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Original research

Clinical success rate of fissure sealants: One-year follow-up*

Mine Koruyucu[1], Dilara Bektaş[1], Cengiz Aydınoğlu[2], Pelin Barlak[2], Figen Seymen[1]

Purpose
The aim of this study is to evaluate clinical success rate of resin-based fissure sealants applied at Istanbul University, Department of Pediatric Dentistry after 1 year of application.

Materials and Methods
Children with at least one pair of caries-free permanent first molars with deep pits and fissures were included in the study. The ages of children ranged from 7-13 (mean age: 9.2±1.22). Resin-based fissure sealant was applied to the 322 fissures of the first permanent molars in 100 children. 12 months after the application, children were recalled for examination. Recall examinations were carried out by the same dentist. Fissure sealants were evaluated at 12th month by using Ryge criteria: Retention (R), precence of caries (PC), marginal adaptation (MA), marginal discoloration (MD) and cracking (C).

Results
12 months after the application, all of the children were recalled and fissure sealants were examined. Our findigs are: R: Alpha 95 (29.5%), Bravo: 143 (44.4%), Charlie: 84 (26%); PC: Alpha 274, Bravo 48 (14.9%); MD: Alpha 322; MA: Alpha 279, Bravo 43 (13.3%); C: Alpha 321, Bravo 1 (0.3%).

Conclusion
The preventive effects of the sealant are only maintained as long as it remains completely intact and bonded in place. After applying fissure sealants, patients must be recalled and sealants must be checked to provide retention and marginal adaptation.

Keywords: *Fissure sealant, Ryge criteria, Marginal adaptation, Retention*

Introduction

The caries is a serious problem in dental health and researchers are still studying on preventive treatment of tooth decay formation. It is indicated that pits and fissures are the best preventive applications for dental caries (1,2).

A few years following eruption has the highest risk for the caries. Teeth are not in contact with their opposite along eruption, so it makes plaque accumulation. This period is about 1.5 years for first and second molar teeth and it is up to 1-2 months for premolar teeth. Molar teeth locate backward in mouth so it is difficult to brush them. All of these factors increase the rate of caries in molar teeth fissures and pits (3). As long as teeth contact with saliva, spit in calcium, magnesium, fluoride and other trace elements enable calcification by entering the enamel structure by diffusion. Therefore, it is more susceptible to decay after eruption for 2 years permenant teeth (4).

Tooth morphology is important to 'plaque formation and accumulation', 'clearance capability of saliva', 'dental hygiene'. Pit and fissure type are individualized. Decay susceptibility depends on verticality of tubercul bevel and depth of fissure (5,6). Because of these reasons, researchers are studying on capping these areas. Pit and fissure sealants are improved,

ORCID IDs of the authors: M.K. 0000-0002-2077-5095; D.B. 0000-0002-0427-0679; C.A. 0000-0002-9172-0550; P.B. 0000-0001-8426-764X; F.S. 0000-0001-7010-2035

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[1] Istanbul University, Faculty of Dentistry, Department of Pedodontics, Istanbul, Turkey

[2] Private Practice, Istanbul, Turkey

Corresponding Author: Mine Koruyucu

E-mail: mine.yildirim@istanbul.edu.tr

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and some materials are used as polyurethane, cyanoacrylate, polycarboxcylate cements, glass ionomer cements and BIS-GMA based resin cement (7).

Fissure sealants prevent accumulation of food borne debris in fissures and pits which are prone to decay. Fissur sealants are classified according to their content, whether they have filler, their color, fluoride content and polymerization features (6,8).

Although occlusal surfaces are clothing the 12.5% area of tooth surface, it is seen that tooth decays occur in 50% rate on that surfaces among the school age children (1,2). About 1/3 rate of total amount of caries are in fissure and pits, 2/3 rate of them are seen in interfaces. Fissure color changes in occlussal caries. Enamel becomes more opaque and tooth color becomes darker. It is hard to see decay on radiograph before it becomes a deep dentine decay (8).

According to Nagano definition (9): U type: anatomically cleanable, so resistant to caries (a) ; I type: some types can come up to dentine so high risk for caries (b); V type: not deep like I type and less risk for caries (c); K type: high risk for caries (d) (Figure 1).

