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Original Article

Pit and Fissure Sealants with Different Materials: Resin Based x Glass Ionomer Cement – Results after Six Months

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Abstract

Objective: To compare the retention and superficial characteristics between a new resin-modified glass ionomer sealant and resin sealant. In addition, the teeth sealed were compared to partially erupted first molars (control group) without sealing in relation to the incidence of dental caries. **Material and Methods:** Initially, 31 children aged 6-8 years participated in this study. The study children showed caries history, but had at least two healthy first molars. A total of 114 teeth were randomly divided into three groups: Clinpro (n=36), Fluroshield (n=38), and control (n=40). The two sealants were applied under relative isolation after previous prophylaxis and enamel etching with phosphoric acid 35% (15s). Clinical evaluation was performed by two calibrated examiners. They evaluated the retention and surface characteristics of the occlusal surface. **Results:** Fluroshield® showed significantly greater retention than ClinproTM Varnish® XT (p=0.002). However, the performance analysis of the success and failure of retention presented no significant difference between the materials (p=0.141). Concerning to the surface characteristics, Fluroshield performed better than Clinpro after analyzing the marginal deterioration, marginal discoloration, and superficial discoloration ($p<0.05$). The surface texture of the materials under study was similar (p=0.071). Sealed groups (Clinpro=Fluroshield) showed similar performance in the prevention of dental caries, which was significantly lower than that of control group (p=0.001). **Conclusion:** Both sealants, Fluroshield® and Clinpro TM Varnish® XT were effective in preventing caries lesion within 6 months, although Fluroshield sealant showed better clinical retention.

Keywords: Pediatric Dentistry; Disease Prevention; Pit and Fissure Sealants.

Introduction

The occlusal surface of posterior teeth is the most susceptible to plaque accumulation and bacterial proliferation because of the specific anatomical morphology [1]. The susceptibility worsens during tooth eruption due to the lack of mechanical cleaning promoted during mastication by oclusal contact and difficult in toothbrushing resulting in more vulnerability to cariogenic challenges [2].

Pit and fissure sealing is one of the most used measures to prevent occlusal caries, since it is a safe, viable, and effective method [3-5]. However, to achieve the best effectiveness as preventive measure, the sealants should be applied at proper time, and some clinical aspects must be known and fulfilled: correct and accurate diagnosis of caries lesion; assessment of the caries risk of the patient; domain of the application technique; oral hygiene education; and control through periodical follow-up appointments [3].

The most used and studied pit and fissure sealant material is that based on Bis-GMA [6]. With the development and improvement of glass ionomer cements (GIC), many authors have proposed its use as pit and fissure sealant aiming at obtaining further preventive effects because GICs are caries inhibitors due to the fluoride inside the composition. Such property is interesting for permanent first molars, especially during the period of eruption [4,7-10].

Many studies comparing resin-based and GIC-based sealants focused on the quality of retention to tooth surface. Thus, better retention results are expected in Bis-GMA based than in GIC-based materials, either conventional or resin-modified GIC used as sealant [11-16]. Although a macroscopic loss of GIC sealant occurs, small portions of the material stays on the fissure bottom releasing fluoride, which perhaps assures protection and prevents caries development even in cases that the sealant seems to disappear clinically [17].

Despite the fact of many studies suggest that the caries preventive effect on pit and fissure of both resin-based and GIC-based sealants is similar [5,14,18-20], more studies are necessary to answer conclusively the equivalency of or difference between these materials [3,21,22]. Other important aspect to be considered is the diversity of materials available to the dentists. However, the equivalence of their clinical behavior is unknown.

Currently, a GIC varnish (ClinproTM XT Varnish, 3M ESPE, Dental Products, St. Paul, MN, U.S.A.) was launched to be used as sealant for partially erupted molars, accordingly to the manufacturer, because of the difficult in performing rubber dam isolation, and consequently possible contamination. The manufacturer claims that the material releases fluoride, calcium, and phosphate to the tooth structure, can be used under humidity, and does not require rubber dam isolation. These conditions are very common during the treatment of the children with partially erupted molars.

