

Twelve-Month Clinical Evaluation of Retention of Resin-Based Sealant on First Permanent Molars

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Abstract

Introduction: The majority of researchers agree that sealants need to be monitored and kept in good condition because even a small amount of sealant loss raises the possibility of developing caries lesions. The first year after application is when sealant loss is reported to be at its highest. This motivated us to monitor silanized patients who received resin-based sealant for a full year.

Aim: The aim of this study was to monitor the retention of resin-based sealant on fully erupted first permanent molars in children aged 7-8 years.

Materials and methods: Prior to sealant application, all first permanent molars included in the study were subjected to visual diagnostics using the ICDAS II system and diagnostics with VistaCamiX Macro using the same system. Silanization was performed according to the indications. The follow-up checks were performed at 3, 6, and 12 months in accordance with the accepted methodology.

Results: At the end of the first year, completely lost sealant was reported in approximately 8%-9% of the monitored surfaces using various diagnostic methods.

Conclusions: Resin-based sealants are suitable for application on occlusal surfaces of teeth when it is possible to properly isolate the field of work. They provide both an excellent prophylactic effect of caries and very good retention.

Keywords

occlusal surface, resin-based sealant, retention, silanization

INTRODUCTION

The high prevalence of occlusal caries lesions in newly erupted teeth and its rapid development are due to the incomplete mineralization of the enamel in this area, as well as the anatomically determined retentive shape of the pits and fissures. These prerequisites require specific preventive measures to be undertaken.^[1,2] Buonocore was the first to successfully apply sealant to deep fissures in 1955.^[1,3] Since then, many studies have been conducted and different types of sealants have been developed.^[4-10]

A fissure sealant is a material that is placed in the pits and fissures of teeth in order to prevent or arrest the development of dental caries lesions.^[2]

The predominant types of sealant materials in the market at present are resin-based sealants and glass-ionomer cements used for silanization.^[11,12]

Indications for sealant application

According to EAPD's recommendations for the use of pit and fissure sealants, a caries risk assessment is critical in

determining who should receive the sealants.^[2] The selection of patients and teeth should be based on the following: in children with acute caries activity, all predisposed pits and fissures should be sealed, including the buccal fissures of permanent molars; in children with medical, physical, or intellectual impairments, all susceptible sites of primary and permanent teeth should be considered for silanization; in children with deep, retentive fissures, all potentially susceptible surfaces to dental caries should be considered for sealing.^[2,13]

Contraindications for sealant application

Sealants are contraindicated if there are extensive carious lesions on the occlusal surface^[1,14], or there is an obturated occlusal surface^[15], or there are approximal carious lesions whose restoration involves the whole fissure.^[16-18]

Sealants should be monitored and maintained since the risk of developing caries lesions in even a partial loss of sealant is as great as in unsilanized surfaces, according to most researchers.^[19-22] The highest loss of sealant occurs in the first year after application.^[4] This motivated us to follow up the silanized patients with resin-based sealant for 12 months.

AIM

To monitor the retention of resin-based sealant on fully erupted first permanent molars in children aged 7-8 years.

MATERIALS AND METHODS

The ethical approval required for our study was obtained from the Clinical Research Ethics Committee of the Medical University of Plovdiv (No. 3/20.05.2021).

Our material of choice was a resin-based sealant (Fissurit F, VOCO) since it was capable of achieving proper isolation. To evaluate the retention of sealants, we used three different diagnostic methods: visual diagnostics using the ICDAS II system (**Table 1**) and diagnostics with VistaCamiX Macro (**Table 1**), and modified Ryge criteria for visual diagnostics.

The modified Ryge criteria we used were based on the modified United States public health service (USPHS), where "Gross Fracture" was replaced by "Retention" to assess the retention of the sealant (**Table 2**).^[23]

These methods were used for assessment of the occlusal surfaces during the follow-up period, since each of them gives us different type of detailed information about the retention of the sealant.

The object of our observation were 53 children aged 7-8 years with permanent molars in occlusion, with a high risk of dental caries development (**Table 3**).

Inclusion criteria

1. Age of patients: 7-8 years.
2. Children with evidence of high risk of oral disease.
3. Age of the tooth up to 2 years after the eruption.
4. Presence of at least one healthy first permanent molar, without sealant or obturation.