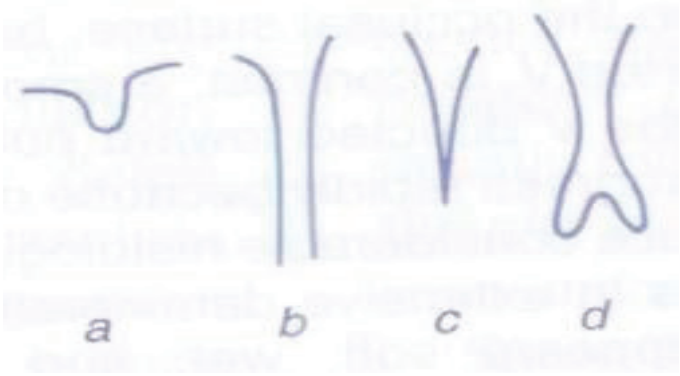

Figure 1. *Morphological forms of fissures.*

It is hard to clean deep fissures from food remnant and bacterias and fissure base line is near to dentinoenamel junction. Although in shallow fissure, enamel thickness is about 1.5-2 mm, this number may change to 0.2 mm. Remineralisation with fluoride can occur at pH 6.7-7.3. But in fissure it is more acidic through plaque. Remineralisation cannot occur at low pH.[8] This explains that occlusal surfaces are susceptible to decay (10,11).

The purpose of this study is to evaluate the clinical success of fissure sealants at the end of 12th month.

Materials and Methods

In our study, we evaluated 100 children between the ages 7-13 (mean 9.2±1.22) years and their completely erupted 322 first molars with fissure sealants which are applied in Istanbul University Faculty of Dentistry of Pediatric Dentistry Department students' clinics. The protocol of this study is approved by İstanbul University Faculty of Dentistry Medical Research Ethics Board (No:2013/104) and parents of children participating in the study were informed about the study and written informed consents were taken.

Fissure sealant applications were done by İstanbul University Faculty of Dentistry student clinic under the control of one pediatric dentist. Before the application of fissure sealants, each tooth was brushed with pumice-water slurry with polishing brush. After washing, the surface was dried with air-water spray, and was isolated with cotton rolls and saliva enjector insulation. Occlusal surface up to the tubercule hill was etched with 37% phosphoric acid (3M™ ESPETM Scotchbond™ Etching Gel) for 30 seconds and then washed with water 30 seconds and dried with air freshener until it was obtained as chalky enamel image. After the enamel surface was prepared, fissure sealant material (3M™ Sealant ESPE Clinpro™) were applied with disposable brush and polymerized 40 seconds with 40 seconds using a conventional visible light-curing unit (HILUX™ 250 Halogen curing light). Occlusion was checked using articulation paper, the contact points on teeth were corrected under water cooling with grany diamond milling cutter to prevent overload formation and to ensure the durability of fissure sealants.

After 12 months, patients were called for follow-up and applied fissure sealants were controlled by mirror and sond. Teeth were dried lightly with air spray and occlusal surface were examined carefully. One year previously applied fissure sealants on the teeth with deep pit and fissures at the high risk which did not have caries or restorations were examined according to the Ryge criterias (Table 1) and the form was filled out for each patient.

Table 1. *Clinical evaluation by Ryge Criterias.*

Retention	ALPHA	Full retention
	BRAVO	Half retention
	CHARLIE	Loss of full restoration
Caries presence	ALPHA	No diagnosed caries
	BRAVO	Diagnosed caries
Ridge adaptation	ALPHA	Full ridge adaptation
	BRAVO	Existance of space
Fracture	ALPHA	No fracture
	BRAVO	fractured
	CHARLIE	
Edge Coloration	ALPHA	No coloration between restoration and tooth
	BRAVO	Less than half of edge environment coloration
	CHARLIE	More than half of edge environment coloration

Results

The 12th month clinical value of the fissure sealants that were applied to the permenant first molars in study are shown in Table 2.

In this study, 322 fissure sealants were applied to 100 children and clinical evaluation of all sealants were made in compliance with Ryge criterias. The results of clinical examination were recorded separately for each tooth.

At the end of the 12th month, retention rate was determined; 95 (29.5 %) teeth had complete retention, 143 (44.4%) teeth had half retention and 84 (26%) teeth had completely lost the sealants. The presence of caries and tooth resto-

Table 2. *12-month clinical follow-up data according to the Ryge Criteria*

	Retention	Presence of caries	Marginal adaptation	Marginal coloration	Fracture
	A-B-C	A-B	A-B	A-B-C	A-B
N	95-143-84	274-48	279-43	322-0-0	321-1
%	29.5-44.4-26	85.1-14.9	86.7-13.3	100-0-0	99.7-0.3

A:Aplha B:Bravo C:Charlie N:Number of fissure sealants

ration were observed in 48 (14.9%) teeth. 43 (13.3%) of 322 fissure sealants were observed with marginal adaptation disorder, only 1 (0.3%) was cracked (Figure 2, Figure 3).

In our study, no marginal discoloration of sealants is observed and recorded as Alpha all the teeth.

