Original Article

Retention of Fissure Sealants Used with Enamel and Dentin Bonding Agents

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Abstract

Background and Aim: Tooth decay is the most common chronic disease. Fissure sealant therapy is among the suitable treatments to prevent occlusal caries. The ability of fissure sealant to prevent pit and fissure caries is due to the sealant retention.
Considering the fact that several bonding agents are available in the market, clinical studies are required to assess the durability of sealants after using bonding agents.
The purpose of this study was to compare the durability of fissure sealants bonded with dentin and enamel bonding agents after 12 months.
Materials and Methods: A total of 30 healthy 6 to 12 year-old patients presenting with at least one caries-free, fully erupted molar tooth at each side of their mandible were selected. All fissures of 60 molars were sealed using the following two techniques: Group1: acid etchant + Single Bond (3M, ESPE) dentin bonding agent +Eco-S (VERICOM); group 2: acid etchant + Margin Bond (Coltene/Whaledent AG) enamel bonding agent +Echoseal sealant. Cotton roll isolation was used in both groups. Sealants were evaluated 12 months after placement. Data were analyzed using Wilcoxon test.
Results: There was no significant difference between the two examined groups. Clinical success was 60% in group 1(dentin bonding agent) and 56.66% in group 2 (enamel bonding agent).
Conclusion: Although no significant difference was found between the two groups, it seems that bonding agents with hydrophilic groups show more favorable results especially when appropriate isolation is not achieved.

Key Words: Fissure sealant, Retention, Bonding

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Introduction

The occlusal surfaces of permanent first and second molars are among the highly susceptible areas to caries in children. Although the occlusal surfaces comprise 13% of all teeth surfaces in young individuals, 88% of caries occur in occlusal pits and fissures [1]. At 12 years of age, about 50% of permanent first molars are carious [2]. Fissure sealants have been used for more than 40 years to seal occlusal pits and fissures susceptible to caries. The conventional technique of application of fissure sealants includes enamel etching by phosphoric acid followed by the application of fissure sealant [3]. Other methods have also been used for tooth surface preparation before the application of fissure sealant such as using burs, laser irradiation, air abrasion, and application of bonding agents. These methods increase the retention and enhance the clinical success of sealants [4]. Studies aim to suggest techniques to increase the retention of fissure sealants and decrease the technique sensitivity of the procedure. This is particularly important in pediatric dentistry [3].

Attempts have been made to increase the retention of fissure sealants by different methods such as the use of bonding agents for fissure sealant therapy. Results of different studies have been controversial in this regard. Bonding agents have been introduced to enhance the seal at the tooth - restoration interface.

Bonding agents are bi-functional molecules comprising of a methacrylate group forming a chemical bond to fissure sealant resin and a functional group with the ability to penetrate into the dentin or enamel surface [5]. The first clinical study in this respect was done by Boksman et al, who demonstrated that using bonding agent had no significant effect on increasing the retention of fissure sealant [6].

Pinar et al, in 2005 demonstrated that application of bonding agent had no significant effect on the clinical success of fissure sealant [7].

Jaberi et al, in their study in 2008 on the effect of enamel bonding on retention of fissure sealant revealed that under dry, isolated conditions, application of enamel bonding agent did not have a significant effect on retention of fissure sealant [8].

However, some other studies have reported contrary results and discussed that application of bonding agent is beneficial in fissure sealant therapy. Usha et al, in 2009 discussed that application of bonding agent as an intermediate layer between sealant and enamel would increase the retention of fissure sealant when isolation and saliva control are difficult to achieve [9]. Also, use of bonding agents in fissure sealant therapy decreases the risk of microleakage in long-term. Cehreli et al, in 2008 reported that application of bonding agents in fissure sealant therapy caused less microleakage in long-term in comparison with teeth treated without the bonding agent [10].

The most commonly available bonding agents in the market are hydrophilic dentin bonding agents. These bonding agents can tolerate humid environment to some extent; thus, they can be used in cases where complete isolation or dryness cannot be achieved. In specific cases where tooth-colored restorations are limited to the enamel only, hydrophobic enamel bonding agents may also be considered for use.