Table 1. ICDAS II criteria used to assess the retentiveness of the sealant and caries development

Obturation / sealant	Caries	Missing teeth	Noncarious lesions
0 - Surface not restored or sealed	0 - Sound surface	97 - Tooth missing due to caries	Fr - Fracture
1 - Sealant, partial	1 - First visual change in enamel	98 - Tooth missing for reasons other than caries	D - Dysplasia
2 - Sealant, full	2 - Distinct visual change in enamel	99 - Unerupted	F - Fluorosis
3 - Aesthetic restoration	3 - Localized enamel breakdown	P - Implant	
4 - Amalgam restoration	4 - Underlying dark shadow from dentine		
5 - Stainless steel crown	5 - Distinct cavity with visible dentine		
6 - Porcelain or gold or PFM crown or veneer	6 - Extensive distinct cavity with visible dentin		
7 - Lost or broken restoration			
8 - Temporary restoration			

Table 2. Modified Ryge criteria used for assessment of sealant retention

Modified United States Public Health Service (USPHS)

Retention	
Alpha	Intact and fully retained
Bravo	Partially retained with some portion of the restoration still intact
Charlie	Completely missing

Table 3. Risk assessment of dental caries and oral diseases in children

Risk factors	Risk indicators		
	High	Average	Low
I. Part: Anamnesis			
Medically compromised patient	Yes	-	No
Conditions, associated with decreased salivary flow	Yes	-	No
Dental examinations	No	Irregular	Regular
Existing carious lesions	Yes	-	No
New carious lesions	<12 months	12-24 months	>24 months
Fixed/removable orthodontic appliance	Yes	-	No
Parents have carious lesions	Yes	-	No
Social status	Low	Average	High
Daily intake of carbohydrate foods and drinks	>3	1-2	Only with main meals
Fluoride intake	No	Only from fluoride toothpaste	Fluoride toothpaste, mineral water, fluoride supplements
Frequency of oral hygiene	<1 time a day	1 time a day	1-3 times a day
II. Part: Clinical condition			
Visible plaque	Yes	-	No
Gingivitis	Yes	-	No
Areas with demineralization of the enamel	>1	1	None
III. Part: saliva test			
Unstimulated salivary flow	Slow	-	Norm
Viscosity of the saliva	viscous	With bubbles	Fluid

The presence of even one risk indicator in the “average” or “high” risk categories means the patient belongs to the respective group

5. Values when performing visual diagnostics according to ICDAS II- 00-healthy tooth surface.

6. Values for diagnostics with VistaCam iX Macro – using ICDAS II criteria-00-healthy tooth surface.

7. Presence of deep and retentive pits and fissures.

Exclusion criteria

1. Children with structural abnormalities of hard dental tissues (HDT).

2. Children with caries or restorations on the occlusal surface of the first permanent molars.

3. Non-cooperative children

4. Children with low risk of oral disease and shallow and wide fissures.

We started the study with occlusal surfaces that were sound and healthy, with no previous restorations, assessed by both methods used – visual diagnostics and diagnostics using VistaCam Macro. The children included in the study belonged to the high risk group of dental caries development. The examination was performed on an isolated and dried working field with cotton rolls, previously performed professional oral hygiene with a brush, oxygenated water, and a low-speed handpiece. No cleaning paste was used to avoid the risk of retention of its particles in the retentive

areas of pits and fissures and subsequent deterioration of the retention of the sealant.

Prior to sealant placement, all first permanent molars included in the study were subjected to visual diagnostics using the ICDAS II system and diagnostics with VistaCam iX Macro, and silanization was performed according to the indications. The material that we used was a resin-based sealant (Fissurit F, VOCO) which we applied following the manufacturer's recommendations.

According to the accepted methodology, the follow-up was performed by visual diagnostics using the ICDAS II system (**Table 1**), visual diagnostics using a VistaCam iX Macro magnifying camera with the help of ICDAS II criteria (**Table 1**), and assessment of the sealant according to the modified Ryge criteria (**Table 2**) for the group of 7-8 year olds at 3, 6, and 12 months. Occlusal surfaces with completely lost sealant or those with caries lesions that appeared during the study were excluded and were not monitored further in the present study, but adequate treatment was carried out in order to treat the patient ethically.

Number of observed teeth in the group of 7-8 year-olds.

Start:	152 teeth
3 months:	152 teeth
6 months:	127 teeth
12 months:	88 teeth

After recoding the data obtained from monitoring the occlusal surfaces of the first permanent molars, we recoded it as follows: Intact sealant / Partially retained / Completely lost sealant, and performed a frequency analysis of the data.

The registered primary data from the study was coded and entered into a computer database, after which statistical grouping, recoding, and subsequent analysis were performed. The data processing was performed using a specialized software product IBM SPSS, version 25.0 and MS Excel 2019. The following methods were used to objectify the results of the conducted analyses: descriptive analysis and graphic analysis to visualize the results.