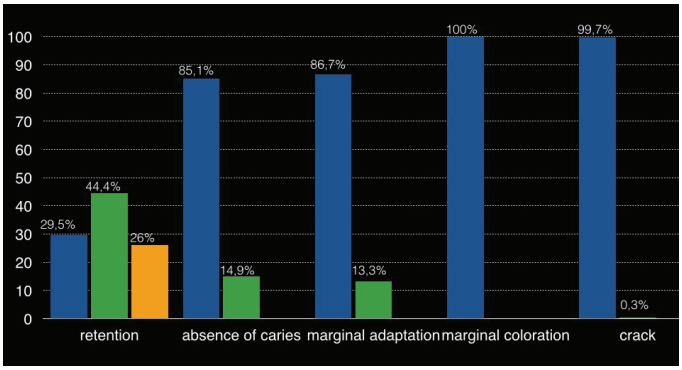

Figure 2. *Appearance of datas as a percentage.*

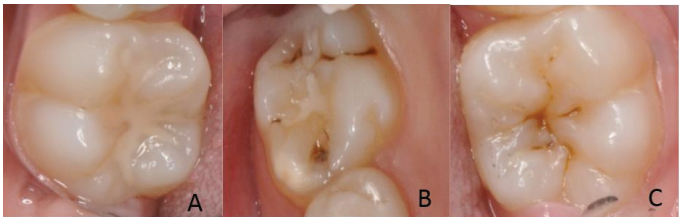

Figure 3a,b. *A: ALPHA retantion B: BRAVO retantion C: CHARLIE retantion .*

Discussion

Today, it is seen that light cure resin-based materials are widely used as a pit and fissure sealant. In this study, the light cure resin fissure sealant material is used.

It is reported that the most important criteria of the evaluation of the success of fissure sealant material are micromechanical connection between enamel surface and material and long-term retention. This retention depends on isolation of working area, material viscosity, preparation of enamel surface and using of adhesive systems (12). In assessment of the retention of fissure sealant, as we did in our study, the degree of the material's structural integrity; whether it is full retention, half retention or full loss is important (13,14).

At the beginning, partial retention of fissure sealants on occlusal surface was accepted as clinical success. During the period when the adhesive dentistry had started it was an optimistic approach, but two decades later studies showed that it was not true. It is shown that both the tooth which has partial retention and not applied fissure sealant have same susceptibility to caries (15,16).

Conry *et al.* (17) reported that the sufficient fissure sealant material leaving deep fissure out or fissure sealant sharp fringe because of material breakage cause plaque involment and caries.

In a study by Simonse (18), the longest clinical follow-up study, fissure sealants are applied to permenant first molars, after 5 years 82% of them, after 10 years 57%, after 15 years 28%, provide full retention. After 15 years, 35% of fissure sealants continue as half retention. In 31% of teeth that fissure sealants are applied, decay or tooth restoration presence is observed and the decay rate of the teeth without fissure sealant is 83%. In this study, fissure sealants are applied only once and it is considered that decay rate can be brought close to zero by making regular checks and repairing of partial losses. When the researches examined, it is reported that the first permenant molars with fissure sealants are observed with failure rate of 5-10% per annum.

The study by Dennison *et al.*(19) reports that the highest failure of fissure sealants is observed in first six months so they should be followed at least six months. In this study the retention rates were compared to previous studies, the success of the resin materials was found to be at lower values.

Majere and Major (20), using resin-based fissure sealants in clinical studies, reported that they observed approximately 90% rate of complete retention at the end of five years. In a study by Elbay *et al*. (21) the time of retention of seven different fissure sealants followed by a year, they observed that resin-based sealants stated in a retention rate of at least 85%. In this study, after one-year follow-up full retention rate was found as 29.5%.

In a study Gazi University Faculty of Dentistry concluded in 2012, it is evaluated the 1st,3rd,6th,12th,24th month clinical success of resin-based and glass ionomer-based fissure sealants done by grade 5 students are evaluated. The result of an annual review, 57 (38.5%) of 143 resin-based fissure sealants are observed with full retention, 66 (46.1%) with partial retention and 20 (13.5%) with total loss. In glass ionomer-based 145 fissure sealants are observed as 47 (35.1%) with full retention, 58 (40%) with partial retention, 40 (27%) with total loss. The presence of decay or restoration are detected in only 5 (3.3%) of the 143 resin-based fissure sealants and in 3 of the glass ionomer-based sealants (2%) are identified with decay or restoration (22). The retention rate we have achieved as a result of this study are similar to these rates.

Adequate moisture control is known to be crucial to the success of making a fissure sealant application. Controlling the humidity is releated to the eruption level of teeth, the patient's ability to cooperation, material and isolation method. To provide isolation for non-full-erupted tooth is difficult and possibility of communication with noncoopere children is considered. Resin-based materials exhibit more technical

precision than polyacid based materials because of its hydrophobic structure (5,9).