Given this information, this longitudinal clinical study aimed to compare the retention and superficial characteristics between a new resin-modified glass ionomer sealant and resin sealant. In addition, the teeth sealed were compared to partially erupted first molars (control group) without sealing in relation to the incidence of dental caries.

Material and Methods

This study was submitted and approved by the Institutional Review Board regarding to the ethical aspects (School of Dentistry of Bauru, University of São Paulo, process no. #144/2011). The initial clinical procedures and sealing procedures were performed after the guardians/parents of the children read and signed a Free and Clarified Consent Form.

Healthy children aged between 6 and 8 years, of both genders, low socioeconomic level, were selected in public schools from the outlying neighborhoods of the city of Bauru, SP. Inclusion criteria comprised the presence of at least two permanent primary molars and indication for sealant, on different sides of the mouth, without clinically or radiographically detectable cavities.

After dental prophylaxis with the aid of air/water/sodium bicarbonate jet (Profident, Dabi Atlante S.A., Ribeirão Preto, SP, Brasil), the caries index of the child, dmft/DMFT was assessed. Next, the eruption level of each study molar was verified and a bitewing radiograph was taken to help in the diagnosis.

Sample Distribution

Initially, 114 teeth were evaluated and divided into three groups: one control (ctr – without sealant) and two experimental (sealed). Group CLP (n=36) were sealed with resin-modified glass ionomer cement (ClinproTM XT Varnish, 3M ESPE, Dental Products, St. Paul, MN, U.S.A.); Group FS (n=38) were sealed with resin-based material (FluroShield®, Dentsply, Germany); and Group CTR (n=40) had no sealant (Table 1).

Table 1. Study groups.

Group (N)	Trade Name	Activation	Composition	Manufacturer
CLP(36)	Clinpro™ XT Varnish	light	**Paste A**= Silanized glass powder, silicon-treated silica, 2-hydroxethylmethacrylate, waters, bisphenol A. diglycidyl ether dimethacrylate (BIS-GMA). **Liquid B**= Copolymer of acrylic and itaconic acid, water, 2-hydroxethylmethacrylate.	3M ESPE, Dental Products, St. Paul, MN, U.S.A.
FS (38)	Fluroshield®	light	Bis-GMA modified urethane, triethylene glycol dimethacrylate, Aluminium and Barium Borosilicate, tetra acrylic esther, phosphoric acid, sodium fluoride, N-Methyl Diethanolamine, and camphorquinone.	Dentsply, Germany.
CTR (40)	-	-	-	-

The teeth in Groups CLP and FS were in the same mouth, following a split-mouth design. This study followed a longitudinal design in which the children and the teeth were randomly selected (Microsoft Excel 2003) for the three groups (CLP, FS, and CRT). Thus, through simple randomization, the child was randomized for either group CRT or "sealed". Next, the children selected for sealants underwent a new simple randomization to determine which material would be applied (CLP or FS).

Clinical Sequence of Sealant Application

The sealing procedure of the teeth was performed by a single operator (Professor of Pediatric Dentistry). Thus, after dental prophylaxis, relative isolation with the aid of cotton rolls was executed. Next, the teeth were etched with 35% phosphoric acid for 15 sec, followed by washing and drying, material application with an explorer on all pit and fissures, and light-curing for 20 seconds.

Clinical Evaluation

The clinical evaluations were executed immediately and 6 months after the sealing procedures (examiner 1: Professor of Pediatric Dentistry; examiner 2: PhD student in Pediatric Dentistry), with an interexaminer agreement index between 85% and 95%, and Kappa value > 0.80.

Ryge and Snyder's criteria [23] were adopted to evaluate both the retention and superficial characteristics of the sealants (Table 2). Success of retention performance was those occlusal surfaces with criteria A + B, i.e., not requiring sealant repair. Failure of retention performance was those occlusal scored as C + D, that is, requiring sealant repair. Caries lesion incidence was evaluated by absence or presence of lesion (Table 3).

Table 2. Criteria for clinical evaluation of pit and fissure sealant [23].