Since fissure sealant therapy is confined to the enamel, this study aimed to assess and compare the retention of fissure sealant in conjunction with enamel and dentin bonding agents.

Materials and Methods

This clinical trial was conducted on 30 patients aged 6-12 years presenting to the Pediatric Dentistry Department of Shiraz University, School of Dentistry. The subjects had two permanent mandibular first molar teeth that were fully erupted at both sides of the mandible with no occlusal or proximal caries and with deep occlusal fissures (n=60). Fully cooperative children were chosen. The study was approved by the Ethics Committee of Shiraz University of Medical Sciences and registered in the Iranian Registry of Clinical Trials (IRCT2014020816525N1). Written informed consent was obtained from the parents. In each patient, one tooth in one quadrant (right or left) of the mandible was randomly treated with enamel bonding and another tooth in the opposite quadrant of the mandible was treated with dentin bonding agent. The occlusal surfaces of teeth were cleaned with a rotary bristle brush using a low-speed hand piece. The specimens were divided into two groups and fissure sealant was applied as follows. The teeth in both groups were similarly isolated using cotton rolls.

Group 1. After cleaning and preparation of teeth, 37% phosphoric acid (DenFil, Vericom Co., Ltd, Korea) was applied to the tooth surface for 20 seconds, rinsed with water and air spray for 20 seconds and air-dried. Single Bond (3M ESPE) dentin bonding agent was applied to the etched surface by a microbrush, thinned by gentle airflow and cured for 20 seconds. In the next step, Eco-S (Vericom Co, Ltd., Korea) fissure sealant was applied to the surface, 10-second time was allowed and cured for 20 seconds.

Group 2. The procedure was similar to group 1. After cleaning and preparation of tooth surface, 37% phosphoric acid (DenFil, Vericom Co., Ltd,Korea) was applied to the tooth surface for 20 seconds, rinsed with water and air spray for 20 seconds and air-dried. One layer of Margin Bond (Coltene/Whaledent AG Altstätten, Switzerland,) enamel bonding agent was applied by a microbrush to the etched surface, gently thinned by air spray and cured for 20 seconds. Eco-S (Vericom Co., Ltd., Korea) fissure sealant material was applied to

the surface, 10- second time was allowed and cured for 20 seconds. The patients were recalled 12 months later. Two independent dental assistants trained for clinical examination of the retention of fissure sealants, who were not aware of the type of treatment examined the teeth for retention of fissure sealants. Only cases with intact material in the grooves were considered as "success". Data were entered in SPSS version 18 and analyzed using Wilcoxon test.

Results

All 30 patients were accessible after 12 months. Patients were in the age range of 6-12 years (16 females and 14 males). Patients in groups 1 and 2 received dentin and enamel bonding agents before the fissure sealant, respectively. The results of examination after 12 months are shown in Table 1. No significant difference was noted between the two groups at 12 months ($p=0.392$, $p>0.05$). The success rate of dentin bonding agent was only 3% higher than that of enamel bonding agent.

Table 1. The frequency distribution and standard deviation of retention of fissure sealant in the two groups at 12 months

Clinical assessment of groups	12 months	
	Group 1 Dentin bonding agent (n=30)	Group 2 Enamel bonding agent (n=30)
Fissure sealant completely remained	%60(18)	%56/66(17)
Fissure sealant partially remained	%26/66(8)	%20(6)
Fissure sealant completely lost	%13/33(4)	%23/33(7)

Discussion

Despite the high dentist-population ratio, tooth decay is still a public health dilemma in many countries. Dentists have the responsibility to treat and prevent tooth caries. Considering the priority of preventive over restorative measures and relatively high success rate of fissure sealant therapy for prevention of occlusal caries, this treatment gained popularity following its introduction in 1970 [11].

Although the occlusal surfaces comprise 13% of all teeth surfaces, about 88% of caries in children and young adults occur in occlusal pits and fissures [1].