The acidified and washed adhesive systems are commonly used in the fissure sealant application. Phosphoric acid is accepted as a standard method for etching enamel surface. However, it is no longer possible to remove microbial dental plaque and remnants, washing after etching to remove acid forms an unpleasant taste in the mouth, and so it is reported that it may cause undesired behavior in pediatric patients (23). Therefore, fissure sealants that do not require isolation or washing during the process and with less technique sensitivity are developed to ensure retention (24).

In a study by Bendinskaite *et al.* (25), they reported that no significant difference was found in 5 years follow-up between etching used in enamel preparation and air abrasion technique. In another study, it is evaluated that the fissure sealants applied following acid etching, ER, Cr:YSGG laser application showed similar retention value in 18 months follow-up. It also focused on how effective etching duration for clinical success. Duggal et al. (26) conducted a study of 264 permenant first molars. The application of fissure sealants was done with different etching duration as 15,30,45,60 seconds. After 6 months and 1 year follow-up, they concluded that different etching duration did not affect the retention of fissure sealants.

To achieve ideal penetration, covering the pit and fissures, and marginal adaptation for fissure sealants, another required factor is material viscosity. In a study by Irinoya *et al.* (27), they evaluated the effect of viscosity and they reported that low viscosity fissure sealant had better penetration compared to high viscosity. However, Barnes *et al.* (28) concluded that viscosity was not important for covering success of material, so instead of modification of the material the surface energy of enamel can be changed for clinical success.

Conclusion

To achieve success in the clinical application of fissure sealants, besides right diagnosis, it is important to apply manifacturer's instructions and be careful in every stage. Good isolation must especially be provided, regular dental examination should be done and appliance should be repeated to the teeth which do not show full retention so that the effectiveness of fissure sealant continues. It should especially be emphasized for parents that it is important to bring their children to control appointments for their oral dental health.

Türkçe Özet: *Fissür Örtücülerin Klinik Başarısı: 1 Yıllık Takip. Amaç: Bu çalışmanın amacı İstanbul Üniversitesi Diş Hekimliği Fakültesi Pedodonti Anabilim Dalı kliniğinde uygulanan fissür örtücülerin bir yıl sonundaki klinik başarısının değerlendirilmesidir. Gereç ve Yöntem: Bu çalışma derin pit ve fissürlere sahip, fissürlerinde herhangi bir restorasyon ya da çürük bulunmayan, yaşları 7 ile 13 (ort. 9.29.2±1.22).) arasında değişen 100 çocuk üzerinde gerçekleştirilmştir. 322 adet birinci büyük azı dişine fissür örtücü uygulanmıştır. Fissür örtücüler tek bir hekim tarafından ayna ve sond yardımıyla 12. ayın sonunda değerlendirilmiştir. Her bir fissür örtücünün değerlendirilme kriterleri, Ryge kriterleri kulanılarak retansiyon (R), çürük varlığı (PC), kenar uyumu (MA), kenar renkleşmesi (MD) ve çatlak (C) olarak belirlenmiştir. Bulgular: Tüm çocuklar kontrollere çağrılarak fissür örtücülerin tamamı aşağıdaki şekilde incelenmiş, elde edilen bulgulara göre: R: Alpha 95 (%29.5), Bravo 143 (%44.4), Charlie 84 (%26); PC: Alpha 274; Bravo 48 (14.9) ; MD: Alpha 322; MA: Alpha 279, Bravo 43 (%13.3); C: Alpha 321 Bravo 1 (%0.3) olarak değerlendirilmiştir. Sonuç: Fissür örtücülerin klinik başarısı, uygulandığı yüzeye retansiyonunu kaybetmediği sürece sağlanmaktadır. Fissür örtücü uygulamasından sonra hastalar düzenli aralıklarla muayene edilmeli, fissür örtücüler retansiyon ve kenar uyumu açısından değerlendirilmelidir. Anahtar Kelimeler: Fissür örtücü, Ryge kriterleri, marjinal adaptasyon, retansiyon*

Ethics Committee Approval: The protocol of this study is approved by İstanbul University Faculty of Dentistry Medical Research Ethics Board (No:2013/104) and parents of children participating in the study were informed about the study and written informed consents were taken.

Informed Consent: The informed consents were provided by the parents and/or guard,ans of the participants.

Peer-review: Externally peer-reviewed.

Author contributions: MK and FS participated in design of the study. MK, CA and PB participated in generating the data for the study. MK and PB participated in gathering the data for the study. CA and PB participated in the analysis of the data. MK and DB wrote the majority of the original draft of the paper. MK and DB participated in writing the paper. All authors approved the final version of this paper.

Conflict of Interest: The authors had no conflict of interest to declare.

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