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# Clinical Success of Fluoride-Releasing Fissure Sealant in Permanent First Molars: 5-Year Retrospective Study

#### SUMMARY

Background/Aim: It is important to prevent caries on permanent first molars. Fissure sealants are very effective in protecting fissures from caries. The study aimed to determine the clinical success of fluoride-releasing fissure sealants in permanent first molars in the long term. Material and Methods: 64 children with 256 healthy erupted first permanent molars and followed for 5 years, comprised the study. Children who received a fluoride-releasing fissure sealant and came regularly to controls throughout 5 years were evaluated by retention rate and development of new caries and compared with a control group. Results: The complete retention rate of fluoride-releasing fissure sealants was 48.5% and 10.7 % of the sealed teeth had caries after 5 years. 25% of the teeth without fissure sealant were decayed after five years. There was no significant difference between the rate of retention of fissure sealants and the frequency of tooth brushing after 1 year. There was no significant difference between the rate of retention of fissure sealants and oral hygiene status of children after 1 year. Conclusions: The fluoride-releasing fissure sealants were effective for the prevention of caries on pit and fissures of permanent molars and long-term clinical success was satisfying.

Keywords: Fluoride Releasing Fissure Sealants, Fissure Sealants, Retention, Fluoride, Caries

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## Introduction

Fissure and pit surfaces are more susceptible to caries than other tooth surfaces and topical fluorides have less caries prevention effect in fissures than other surfaces. The water fluoridation, diet, and plaque controls decrease the caries prevalence. This decline is seen especially on the smooth surfaces<sup>1</sup>. It is difficult to clean pit and fissures and the plaque retentive nature of them increase the risk of caries<sup>1,2</sup>. The largest plaque accumulation is in the fissures of erupting permanent molars<sup>3</sup>. It was shown that there was a rapid progression of caries in this surface and fissure surfaces were eight times more vulnerable to tooth decay than smooth surfaces<sup>4</sup>.

Fissure sealant applications are a very effective preventive approach to protect fissures from caries by producing a barrier<sup>2</sup>. It was reported that 74% of permanent sealed teeth were caries-free after 15 years<sup>5</sup>.

The American Dental Association and the American Academy of Pediatric Dentistry advised the application of fissure sealants for fissure caries<sup>2,6</sup>. There are several different formulations in resin-based fissure sealants<sup>4</sup>. The fluoride-releasing fissure sealants (FRFS) are grouped as the fourth generation. This product includes fluoride-releasing particles to inhibit caries<sup>5</sup>.

Both fluoride varnish and fissure sealants showed similar protection for fissures in a recent randomized clinical study<sup>7</sup>. Muller-Bolla et al stated that the effects of the sealants were similar regardless of whether they contained fluoride or not<sup>8</sup>. However, it was stated in the literature that FRFS could have a cariostatic effect on the fissures of teeth<sup>9</sup>. For this reason, it is important long-term clinical studies to determine clinical retention and the cariostatic effect of FRFS. Therefore, this study aimed to evaluate the clinical success of fluoride-releasing fissure sealant using survival rate and caries as the outcomes.

## **Material and Methods**

The ethical approval was obtained from the Institutional Ethics Committee of Izmir Demokrasi University (ethical code 2019/03-07). All procedures performed were by the ethical standards of the institutional research committee and with the World Medical Association's Declaration of Helsinki as revised in 2013.

The study conducted a retrospective design. Children who have received fluoride-releasing fissure sealant on four first permanent molars, aged 6-9 years and followed for 5 years were randomly selected from the files of the pediatric dentistry clinic as the study group. Children with healthy first molar teeth and attending 5-year regular follow-up visits were randomly selected as the control group. The control subjects have not received fluoridereleasing fissure sealant in four first permanent molars. The children and their parents visited the hospital for orthodontic treatment, but the children did not receive orthodontic treatment.

Inclusion Criteria: Records of 30 children who have received fluoride-releasing fissure sealant on four first permanent molars (n=120) during April-September 2012 and 34 age-mate controls (n=136) were evaluated. Healthy children without any known history of systemic illness were included.

Exclusion Criteria: Children who received topical fluoride application were excluded. Children who didn't attend periodic controls were not included in the study.

As a policy of the clinic, all children in the study and control groups received oral health education during their regular visits each year.

Study design and procedures: The fissure sealant material was Teethmate F-1 (Kuraray, Japan). Four permanent first molars were sealed in the same session and by the same operator. The files included regular follow-up visit records 3, 6 months, 1, 2, 3, 4, and 5 years after application. The retention rate of the fissure sealants and the presence of secondary caries of the teeth were reported from their files. The hospital files of the control group were used for comparison of the findings.