RESULTS

Dental sealants have been used for decades. However, the concern has remained that partial loss of the sealant leads to a higher risk of the development of caries lesions. During

the one-year follow-up period, we managed to collect detailed information about the retention of the resin-based sealant applied on fully erupted first permanent molars with and without the help of magnification.

We started the study with 152 first permanent molars. Prior to sealant placement, all first permanent molars included in the study were subjected to visual diagnostics using the ICDAS II system and diagnostics with VistaCamiX Macro using the same system (Figs 1, 2).

After performing a frequency analysis of the data at the third month, the results of the visual diagnosis and the diagnosis with the modified Ryge criteria were identical. They showed the presence of fully retained sealant in 90.10% of cases and partially retained sealant in 9.90% of silanized surfaces. According to the diagnostics with VistaCamiX Macro magnification, the sealant was intact in 85.5% of the cases and the sealant was partially retained in 14.50% of the silanized surfaces. Completely lost sealant was not observed after the application of any of the diagnostic methods (Fig. 3).



Figure 1. Before silanization of maxillary first permanent molar in occlusion of a 7-year-old child with resin-based sealant (Fissurit F, VOCO).



Figure 2. After silanization of maxillary first permanent molar in occlusion of a 7-year-old child with resin-based sealant (Fissurit F, VOCO).

The data from the control examination at 6 months was as follows: according to the visual diagnostics, intact sealant was present in 64.3% of the monitored occlusal surfaces; partial in 33.3%; and completely lost in 2.3%.

According to the diagnostics with VistaCamiX Macro, in 50.4% of the silanized surfaces the sealant was completely retained, and in 49.6% – partially retained. The results of the modified Ryge criteria were again similar to those of the visual diagnostics: 62% – completely retained sealant; 35.7% partially retained; and 2.3% – completely eliminated sealant (Fig. 4).

In the 12-month diagnosis, the visual method assessed 57.5% of the silanized surfaces with intact sealant, 33.3% with partial sealant, and 9.2% with lost sealant. The results were identical after applying the modified Ryge criteria.

When examined under magnification, the percentage of intact sealant was found to be lower – 36.8%, while in most of the surfaces, there was a partial sealant of 55.2% and lost in 8% (Fig. 5).

DISCUSSION

After conducting in-depth research, we found that the results regarding the characteristics of resin-based sealants were comparable to those we obtained, despite differences in the design of the various studies.^[6,24-26]

The various diagnostic methods we used allowed us to make detailed observations of the sealant's integrity and the condition of the surrounding hard dental tissues, with and without magnification.

In similar studies with a one-year follow-up, the presence of sealant was diagnosed in 90% of the examined surfaces, but violations in its integrity were reported in 50% to 80% of cases.^[24,25]

In a study conducted in Turkey, 5th year students compared the retention of glass ionomer and resin-based sealant. The study was a randomized split-mouth clinical study involving 173 children aged 7 to 15 years and 346 silanized occlusal surfaces. The results were similar to our results:

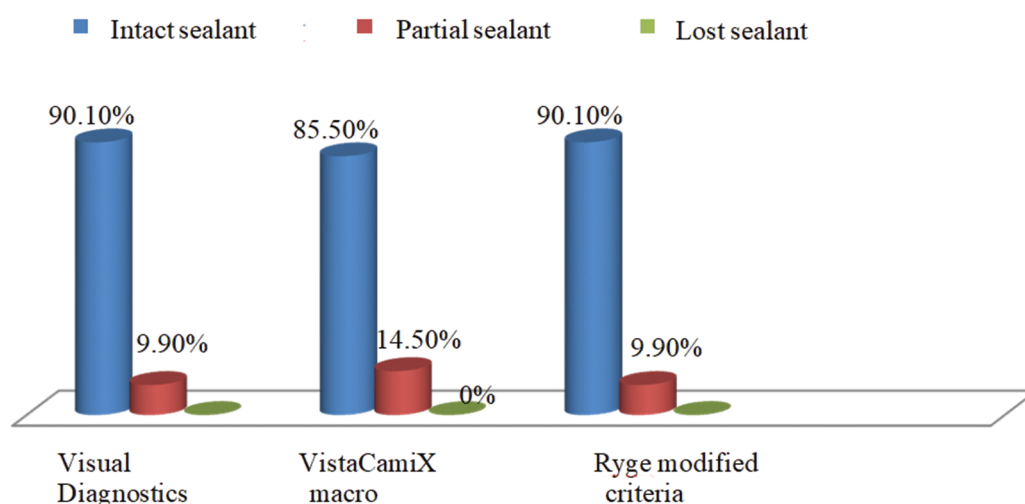


Figure 3. Retention of sealant at 3 months in the group of 7-8-year-olds.

