

**ORIGINAL ARTICLE****A 1-year Clinical Evaluation of Fissure Sealants on First molars Applied by dental student****Sara Ghadimi<sup>1</sup>, Samaneh Sarshar\*<sup>2</sup>, Farideh Baghaei<sup>2</sup>**<sup>1</sup>Pediatric Dentistry Department, school of Dentistry, Tehran University of Medical Sciences, Tehran, Iran<sup>2</sup>Community Oral Health Department, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran

\*Corresponding Author: SamanehSarshar

E-mail: [lambeh\\_202000@yahoo.com](mailto:lambeh_202000@yahoo.com)**ABSTRACT**

*The fissure sealant technique is an efficient and safe means of preventing pit and fissure caries in recently erupted teeth. The students are also fissure sealant therapy operator. According to the role of the operator, the present study was conducted with the aim of evaluation the sealants retention and existence of caries in molar teeth after one year follow up in 7 to 11 years old children that were treated by junior dental students. 59 children with the mean age of 9 (7 to 11 years old) were selected from people who referred to pediatric department of Tehran dental university in 2013. The children who had including criteria were candidate for inclusion in the study. Fissure sealant therapy was applied by dental students. Two professors who were member in pediatric department, observed the procedure. The clinical evaluation was obtained after one year by two investigators. The sealants were evaluated in terms of retention, presence of caries, marginal discoloration and their needs to repair. The samples were divided in to two groups according to their age. Group 1: 7 to 8 years old and group 2: 9 to 11 years old. After one year evaluation 45% of sealants were completely retained, 43% partially lost and 11% were totally lost. The retention of fissure sealant of all indexes in upper jaw was significantly higher than lower jaw ( $P<0.001$ ,  $P<0.001$ ,  $p=0.05$ ). The retention of fissure sealant of group 1 in partially lost and totally lost cases was significantly higher than group 2 ( $P<0.001$ ,  $p=0.044$ ). According to the results, retention of fissure sealant was more successful in upper jaw and older children. It will be concluded that lack of accurate and correct fissure sealant therapy can cause harmful effects in patients. So we recommend that students in their first trials of fissure sealant therapy work on older children and upper jaw. In addition, it seems periodic recall will be effective to explore the probable discolorations and caries which may be occur in some cases.*

**Key words:** Fissure sealant, dental student, one year follow-up

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**INTRODUCTION**

Although the field of dentistry has shown outstanding scientific advances in restorative materials and innovative prevention techniques over recent decades, dental caries remains a highly prevalent pathology worldwide [1-3]. Approximately 90% of caries lesions are found in the pits and fissures of permanent posterior teeth [4]. These surfaces of permanent teeth are particularly at risk. For example, in the united states, occlusal surface caries comprised 56% of the permanent tooth caries in 5-17 years old children [5,6].

Although fluorides are highly effective in preventing caries on smooth surfaces, they are not equally effective in protecting occlusal surfaces [2, 7]. Reasons for this include the morphology of occlusal pits and fissures that make mechanical cleaning difficult and facilitate the retention of bacteria, nutrients and debris" [6, 8]. Therefore, a specific barrier between the tooth surface and the oral environment is needed to avoid the development of caries. One of the most appropriate and cost effective treatments for prevention of occlusal caries in children and adolescents of high risk is the application of pit and fissure sealants [2, 4, 9, 10]. Pit and fissure sealants were introduced in the 1960s as an effective caries

prevention method and have shown high retention rates [2]. Thereafter, several methods and materials were introduced for fissure sealant therapy.

The efficacy of sealants depends on many factors. Some of them can be controlled by dentists such as isolation, bonding and fissure sealant agents and the procedure of surface treatment [6, 11]. Factors such as the existence caries, fluoride exposure, diet, oral hygiene, age and patient behavior may also contribute in sealant success [10]. Many studies have focused on sealant effectiveness based on method and materials.

Now a few studies have focused on the importance of operator's skill on treatment success. For example Falke *et al.* evaluated the success rate of the fissure sealant therapy in three groups including dentists, hygienists and assistants over 10 years [10]. Their results indicated that the success rate of hygienists were significantly higher than other two groups. Studies evaluating only dental assistants and only dental hygienists verified similar success rates to studies with dentist applying sealants. This indicates that these operators are effective in applying sealants, although individual differences in operators exist and must be considered in all training [10, 12, 13].

According to the technique sensitivity of this method, assurance of accuracy and correctness of treatment is the main factor and applying sealants with poor technique and inadequate skill, not only is not considered as a preventive treatment but also is considered as a stimulating factor of decay and destruction. Otherwise, partial loss of the sealant material inherently leads to occurrence of marginal leakage and hence to caries development underneath the sealant [2].