Marginal Deterioration	**Alfa**	Existent contour continuity
	Bravo	Existent contour discontinuity lesser than 50%
	Charlie	Existent contour discontinuity greater than 50%
Marginal Discoloration	**Alfa**	Lack of discoloration
	Bravo	Margin discoloration
	Charlie	Discoloration under the sealant
Superficial Texture	**Alfa**	Smoothness similar to that of enamel
	Bravo	Light roughness
	Charlie	Rough surface
	Delta	Very rough and marked surface
Superficial Discoloration	**Alfa**	Lack of discoloration
	Bravo	Light discoloration
	Charlie	Evident discoloration
	Delta	Rough discoloration
Classic technique retention	**Alfa**	Total retention
	Bravo	Partial retention with partial exposure of one fissure without risk of caries
	Charlie	Partial retention with exposure of one or more fissures with risk of caries
	Delta	Complete sealant loss

Table 3. Caries assessment criteria according to lesion absence or presence.

Absence	Sound surface (the tooth is considered as sound if it shows no evidence of treated or untreated caries; light stains are allowed).
Presence	From initial caries lesion (no clinically detectable structure loss – enamel caries; white spot lesion.) to dentin caries (caries lesion extending to dentin).

Statistical Analysis

The sealed groups (CLP and FS) were compared through Mann-Whitney test for retention and superficial characteristics. The success/failure on all occlusal surface and presence of caries lesion at 6 months were analyzed by Chi-square test. The level of significance adopted was of 5%.

Results

The children were evaluated after 6 months. Twenty-eight teeth of Group CRT (32 teeth lost) and 68 teeth of Group "sealed" (n=33 – Clinpro / n=35 – Fluroshield) were reassessed. The results of clinical assessment regarding to retention, superficial characteristics, and caries lesion presence are described in table 4. For retention, Group FS (Fluroshield) exhibited better results than Group CLP (Clinpro) (p=0.002). However, for the retention performance (success and failure) the materials were statistically similar (p=0.141). For superficial characteristics, Fluroshield (FS) demonstrated better performance than Clinpro (CLP) in relation to marginal deterioration (p=0.000), marginal discoloration (p=0.008), and superficial discoloration (p=0.001). The superficial texture of both materials were statistically similar (p=0.071).

Concerning to caries incidence, the three groups showed different behaviors in relation to the presence or absence of caries (p=0.001): Group CRT (control), without sealant, showed greater caries presence than the group "sealed" with either Fluroshield (FS) or Clinpro (CLP).

Table 4. Performance regarding to retention and superficial characteristics at 6 months, according to the modified criteria of Ryge and Snyder. Presence of caries per tooth at 6 months.

Groups		CLP	FS	ctr	p
Assessment		n (%)	n (%)	n (%)	
Retention	A	17 (51.5)	31 (88.6)	-	0.002
	B	9 (27.3)	1 (2.9)	-	
	C	7 (21.2)	3 (8.6)	-	
	D	0 (0)	0 (0)	-	
Marginal	A	4 (12.1)	20 (57.1)	-	0.000
deterioration	B	28 (84.8)	15 (42.9)	-	
	C	1 (3)	0 (0)	-	
Marginal	A	20 (60.6)	31 (88.6)	-	0.008
Discoloration	B	12 (36.4)	4 (11.4)	-	
	C	1 (3)	0 (0)	-	
Superficial	A	6 (18,2)	19 (54,3)	-	0.071
Texture	B	16 (48,5)	4 (11,4)	-	
	C	1 (3)	2 (5,7)	-	
	D	10 (30,3)	10 (28,6)	-	
Superficial	A	14 (42,4)	28 (80)	-	0.001
Discoloration	B	15 (45,5)	7 (20)	-	
	C	4 (12,1)	0 (0)	-	
	D	0 (0)	0 (0)	-	
Caries	Presence	1 (3)	1 (2,8)	10 (35,8)	0.001
	Absence	32 (97)	34 (97,2)	18 (64,2)	

CLP= Clinpro, FS= Fluroshield, ctr= control.

Discussion

Studies suggest that the onset and progression of occlusal caries relates to the macromorphology of the occlusal surface [2]. Thus, the incidence of occlusal caries lesion in children and teenagers are still very high [5], justifying the use of pit and fissure sealants as preventive measure [3,5,24, 25].

