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

**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), presence 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 findings 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 permanent 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 tubercle bevel and depth of fissure (5,6). Because of these reasons, researchers are studying on capping these areas. Pit and fissure sealants are improved,
and some materials are used as polyurethane, cyanoacrylate, polycarboxylate 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 occlusal 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).

It is hard to clean deep fissures from food remnant and bacteria 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. 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 Istanbul 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 Istanbul 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 ejector insulation. Occlusal surface up to the tubercule hill was etched with 37% phosphoric acid (3M™ ESPE TM 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.

**Results**

The 12th month clinical value of the fissure sealants that were applied to the permanent 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-
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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.

**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  |
| %         | 29.5-44.4-26       | 85.1-14.9           | 86.7-13.3           | 100-0-0  |

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

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 permanent 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 permanent 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%.

Adequate moisture control is known to be crucial to the success of making a fissure sealant application. Controlling the humidity is related 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

**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).
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 permanent 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 manufacturer’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.

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