One of the courses in dentistry is fissure sealant therapy. Thus, the students are also fissure sealant therapy operator. According to the role of the operator, the present study was conducted with the aim of evaluation the sealants retention and existence of caries in molar teeth after one year follow up in 7 to 13 years old children that were treated by junior dental students.

## **MATERIAL AND METHODS**

### **Protocol**

59 children with the mean age of 9 (7 to 11 years old) were selected from children who referred to pediatric department of Tehran dental university in 2013. All parents were received detailed information about principle of treatment, procedure and aim of the study then they signed the consents forms of cooperation.

### **Patient selection**

The children with following criteria were included in the study.

Inclusion criteria:

- 1) 7 to 11 years old children with good general health.
- 2) Existence of at least 2 fully erupted first molars.
- 3) Intact pit and fissure or early enamel lesion on occlusal surface of first permanent molar

Exclusion criteria:

- 1) Fissure sealant or any other restorations on first molars
- 2) An obvious cavity in occlusal surface of first permanent molars
- 3) Partially erupted first permanent molars
- 4) Lack of patient's cooperation for treatment and follow up
- 5) Participation in any interventional study such as fluoride therapy

### **Fissure sealant therapy**

Fissure sealant was placed on occlusal pits and fissures of permanent first molars by dental students. Two academic members of pediatric dentistry department, observed the procedure. First, the samples were checked by dentists with mirror and blunt explorer if first permanent molars need fissure sealant therapy or not. Then the fissures of the first molars were cleaned with slurry of pumice, applied with a bristle brush to remove salivary pellicles and any remaining plaque. The selected teeth were washed with water spray for 60s to remove pumice residues and isolated with cotton roles and flexible plastic saliva ejector. The occlusal surfaces of teeth were etched with phosphoric acid 37% for 20 seconds [6, 9]. After etching each teeth was rinsed with water for 30 seconds [6] and then dried with air blast until it had a chalky, frosted appearance before applying the sealants [6, 14].

Finally, one layer of resin based sealant material was applied on etched occlusal pits and fissures and cured with halogen light curing unit (600 mw/cm<sup>2</sup>) according to the manufacturer's instructions. Then the result was evaluated by dentists to explore any voids and air entrapment. After confirmation of this step, the cotton roles and plastic saliva ejector were removed and the premature contacts were removed using fine-grit round bur.

### **Evaluation**

The teeth were evaluated clinically after one year by two investigators who didn't have any intervention in treatment procedure.. Before evaluation two investigators were trained about evaluation and scoring the fissure sealant and were calibrated. Each investigator evaluated the teeth using mirror and blunt explorer and if there was any disagreement between two investigators, a consensus was reached after discussion.

The sealants were evaluated in terms of retention, presence of caries, marginal discoloration and their needs for repair as follows:

**Retention scoring** [2, 4, 6, 9, 15, 16]:

- 1) (FR) Fully Retained: the materials were fully present on the occlusal surface
- 2) (PL) Partially Lost: the materials were present but as a result of either wash or loss of the material, part of a previously sealed pit and fissure or both was exposed
- 3) (TL) Totally Lost: no trace of materials was detected on the surface

**Presence of caries**(2, 15):

Caries lesions were evaluated according to the caries associated with restorations and sealants scans of the ICDAS II (International Caries Detection and Assessment System)usual classification criteria as follows:

- 0) Sound teeth surface adjacent to the sealant margin
- 1) After prolonged air drying of the surface, first visual change consistent with the demineralization
- 2) Distinct visual change in enamel adjacent to sealant margin

The scoring of marginal discoloration [15] and need to repair [6] were performed in terms of 0: acceptable and 1: non acceptable.

**RESULT**

A total of 124 teeth of 59 children aged 7 to 11years old (mean age 9.10) were sealed and evaluated. All patients returned for one year follow up evaluation. The details were described in table 1.After one year evaluation 46% of sealants were completely retained, 43% partially lost and 11% were missed.

Table 1. distribution of demographic data

	Upper jaw	Lower jaw	Right sight	Left sight	7-8 yrs	+9 yrs
number	61(49%)	63(51%)	67(54%)	57(46%)	56(45%)	68(55%)

The fully retained sealants in upper jaw were 60.7% (37 samples).The difference was statistically significant (P=0.05). The partially retained sealants in upper jaw were 32.8% (20 samples).The difference was statistically significant(P<0.001). The totally lost sealants in upper jaw were 6.6% (4 samples)The difference was statistically significant (P<0.001).The details were described in table 2.

The fully retained sealants in left side were 49.1% (28 samples). The difference was not statistically significant (P=0.089). The partially retained sealants in left side were 43.9% (25 samples) .The difference was statistically significant (P<0.001). The totally lost sealants in left side were 7% (4 samples) . The difference was not statistically significant (P=0. 33). The details were described in table 3.