Given that pit and fissure sealants aims at forming a mechanical barrier against the accumulation and maturation of the biofilm [3], the evaluation of the sealant retention on occlusal surface is an important parameter to be assessed. In this present study, total retention of Group FS sealants occurred in 88.6% of the occlusal surfaces, which was significantly greater than that of Group CLP sealants (51.5%) (Table 4). This higher retention of resin-based sealants than that of GIC-based sealants is in agreement with the literature [11-16].

On the other hand, when the performance of success (criteria A+B) and failure (criteria B+C) of retention was evaluated according to the need of repair, no different between the performances of the materials were found. Therefore, after 6 months from application, both materials exhibited satisfactory clinical behavior. One of the factors that might contribute for the good clinical behavior of GIC sealant is the formulation, that is, the presence of resin components that improve the material viscosity [26] and the mechanical and physical properties, thus increasing the retention rate of the material [27]. Moreover, according to the Clinpro's manufacturer, the material retention should last 6 months, because this is the mean period between dental appointments. Notwithstanding, the analysis of behavior of this material should be assessed for a longer period to know the mean retention period and verify whether a new application is required.

At the evaluated period, Group FS showed the best superficial characteristics, except for superficial texture (Table 4). Marginal deterioration is related to the contour continuity of the material in relation to the tooth. As time goes by, the reduction of the material continuity is expected because intraoral occlusal forces lead to the natural weariness of the material. At 6 months, we observed the reduction of continuity for both materials, but in Group CLP, a little more than 10% of the sealed teeth showed an intact original contour (Table 4). By comparing the results at 6 months obtained by other author, the resin sealants can maintain the original contour continuity more effectively than GIC sealants [14], which is agreement with the results of this present study.

Concerning to Marginal Discoloration, Group FS showed the lack of discoloration in almost 90% of the sealants versus a little more than 60% for Group CLP (Table 4). Results similar to those of this present study were found by other author [18]. The marginal adaptation of resin-based sealant is better than that of GIC-based sealant because the mean width of the marginal gap is smaller [28]. Thus, the capacity of marginal adaptation would be one of the main factors determining the efficacy and longevity of the sealing material.

Superficial texture was the only superficial characteristic which statistically significant difference was not found between groups (Table 4). Notwithstanding, some studies in the literature report the superiority of resin-based versus GIC-based sealants for this characteristic [14,15]. It is

worth emphasizing that the deterioration of superficial texture can provide a niche for biofilm accumulation and food remnants, which could beginning a secondary caries lesion on the margins of the sealant [15].

Eighty percent of the teeth from Group FS showed the sealant with the original color while more than 45% of the teeth from Group CLP exhibited light discoloration (Table 4), results different from other author [18].

The preventive effect of resin-based sealant, due to the retention capacity, is well known in the literature [4]. However, in this present study, although the CIG-based sealant demonstrated smaller retention, the caries incidence was similar to that of resin-based sealant and both groups exhibited significantly lower caries lesion incidence than that of control group, without sealants. This result strengthens the view that even with the superficial loss of GIC, some amount might stay on the bottom of the fissure, although not macroscopically verified, promoting a residual effect of protection against the development of caries lesion in this area [17]. The rationale behind this fact is that the up taking and releasing of fluoride by GIC inside the mouth could enhance dental enamel remineralization [29]. This property would be especially beneficial for patients at high risk for caries.

The results found in the literature also point out no difference in the caries preventive effect between resin-based and GIC-based sealants. Therefore, both materials seem to be equally adequate for clinical application as pit and fissure sealants [14,18-20]. However, further studies are necessary to answer conclusively the equivalency of or difference between these materials in the prevention of caries on pit and fissures [3,21,22]. Accordingly, the sealing of occlusal surface is one of the options for caries control, mainly in young permanent molars [3] because sealant application reduces caries when compared to teeth not sealed, after 48-month following-up [5].

The following-up period (6 months) is one the limitations of this present study because more effective results about the material's quality and caries prevention require longer follow-up periods. Other important factor is the cost of the GIC-based sealant, which may make impracticable its use in public health.

Conclusion

Both resin-based and GIC-based sealants were effective in preventing the development of caries lesion, although Fluoroshield showed better clinical retention. However, longer follow-up periods are necessary.

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