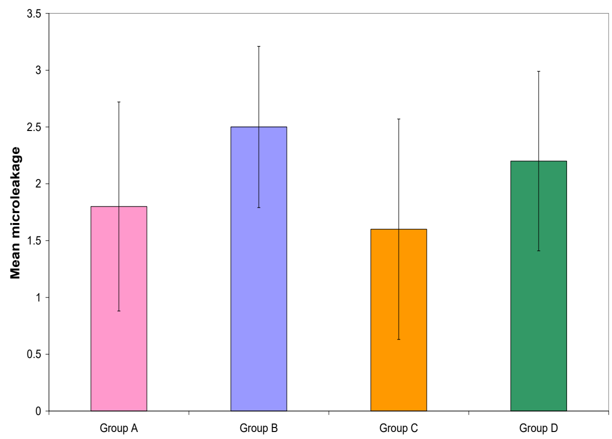

Figure 1: Comparison of Mean microleakage Score in different groups (Scoring Criteria)

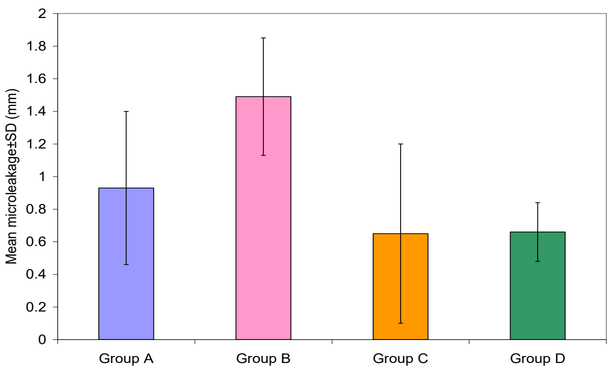

Figure 2: Comparison of Mean microleakage Values in different groups (mm) using Photomagnification method

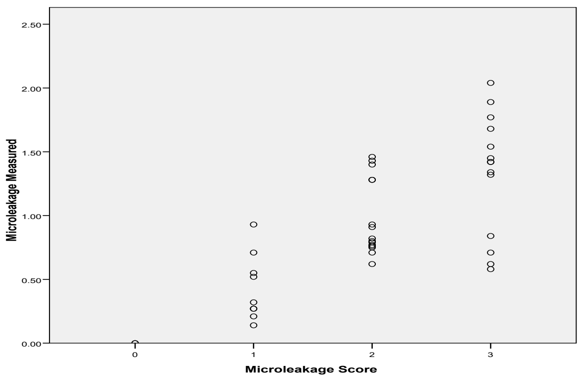

Figure 3: Correlation between Dye penetration Scores and measurement in millimeters (N=40).

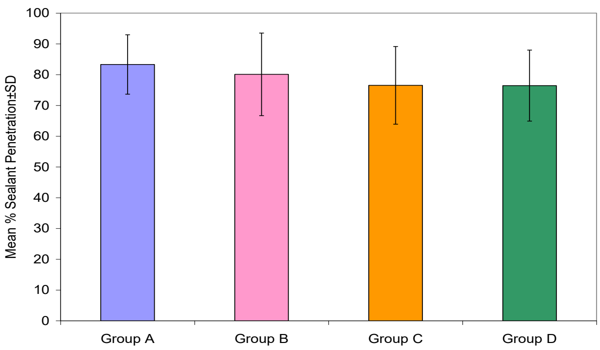

Figure 4: Comparison of Mean Percentage Sealant Penetration in different groups using Photomagnification method.

DISCUSSION

The properties of an ideal sealing material include biocompatibility, retention and resistance to abrasion and wear (Pérez-Lajarin, 2003)[7]. Sealant bonding to enamel is of vital importance because microleakage at tooth-material interface can lead to treatment failure.

Though there are innumerable new materials available as options for fissure sealing still a great deal of controversy exists regarding the most appropriate type of pit and fissure sealants. The present study was henceforth undertaken to comparatively evaluate the microleakage and depth of penetration of a conventional unfilled resin based sealant, a glass ionomer, a flowable Giomer and a flowable composite resin in vitro.