The samples were divided in to two groups according to their age. Group 1: 7 to 8 years old and group 2: 9 to 11years old.

The fully retained sealants in group 1 were 37.5% (21 samples). The difference was not statistically significant (P=0.76). The partially retained sealants in group 1 were 48.2% (27 samples). The difference was statistically significant (P<0.001). The totally lost sealants in group 1 were 14.3% (8 samples) and. The difference was statistically significant (P=0.044).. The details were described in table 4.

In the present study we analyzed the data by generalized estimating equation (GEE) method with exchangeable correlation matrix and logistic model. Three outcomes were evaluated including need to repair, caries and discoloration by multinomial and cumulative logit link function.

Table2. Distribution of retention rate, repair, discoloration and caries in upper and lower molars

	Fissure Sealant			Repair		Discoloration		Caries	
	Fully Retained Number (%)	Partially Retained	Totally Lost	Yes	no	yes	no	yes	no
maxilla	37 (60.7%)	20 (32.8%)	4 (6.6%)	14 (23%)	47 (77%)	11 (18%)	50 (82%)	11 (18%)	50 (82%)
mandible	20 (31.7%)	33 (52.4%)	10 (15.9%)	24 (38.1%)	39 (61.9%)	18 (28.6%)	45 (71.4%)	16 (25.4%)	47 (74.6%)
p-value	0.05	<0.001	<0.001	0.053		0.134		0.3	

Table3. Distribution of retention rate, repair, discoloration and caries according to side

	Fissure Sealant			Repair		Discoloration		Caries	
	Fully Retained	Partially Retained	Totally Lost	Yes	no	yes	no	yes	no
Left side	28 (49.1%)	25 (43.9%)	4 (7%)	17 (29.8%)	40 (70.2%)	14 (24.6%)	43 (75.4%)	11 (19.3%)	46 (80.7%)
Right side	29 (43.3%)	28 (41.8%)	10 (14.9%)	21 (31.3%)	46 (68.7%)	15 (22.4%)	52 (77.6%)	16 (23.9%)	51 (76.1%)
p-value	0.089	<0.001	0.33	0.82		0.74		0.49	

Table 4. Distribution of retention rate, repair, discoloration and caries according to age

	Fissure Sealant			Repair		Discoloration		Caries	
	Fully Retained	Partially Retained	Totally Lost	Yes	no	yes	no	yes	no
Group 1 (7-8 yrs)	21 (37.5%)	27 (48.2%)	8 (14.3%)	19 (33.9%)	37 (66.1%)	18 (32.1%)	38 (67.9%)	16 (28.6%)	40 (71.4%)
Group 2 (+9 yrs)	36 (52.9%)	26 (38.2%)	6 (8.8%)	19 (27.9%)	49 (72.1%)	11 (16.2%)	57 (83.8%)	11 (16.2%)	57 (83.8%)
p-value	0.76	<0.001	0.44	0.44		0.037		0.1	

## DISCUSSION

Taking into consideration a developing country like Iran, the preventive measures toward oral health are imperative. Even if the initial cost of preventive measures like sealants may be higher than the cost of restorative materials, in the long term, sealants or any other preventive measure would be more cost-effective as the tooth would be maintained in a state of health [15].

In case of partially erupted permanent molars that are prone to caries, their location and gingival covering present difficulties in cleaning and consequently might lead these teeth to become carious before they are fully erupted. Effectiveness of sealant may be jeopardized by the difficulty in obtaining ideal isolation and management of tissue during its application. Effectiveness of sealant as a caries preventive agent is dependent upon its full retention. Several authors have showed that the caries increment is low when there is full retention of the sealant [15, 17-19].

Literatures have reported that most sealing failures occur within 1 year of application [25, 26] and the overall sealant retention rates are estimated to be 74%–96% (16) and 79%–92% (6) after one year, which could be considered clinically success [2].

Many clinical studies of resin sealants have achieved retention rates of > 90% after 1 year and > 80% after 10 years (15,16). Clinical studies have annual failure rates of 0.5%–2.5% [9, 20].

One year follow up is valuable because usually failures due to poor technique and fissure sealants material occurs in this period of time [16].

In other article the average yearly failure rates were from 1% to 10% (16, 21) consideration of various kinds of sealants failure is in order. Failure can take four forms:

- 1- 1. Failures due to poor technique at the time of placement (e.g. salivary contamination, not sealing all pits and fissures, inadequate rinsing or drying, insufficient etching time, etc.).
- 2- Non-sealant-failures (e.g. proximal caries, extraction for orthodontic reasons, or exfoliation).
- 3- Failures due to a combination of the above. [5]

According to our follow up period our failures contain number 1 and 2 [6, 16, 21]

The results demonstrate that the pre-doctoral educational program was effective in preparing dental students to apply occlusal sealants. The results also demonstrate that occlusal sealants applied to first permanent molars by dental students as part of comprehensive care program with periodic patient recall were an effective preventive procedure. This clinical evaluation of performance demonstrated the results similar to those reported by Mertz-Fairhurst *et al* [23, 24].