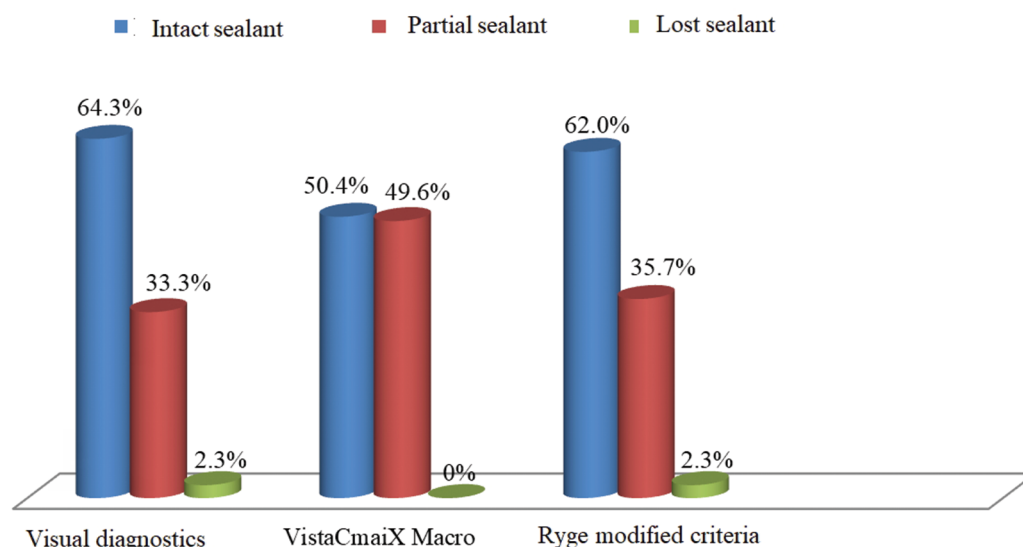


Figure 4. Retention of sealant at 6 months in the group of 7-8-year-olds.

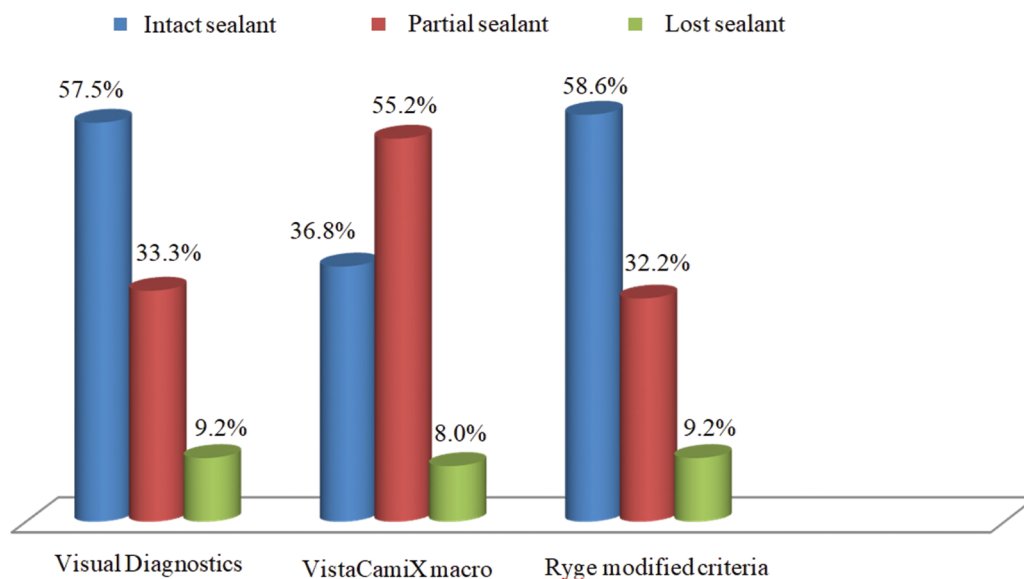


Figure 5. Retention of sealant at 12 months in the group of 7-8-year-olds.