The potential of fissure sealant to prevent occlusal caries depends on its retention [12]. Increased penetration depth of sealant into the occlusal pits and fissures enhances its retention. Due to low viscosity and greater penetration depth of filler-free bonding agents into fissures, use of bonding agents can increase the retention of sealants [13]. Using a hydrophilic dentin bonding agent as an intermediate layer between the etched enamel and sealant was first reported in 1992 and it was demonstrated that this layer increased the retention of sealant and decreased microleakage in case of saliva contamination of enamel [14].

Some previous studies have rejected the role of bonding agents in increasing the clinical success of fissure sealants. Pinar et al, in 2005 evaluated the clinical efficacy of fissure sealants with and without bonding agents and reported that bonding agents did not affect the clinical success of fissure sealants [5].

Makarem et al, in their study on the effect of self-etch and total-etch bonding agents on the retention of fissure sealants demonstrated that no significant difference existed in retention of fissure sealant between the two groups [2].

Soleimani et al, in their study on the efficacy of bonding agents in case of salivary contamination demonstrated that the microleakage was significantly lower in fissure sealant plus bonding agent group [5].

In another study, Jaberi et al. evaluated the effect of enamel bonding on retention of fissure sealant in 2008 and reported that under isolated conditions, application of enamel bonding had no significant effect on retention of fissure sealant [8].

Locker et al. explained that using bonding agents in fissure sealant therapy did not increase retention [12]. Usha et al, in their review article stated that using bonding agent had no effect on the success of fissure sealant unless in cases with difficult saliva control and risk of saliva contamination [9].

In fissure sealant therapy, complete isolation may not be perfectly possible especially in young uncooperative children. Thus, application of a layer of bonding agent below the fissure sealant

may be helpful. It must be noted that isolation was complete in all previous studies that rejected the positive effect of bonding agent on retention of fissure sealant.

Bonding agents available in the market are divided into two groups of enamel (hydrophobic) and dentin (hydrophilic) bonding agents. Since fissure sealant therapy is performed on the enamel, this study aimed to assess the clinical success of enamel and dentin bonding agents. The results showed no significant difference in retention of fissure sealant between the two groups of enamel and dentin bonding agents. However, the success rate of dentin bonding agent was 3% higher than that of enamel bonding agent.

Jaberi et al. indicated that application of enamel bonding to maxillary molars slightly increased the retention of fissure sealant compared to mandibular molars; this may be due to inadequate saliva control in the mandible and better isolation in the maxilla; however, the difference between the two was not statistically significant [8]. Since enamel bonding agents are hydrophobic, it would be better to use a hydrophilic bonding agent when complete isolation cannot be achieved.

Slightly higher success rate of dentin bonding compared to enamel bonding agent may be due to inadequate isolation for fissure sealant therapy; since cotton roll was used for isolation of all teeth in the current study. Some factors may be responsible for controversial results of studies such as:

1. Patient-related factors
2. Tooth-related factors
3. Therapeutic factors [15]

Patient related factors include age, sex, and patient cooperation at the time of fissure sealant therapy. Folke in 2004 found no association between gender and success of fissure sealant therapy [16]. The higher the age and the better the cooperation of patient, the higher the success rate of treatment [15].

In terms of tooth-related factors, the success of fissure sealant therapy decreases when the tooth does not have deep, retentive fissures [15].

Therapeutic factors include technique of procedure, type of material used, and use of bonding agent; the majority of previous studies have focused on these factors.

Since fissure sealant therapy is performed on the enamel, we expected the results of enamel bonding agent to be more favorable. But, no significant difference was found between the two groups. Since saliva control and optimal isolation are difficult to achieve, and also the fact that deep fissures may not be completely dried and some moisture may still remain, it is recommended to use a hydrophilic bonding agents if a bonding agent is to be used. Considering the limited number of studies in this regard, future clinical trials are required to compare enamel (hydrophobic) and dentin (hydrophilic) bonding agents for fissure sealant therapy

Conclusion

No statistically significant difference exists between the efficacy of enamel and dentin bonding agents for retention of fissure sealants.

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