The results were categorized into five groups according to the Modified Simonsen criteria<sup>10</sup> as follows:

- Complete retention-complete retention of the sealant and no caries (0).
- Partial retention: sealant with loss of material and no caries (1).
- Partial retention: sealant with loss of material and caries (2).
- Missing: missing of the sealant and no caries (3).
- Missing: missing of the sealant and caries (4).

The files included oral hygiene status and daily tooth brushing frequency records, which were recorded at the children's first visit. Children's oral hygiene status was recorded in their files as poor, fair, and good. Children's daily toothbrushing frequency was recorded in their files as none, occasionally, once a day and twice a day.

Data analysis: Statistical analysis was done using SPSS 18 (SPSS Inc, Chicago, USA), statistical significance was set p<0.05. In addition to descriptive statistics, the Chi-Square test was used to evaluate the effect of oral hygiene and the frequency of toothbrushing on the retention of fissure sealants.

## Results

The mean age of the study group was 7.83, that of the control group was 7.61. The mean dmft  $\pm$  SD of the study group was  $3.86\pm 1.41$ , that of the control group was  $3.81\pm 1.37$ . At the end of the 5th years, the retention rate was determined; 48.5 % teeth had complete retention, 34.1 % teeth had partially retention-no caries, 4.9% teeth had partially retention-caries, and 6.7 % teeth had completely lost the sealants.

The presence of caries and tooth restoration was observed in 10.7 % of teeth after 5 years. 25% of the teeth (34 of 136 permanent molars) in the control group were restored due to caries after 5 years. The results of retention rates are presented in Table 1.-

Criteria	3month	6month	1 year	2 years	3 years	4 years	5 years
Complete retention (no caries) %	88.3	80.0	67.5	56.7	55.0	49.3	48.5
Partial retention (no caries) %	11.7	20.0	29.2	32.5	33.3	34,1	34.1
Partial retention (caries) %	0.0	0.0	3.3	3.3	3.3	4.1	4.9
Missing (no caries) %	0.0	0.0	0.0	4,2	5.1	6.7	6.7
Missing (Caries) %	0.0	0.0	0.0	3.3	3.3	5.8	5.8
Total %	100	100	100	100	100	100	100

Table 1. Results of Fissure Sealants of Permanent First Molars

Tooth Number	Frequency of Toothbrushing	Complete retention (no caries) (n)	Partial retention (no caries) (n)	Partial retention (caries) (n)	Missing (no caries) (n)	Missing (caries) (n)	person	р
16	None	1	1	0	0	0	2	0.648
	Occasionally	6	1	1	0	0	8	
	Once a day	5	3	0	0	0	8	
	Twice a day	8	4	0	0	0	12	
26	None	0	2	0	0	0	2	0.544
	Occasionally	4	3	1	0	0	8	
	Once a day	4	4	0	0	0	8	
	Twice a day	6	6	0	0	0	12	
36	None	1	1	0	0	0	2	0.137
	Occasionally	4	3	1	0	0	8	
	Once a day	8	0	0	0	0	8	
	Twice a day	11	1	0	0	0	12	
46	None	1	1	0	0	0	2	0.(2)
	Occasionally	6	1	1	0	0	8	
	Once a day	6	2	0	0	0	8	0.636
	Twice a day	10	2	0	0	0	12	

Table 2. Retention-Caries Status and Frequency of Toothbrushing (1. Year)

Table 3. Retention-Caries and Oral Hygiene of Children (1. Year)

Tooth Number	Oral Hygiene	Complete retention (no caries) (n)	Partial retention (no caries) (n)	Partial retention (caries) (n)	Missing (no caries) (n)	Missing (caries) (n)	person	р
	poor	6	4	0	0	0	10	
16	medium	8	4	1	0	0	13	0.606
	well	6	1	0	0	0	7	
26	poor	6	4	0	0	0	10	
	medium	5	7	1	0	0	13	0.698
	well	3	4	0	0	0	7	
36	poor	6	4	0	0	0	10	
	medium	12	0	1	0	0	13	0.110
	well	6	1	0	0	0	7	
46	poor	7	3	0	0	0	10	
	medium	11	1	1	0	0	13	0.519
	well	5	2	0	0	0	7	

There was no significant difference between the caries formation and the frequency of tooth brushing after 1 year in the children who applied fissure sealants was reported in Table 2. (p>0.05). There was no significant difference between the rate of retention of fissure sealants and the frequency of tooth brushing after 1 year. (p>0.05). There was no significant difference between the rate of retention of fissure sealants and oral hygiene status of children after 1 year. (p>0.05) Table 3.