Dye penetration method has been used in several studies as reported by Hatibovic-Kofman, 1998[8]; Fuks, 1984[9] to assess the presence of marginal leakage around the sealant enamel surface. Methylene blue was used as the dye in the present study for several reasons. Firstly, it is readily detectable under visible light, secondly it is soluble in water and lastly, it is able to diffuse freely.

In the present study both qualitative and quantitative technique of stereomicroscopic evaluation of dye penetration were used. It was observed that for two different scores, overlapping microleakage measurements were present thus indicating the possibility of some subjective error in microleakage scoring. But Overall, there was a strong correlation between microleakage score and microleakage measurements (Table 3).

In the present study, samples in each group were subjected to pumice prophylaxis with slow speed handpiece to improve the penetration and retention of sealant in deep pits and fissures, as suggested by Ansari et al (2004)[10]. In the present study 37% Phosphoric acid gel was used with a etching time of 20 seconds to produce adequate sealant bonding while minimizing the loss of surface enamel. Eidelman et al (1988)[11] also suggested similar time for acid etching. The bonding agent used in this study was polymerized for 10 seconds and the use of bonding agent was in accordance with Feigal et al (1993)[12].

All materials were applied without enameloplasty in order to observe the behaviour of these materials without removal of tooth substance. Sealant materials were polymerized by conventional halogen curing light (Dentsply) for minimum of forty seconds as per manufacturer instructions.

Rudney (1995)[13]used the test materials after subjecting to action of different factors, such as salivary flow and composition, which vary throughout the day within the oral environment. To simulate the oral conditions, the sealed teeth in the present study were immersed in artificial saliva in plastic containers for 7 daysin an incubator at 38°C as demonstrated by Hatibovic-Kofman (1998)[9].

The artificial saliva used in this present study was prepared according to specifications already performed & provided by Mcknight -Hane and Whitford (1992)[14].

In the present study all the samples were subjected to thermocycling effect, which induces a thermal stress in in vitro samples, and simulates the oral environment that may be present during the procedure of a sealant. The samples were thermocycled between 5°C , 37°C and 55°C, which approximates the maximum temperature range measured in vivo, as demonstrated by Simmons et al (1976)[15].

As far as the results of the present study are concerned, all the groups exhibited some degree of dye penetration. This finding is in accordance with the studies conducted by Theodoridou–Pahini et al (1996)[16] and Do Rego et al (1999)[17] who stated that microleakage can be expected in all restorative materials. This may largely be due to difference in coefficient of thermal expansion of sealants that is much greater than the coefficient of thermal expansion of the teeth.

The results of the present study obtained by scoring criteria, showed no significant difference (p=.631) in microleakage between the glass ionomer cement and conventional unfilled resins (Table 1), indicating that the sealing ability of glass ionomer cement is comparatively similar to the conventional unfilled resins, with additional benefit of fluoride release which was in accordance with the findings of Ashwin et al (2007)[18].

Contrary to present findings, Khanal et al (2010)[19] found that resin based sealant had lesser microleakage when compared to glass ionomer sealant.This difference could be probably due to the noninvasive method used in the present study. Vineet and Tandon (2000)[3]however performed a study to evaluate marginal integrity under scanning electron microscope of a conventional resin and glass ionomer and obtained results showed that conventional resin had better marginal integrity and favored the use of invasive technique over non-invasive technique.

The findings of this study indicated no statistically significant difference (p=.393) between the conventional sealant and flowable composite (Table 1). This was well in accordance with recent works conducted by Aguilar et al, (2007)[20].

Contrary to the present findings, flowable composite showed significantly more microleakage than the filled sealants in a clinical trial conducted by Kwon et al (2006)[21]. This may be again due to difference in the techniques used for the placement of sealants.

Among the conventional Sealant and flowable Giomer there was difference in the level of mean microleakage but it was not significant statistically (Table 1). However, there was statistically significant difference (p=.043) between glass ionomer sealant and flowable Giomer sealant (Table 1). This was supposed to be first time a flowable Giomer was compared with glass ionomer sealant with the former showing more microleakage. The reason of more micro leakage in Giomer could have been due to polymerization shrinkage occurring during their setting reaction as a result of which contraction stresses build up and the marginal integrity at the resin-tooth interface may be compromised.