in the monitoring of occlusal dental surfaces silanized with resin-based sealant Fissurit F at 3 months they were as follows: the sealant was fully preserved in 62.7% of the observed surfaces, in 32.2% it was partially preserved, and in 4.9% it was completely lost. The results after the examination of the occlusal dental surfaces silanized with a resin-based sealant Fissurit F at 6 months were as follows: the sealant was fully preserved in 47% of the examined surfaces, it was partially preserved in 40.3%, and in 11.9%, the sealant was completely lost. The results of monitoring occlusal dental surfaces silanized with composite-based sealant Fissurit F at 12 months were as follows: the sealant was fully preserved in 38.5% of the assessed surfaces, in 44.5% it was partially preserved, and in 13.5%, it was completely lost.^[6]

Dentists from India obtained similar results. In a study on the retention of resin-based sealants, researchers in India tracked the retention of sealants with and without filler after applying them to the first permanent molars of children between the ages of 6 and 9 years. The study had a split mouth design, and follow-up was at 2, 4, 6, 8, and 12 months. The authors concluded that there was no statistically significant difference in the retention of composite-based sealants with and without fillers. The reported results were as follows: 2 months after application of the sealants, it was completely retained in 77-83% of the tooth surfaces monitored by visual diagnostics (mirror and probe). At 6 months, the sealant was completely retained in 71%-80%. At the end of the year, the sealant was completely retained in 53.57%-64.29% of the traced with tooth surfaces.^[5]

Results consistent with ours were published in JADA, where dentists compared sealants: resin-based and glass-ionomer based at 3, 6, 12, and 24 months, placed on occlusal surfaces of the first permanent molars of children aged 5-9 years which also included laser diagnostics with Diagnodent. The results that the authors described were as

follows: for the resin-based sealant (Delton), at 3 months the sealant was completely retained in 73% of the tooth surfaces. At 6 months, the sealant was completely retained at 63.5% of the dental surfaces, and at 12 months, the sealant was completely retained at 61.8%.^[26]

The results obtained by us were in accordance with those cited above, as the differences were due to the age range of silanized children in the described study, which differed from the age group in our study.

There were also studies that reported results different from ours. A higher percentage of total retention of sealant on a composite basis was also described by Forss et al. – 82% after a 2-year follow-up.^[27]

Other studies also reported a significantly higher rate of resin-based sealant retention at the end of the first year – 88% complete retention of Fissurit FX sealant and 12% – partial loss.^[28] We attributed the difference to the fact that the materials used for silanization were different, and that the diagnostic techniques we applied were very detailed and could take into account any, even minimal changes in the state of the sealant.

CONCLUSIONS

In conclusion, silanization of occlusal surfaces is an effective method for dental caries prevention in children at high risk of developing dental caries. Accurate diagnosis is crucial for the choice of prophylactic agent. At the end of the first year, we reported completely lost sealant in approximately 8-9% of the monitored surfaces using various diagnostic methods. Resin-based sealants are suitable for silanization of occlusal surfaces of teeth, when adequate isolation of the working field is possible. They provide both an excellent caries-prophylactic effect and very good retention.

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Competing Interests

The authors have declared that no competing interests exist.

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Двенадцатимесячная клиническая оценка ретенции герметика на основе смолы на первых постоянных молярах

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Резюме

Введение: Большинство исследователей согласны с тем, что герметики необходимо контролировать и поддерживать в хорошем состоянии, потому что даже небольшая потеря герметика повышает вероятность развития кариеса. Сообщается, что в первый год после нанесения потеря герметика является самой высокой. Это побудило нас наблюдать за силанизированными пациентами, которые получали герметик на основе смолы в течение всего года.

Цель: Целью данного исследования было отслеживание удерживания герметика на основе смолы на полностью прорезавшихся первых постоянных молярах у детей в возрасте 7-8 лет.

Материалы и методы: Перед нанесением герметика все первые постоянные моляры, включенные в исследование, были подвергнуты визуальной диагностике с использованием системы ICDAS II и диагностике с помощью VistaCamiX Macro с использованием той же системы. Силанизацию проводили по показаниям. Контрольные осмотры проводились через 3, 6 и 12 месяцев в соответствии с принятой методикой.

Результаты: В конце первого года сообщалось о полной потере герметика примерно на 8 % - 9 % проверенных поверхностей с использованием различных методов диагностики.

Заключение: Герметики на основе смол пригодны для нанесения на окклюзионные поверхности зубов, когда есть возможность качественно изолировать рабочее поле. Они обеспечивают как отличный профилактический эффект от кариеса, так и очень хорошую ретенцию

Ключевые слова

окклюзионная поверхность, герметик на основе смолы, ретенция, силанизация