## Discussion

The risk of fissure caries formation is the highest in the first and second years after the eruption of posterior teeth<sup>10,11</sup>. Fissure sealants are an effective tool for the prevention of the caries of the pit and fissures in permanent molar teeth<sup>12</sup>. American Academy of Paediatric Dentistry declared that fissure sealants reduce the incidence of carious on pit and fissures compared to the non-use of sealants<sup>2</sup>.

There are several different types of resin fissure sealants with different particle sizes, different formulations, and application methods. FRFS has the advantage of fluoride incorporated with fluoride-releasing particles within the material. However, Simonsen reported that FRFS was not a fluoride reservoir that provided a long-term release of fluoride and for this reason, this kind of sealants provide no additional clinical benefit<sup>4</sup>.

The retention of fluoride-containing fissure sealants could be similar to resin fissure sealants<sup>9</sup>. Morphis et al., declared that fissure sealant retention was not adversely affected by the presence of fluoride<sup>13</sup>. It was reported that the fluoride content did not make a difference between the two materials in terms of the caries prevention effect. Moreover, it was stated that the sealant retention was not a valid predictor itself for caries and there was no statistically significant difference regarding caries when comparing light polymerizing resin-based sealants with FRFS at 12 months<sup>14</sup>. However, another study showed significantly better retention for light polymerizing resinbased sealants compared with FRFS at the 48-months follow-up<sup>15</sup>. Kobayashi et al., also stated that resin-based sealant without fluoride exhibited the best performance regarding both retention and surface characteristics compared to FRFS for 2 years<sup>16</sup>. The percentage of retention of FRFS was 34.6%, that of the resin-based sealant without fluoride was 66.0% for 2 years in that study. The retention of FRFS was better than that of glass ionomer sealant in another study, however, their effectiveness in preventing fissure caries did not differ in 2 years period<sup>17</sup>. It was found that the percentage of retention of FRFS was 56.7% for 2 years in the present study.

As the effectiveness of fissure sealant material is related to its bonding to the enamel, the retention of the fissure sealant is of great significance<sup>4</sup>. Colombo and Ferrazzano stated that sealants provide 100% caries prevention effect as long as they remain in the fissures and the retention rate after the first year was 85-100% <sup>18</sup>. Kobayashi et al., reported that the percentage of retention of FRFS was 55.4% after the first year<sup>16</sup>. Ismail and Gagnon reported that most of the failure happened within the first year after the application of the fissure sealants<sup>19</sup>, similarly, most of the failure of FRFS occurred within the first year in this study, and the retention rate for FRFS was 67,5%. Colombo and Beretta showed that sealant loss was 50% after five years in their study. For this reason, they recommended replacing them after five years. Kühnisch et al., reported that the five years retention rate for FRFS sealants was 69.9%<sup>21</sup>. However, the retention rate was 48.5 % after five years, in the present study.

Fissure sealants have been advised to reduce the incidence of dental caries in children<sup>22</sup>. It was reported that fissure sealants had a preventive effect against fissure caries in the studies<sup>23,24</sup>, and should be used to high caries risk children for preventing progression of incipient caries lesions<sup>24</sup>. The benefits of sealed teeth on lowcaries risk children are controversial<sup>25</sup>. AAPD declared that it was necessary to classify the children according to their caries risk<sup>26</sup>. Oral hygiene, general health status, and fluoride prophylaxis have an important role in deciding the necessity of applying fissure sealants<sup>27</sup>. In the present study, the rate of retention of fissure sealants and oral hygiene status of children after 1 year were not statistically different. Besides, the rate of retention of fissure sealants and the frequency of tooth brushing after 1 year were not statistically different.

Zin *et al.*, reported that although FRFS released a lower amount of fluoride, their anti-demineralization efficacy of them was greater than that of glass ionomer sealants<sup>28</sup>. However, it was reported that both FRFS and high-viscosity glass ionomer sealants protected caries on the surface of primary molars<sup>29</sup>. It was presented parallel results with this study by reporting that FRFS might provide an anti-demineralization effect on adjacent unsealed surfaces<sup>28</sup>. Few of the teeth that used FRFS before were decayed after 5 years. For this reason, it was thought that FRFS could have an anti-demineralization effect and prevent caries formation. The limitations of the study are the use of only one fluoride-releasing fissure sealant and the low number of teeth.

## Conclusions

In a conclusion, the present study demonstrated that the percentage of caries on the teeth was lower on sealed permanent molars. Even if the sealant was missed, its effect of preventing caries on the tooth surface could continue for a long time. Public health programs should include oral health education, effective toothbrushing and sealants for overall success.

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