When the results of dye penetration were obtained quantitatively, no significant difference (p=.105) was found between the microleakage of conventional unfilled resins and flowable composite (Table 2), similar result was found in a study done by Dukic et al (2009)[22]. In the present study no significant difference (p=.393) in microleakage by quantitative analysis was found between the glass ionomer cement and conventional unfilled resins (Table 2). Contrary to this in a study done by Johnson et al (1995)[23] resin based sealant showed less microleakage than glass ionomer cement. This could be due to strong adhesion property of glass ionomers or viscosity of resin which are likely to create more gap at the interface of material and tooth surface.

The microleakage in flowable Giomer was significantly higher than all the other groups (Table 2). It was seen that when qualitative analysis was done by scores criteria the microleakage of flowable Giomer was significantly higher(p=.043) than glass ionomer cement (Table 2). This reflects the property of Giomers where low viscosity of material increases the flowability, resulting in poor strength at sealant enamel interface.

Regarding sealant penetration, sealants in all groups penetrated into the fissures quite well, but no correlation was found between sealant penetration and microleakage . As supported by a previous study conducted by Duangthip et al (2003)[24]it was observed that penetration of the material (adhesive and/or sealant) is not necessarily required for restorative success. This study supported earlier conclusions that sealant effectiveness is predicted on sufficient bonding at the coronal portion of the fissure, not relying on complete penetration of the material into the underlying fissure depths.

In the present study glass ionomer showed good penetration which was comparable to penetrability exhibited by conventional resin based sealant. (Table 4) similar findings were reported in studies by Fracasso et al (2005)[25], Bojan et al (2006)[26] .Contrary to the present study the studies by Moore et al (1995)[27] ,Covey et al (2004)[28] have shown better penetration of fissures with glass ionomer cement than the conventional resin sealants .

The findings of this study indicated that there was no statistically significant difference (p=.247) between the conventional resin based sealant and flowable composite materials with respect to depth of penetration. This was in accordance with the study done by Aguilar et al (2007)[20].

Although the results of microleakage tests must be applied with caution to the clinical situation, such studies are a valuable tool for the evaluation of new materials or techniques. The penetration of a dye, although not an absolute value, can demonstrate the lack of adaptation of the material to the preparation walls and the absence of a perfect seal. The comparison of microleakage results from the literature on sealants is difficult because there is no universal protocol for the experiments and there is difference in tested materials and dye indicators used.

CONCLUSION:

On the basis of observations made during the course of study the four sealants presented a similar pattern of penetration into the pits and fissures, with no statistically significant difference. However scoring criteria indicated that the sealing ability of glass ionomer cement is comparatively better than flowable Giomer, the photomagnification method indicated that the sealing ability of conventional unfilled resin , glass ionomer cement and flowable composite is comparatively better than the flowable Giomer.

Overall results indicate a strong correlation probability between scoring and photomagnification criteria, subject to elimination of relative error.

The present study provides some data to warrant further research on the use of flowable Giomer as a pit and fissure sealant.

REFERENCES:

1. Nagano T. Relation between the form of pit and fissure and the primary lesion of caries. Dent Astr 1961; 6:426.
2. Hatibovic-Kofman S, Butler S , Sadek H microleakage three sealents following conventional, bur, and air-abrasion preparation of pit and fissures. Int J Pediatr dent 2001;11 (6):409-416 .
3. Vineet D, Tandon S. Comparative evaluation of marginal integrity of two new fissure sealants using invasive and non-invasive techniques; a SEM study. J Clin Pediatr Dent 2000 Summer; 24(4):291-7.
4. Wimonchit S, Timpawat S, Vongsavan N. A Comparison of Techniques for Assessment of Coronal Dye Leakage. J Endod 2002 Jan; 28(1):1-4.
5. Ovrebo RC, Raadal M. Microleakage in fissures sealed with resin or glass Ionomer cement. Scand J Dent Res 1990 Feb; 98(1):66-9.
6. Aranda W, Courson F, Degrange M. In vitro evaluation of a simulated oral environment of different materials for Pit and Fissure Sealing. European Cells and Materials 2005; 9 (1): 73-74.
7. Pérez-Lajarin L, Cortés-Lillo O, García-Ballesta C, CózarBraz Hidalgo A .Marginal microleakage of teo fissure sealants: acomparative study. J Dent Child 2003 Jan-Apr; 70(1):24-8.
8. Hatibovic-Kofman S, Wright G, Braverman D. Microleakage of sealants after conventional, bur, and air-abrasion preparation of pits and fissures. Pediatr Dent 1998; 20:173-178.
9. Fuks AB, Grajower R, Shapira J. In vitro assessment of marginal leakage of sealents placed in permanent molars with different etching time. J Dent Child 1984 Nov-Dec; 51(6):425-7
10. Ansari G, Oloomi K, Eslami B. Microleakage assessment of pit and fissure sealant with and without the use of pumice prophylaxis. Int J Paediatr Dent 2004;14 (4): 272-8.
11. Eidelman E, Shapira J, Houpt M . The retention of fissure sealants using twenty-second etching time: three-year follow-up. J Dent child 1988; 55(2): 119-20.
12. Feigal RJ, Hitt J, Spleith C. Retaining sealants on salivary contaminated enamel. J Am Dent Asso 1993; 124(3): 88-97.
13. Rudney JD. Does variability in salivary protein concentrations influence oral microbial ecology and oral health? Crit Rev Oral Biol Med 1995; 6(4): 343-67.
14. Mcknight-Hanes C, Whitford GM. Fluoride release from three glass ionomer materials and the effects of varnishing with or without finishing. Caries Res 1992; 26(5): 345-50.
15. Simmons EW, Barghi N, Muscott JR: Thermocycling of pit and fissures sealants. J Dent Res 1976 Jul-Aug; 55(4): 606-10.
16. Theodoridou-Pahini S, Tolidis K, Papadogiannis Y. Degree of microleakage of some pit and fissure sealants: an in vitro study. Int J Paediatr Dent 1996 Sep; 6(3): 173-6.
17. Do Rego MA, De Araujo MAM .Microleakage evaluation of pit and fissure sealants done with different procedures, materials, and laser after invasive technique. J Clin Pediatr Dent 1999; 24(1): 63-68.
18. Ashwin R , Arathi R. Comparative evaluation for microleakage between Fuji-VII glass ionomer cement and light-cured unfilled resin: A combined in vivo in vitro study. J Indian Soc Pedod Prev Dent 2007 Apr-Jun; 25(2): 86-7.
19. Khanal S, Suprabha BS, Srikant N. Evaluation of microleakage and adaptability of glass ionomer and resin sealants with invasive and non invasive technique. Journal of Nepal Dental Association 2010; 11(1): 4-10
20. Aguilar F, Drubi-filho B, Casemiro L, Watanabe M. G. C, Pires-de-souza F. C. Retention and penetration of a conventional resin-based sealant and a photochromatic flowable composite resin placed on occlusal pits and fissures. J Indian Soc Pedod Prevent Dent 2007 Oct-Dec; 25(4): 169-73.
21. Kwon HB, Park KT. SEM and microleakage evaluation of 3 flowable composites as sealants without using bonding agents. Pediatr Dent 2006 Jan-Feb; 28(1): 48-53.
22. Dukic W, Dukic O, Milardovi S. The Influence of Healozone on Microleakage andFissure Penetration of Different Sealing Materials. Coll Antropol 2009; 1: 157–162.
23. Johnson LM, Duke ES, Camm J, Hermesch CB, Buikema DJ. Examination of a resin-modified glass-ionomer material as a pit and fissure sealant.Quintessence Int 1995 Dec; 26(12):879-83.
24. Duangthip D, Lussi D. Effects of Fissure Cleaning Methods, Drying Agents, Fissure Morphology on Microleakage and Penetration Ability of Sealants in vitro. Pediatr Dent 2003; 25: 527-532.
25. Fracasso MC,Daniela R, Machado MA. Evaluation of marginal microleakage and Depth of penetration of glass ionomer Cements used as occlusal sealants. J Appl Oral Sci 2005; 13(3): 269-74.
26. Bojan P, Dejan M, Duska B. The impact of occlusal morphology on fissure sealant penetration . Stomatoloski glasnik Srbije 2006; 53(2): 87-94.
27. Moore BK, Winkler MM, Ewoldsen N. Laboratory testing of light-cured glass ionomers as pit and fissure sealants.Gen Dent 1995 Mar-Apr; 43(2): 176-80.
28. Covey D A, Johnson W W ,Hopper L R. Penetration of various pit and fissure sealants into occlusal grooves. J Dent Res 2004; 83(A): Sequence#359 (Abstract#3471).