In the present study, the one year evaluation of the fissure sealant retention showed 46% fully retained and 43% partially lost and 11% total lost,

Ulusa *et al* have studied about success rate of fissure sealant placed by dental student and have reported 38.5% fully retained and 44.5 partially lost and 13.5 total lost, which is similar to our report [4].

Louise Brearley Messer have reported 70 fully retained and 27 partially lost and 5% total lost in one year follow up although the operators were dentist [22].

In the present study, FS application was performed by inexperienced undergraduate dental student. Although two experienced pediatric dentists in the clinic supervised all of the procedures, dental students might not have been able to effectively apply FS [4].

Clinical evidence suggests that sealant loss (retention failure) occurs in two phases: firstly, an initial loss due to faulty technique (such as moisture contamination), followed by a second loss associated with material wear under the forces of occlusion [20]. Therefore, it seems reasonable to assume that tooth selection or technique failure at the time of sealant placement were responsible for the majority of partially retained or missing sealants within one year of placement. This was most likely due to inadequate moisture control. Presumably sealants which were placed in less than ideal conditions would fail within one year of placement, while those which were placed in ideal conditions (i.e., good moisture control and placement technique) would remain intact up to two years [22].

In the present study, the success rate of fissure sealant was evaluated according to upper or lower jaw, right or left side and age. However, the FR rate did not have significant relation with age but the PL and TL rate were significant according to age.

The dental literature confirms resin-based FS have presented lower retention rates in younger children [4, 8, 14, 25, 26].

These results have indicated that the age factor didn't have any influence on the success rate of fissure sealant therapy applied by students who were professional in fissure sealant therapy but for students that were amateur the age of children was effective on fissure sealant success rate. So that, in the younger children (7 to 8 yrs) the PL and TL rate were significantly higher than the others.

In this study, the success rate of fissure sealant was assessed according to location of molars in left or right side. The PL rate in right molars was significantly higher than left one and the differences of FR and TL rates between two sides of jaw were not statistically significant.

The evaluation of the success rate of fissure sealant according to location of teeth in upper or lower jaw have indicated that location of teeth in upper jaw have been reckoned as an effective factor in the success rate of fissure sealant. So that, all the FR, PL and TL rates in upper jaw were significantly better than these rates in lower jaw. The retention of fissure sealant in maxillary first molar was higher than mandibular that this difference between fissure sealant retention in maxillary first molar and mandibular first molar was statistically significant (FR:  $P=0.05$ , PL:  $P<0.001$ , TL:  $P<0.001$ ). And the other indexes had not significant differences in upper and lower jaw. However, Robert A et al. in 1980 had the same results that have evaluated the fissure sealant therapy of dental student [16]. The better retention of maxillary teeth compared to mandibular is confirmed by Burr *et al* [9] and Whitehurst and Soni [27, 28]. We believe that better retention rate for upper jaw maybe due to easier isolation because the control of saliva has a main role for dental students who have done his/her first trial. Ugurerdemir *et al* and YILDIZ (A comparative study of two fissure sealants) have concluded different results.

They have described that fissure sealant materials showed better retention and caries-prevention effects on the lower molars than upper molars [6, 19]. Of course their target group was 16 to 22 years old patients. This maybe the reason of our different results. They believe that incorrect positioning of the curing light tip affects the results. McCune et al. and Anson found have showed no differences [16, 29].

The rates of caries and need to repair were not significant according to upper or lower jaw, right or left side and age. Although, the rates of need to repair in lower jaw, left side and younger group was higher than the other rates.

The discoloration rate in the younger group was significantly higher than older group. Although Gale *et al* have reported no relationship between the patient's age and sealant performance of student [23]. Regarding retreatment, sealants placed in first permanent molars in 6, 7 and 8 years old children required more retreatment than those in older children [30, 31]. The most caries susceptible period of the first molar tooth is during 1- 1.5 year-long eruption phase [32]. In this period, the enamel is not fully matured, and it is usually difficult for a child to clean the erupting tooth surfaces [4, 11].

## CONCLUSION

According to the results, retention of fissure sealant was more successful in upper jaw and older children. This indicated oral hygiene observation was done with low quality in younger children and according to the higher rate of PL and TL indexes in younger children, it will be concluded that lack of accurate and correct fissure sealant therapy can cause harmful results for patients. So we recommend that students in their first trials of fissure sealant therapy work on older children and upper jaw. In addition, It seems periodic recall will be effective to explore the probable discolorations and caries which may be occur in some cases.

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