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ORIGINAL ARTICLE

Comparison of the caries-preventive effect of a glass ionomer sealant and fluoride varnish on newly erupted first permanent molars of children with and without dental caries experience

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Abstract

Purpose: This longitudinal clinic study evaluated the effect of a glass ionomer sealant (GIS) and a fluoride varnish (FV) in the prevention of dental decay on newly erupted permanent molars of children with and without caries experience. ***Materials and methods:*** Eighty children, aged 6–8 years, with all four newly erupted first permanent molars, were divided into two groups. Group 1 consisted of 53 children without caries experience and group 2 consisted of 27 children with dental caries experience. Permanent molars of the right side were sealed with GIS and the fluoride varnish was applied on the other two permanent first molars. Evaluation of GIS retention and the effectiveness of both materials in the prevention of dental caries were performed after 6, 12 and 18 months. ***Results:*** After 18 months, of the 299 teeth, 271 (91%) showed no caries lesions and 28 presented caries lesions (9%). Teeth sealed with GIS had more carious lesions (15) than teeth with fluoride varnish (13). Most of the teeth (70%) that presented carious lesions were in group 2. Of the 138 sealed teeth, only one showed GIS to be totally present, 95 were partially present and 42 teeth were absent. ***Conclusion:*** The caries-preventive effect was very similar between both treatments. The presence of dental caries prevailed in the children with caries experience.

Key Words: *Caries experience, fluorides topical, pit and fissure sealants, permanent teeth*

Introduction

Dental caries continues to be a major problem in dentistry and should receive greater attention in daily practice, not only from the viewpoint of restorative treatment, but also in terms of educational and preventive measures designed to reduce the problem [1] In addition to the detection of carious lesions in early stages (non-cavitated or incipient lesions), modern concepts of caries management emphasize the diagnosis of the disease process, not only in terms of the disease signs and identification of all risk factors, including behavioural factors, but also classical etiological factors, such as oral hygiene, diet and the presence of micro-organisms [2,3].

Literature data suggest that past caries experience is a strong predictor of the occurrence of new lesions [4,5]. According to Zero et al. [5], determination of caries activity in a patient is important to establish the future risk of dental caries. In addition, some situations, such as tooth position and eruption phase, increase the risk of caries development, especially in the permanent first molars, as they are associated with a higher risk of caries development due to the large number of sites (fissures) susceptible to the accumulation of bacterial plaque and colonization of cariogenic micro-organisms [6].

Pit and fissure sealants have been developed for the prevention of caries at these anatomical sites. Resin-based sealants are the most widely used sealants in clinical practice and their medium- and long-term efficacies have been demonstrated in numerous studies [6–9]. Glass ionomer cement, a material whose biological properties allow it to be used as a pit and fissure sealant, was subsequently introduced with promising results [10]. Glass ionomer can be used as an alternative to resin sealants, especially when their use is contraindicated (i.e. when isolation is difficult or permanent molars have not completely emerged). Comparative clinical studies have shown a

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long-term superiority of resin-based sealants in terms of their retention and effectiveness in caries prevention [11,12].

Another method widely used for the prevention of occlusal caries is the application of fluoride varnish, a method introduced in the 1960s [8,13–15]. However, the effectiveness of this method at these sites remains controversial to date, with some studies reporting good results [16,17] while others suggest the need for complementary investigations to indicate this method [14,18]. Recent reviews conclude that the data are insufficient to determine whether fluoride varnishes are more effective in preventing dental caries [7,8].

Because both sealants and fluoride varnishes are widely used for caries prevention in dental programs and private clinics, continuous investigation of these materials to support their use is justified. Studies comparing glass ionomer sealants and fluoride varnishes are scarce in the literature [19]. Therefore, the objective of the present study was to compare the caries-preventive effect of a glass ionomer cement sealant and fluoride varnish in children with and without dental caries experience.

Materials and methods

This randomized, longitudinal clinical trial was carried out in the Department of Pediatric Dentistry, from December 2007 to December 2009. Before the start of the study, approval was obtained from the ethics committee of the participating institution; moreover, only children whose parents gave written, informed consent were enrolled.

Eighty healthy children (aged 6–8 years) of both genders, whose permanent first molars (maxillary and mandibular) were caries-free and newly erupted (occlusal surface completely visible and free of mucosal tissues) participated in the study. Caries experience was determined by clinical verification of one or more primary or permanent teeth, except for the first permanent molars, showing cavitated carious lesions and/or extensive carious lesions involving one or more dental tissues. The definition of caries experience also included undergoing at least one dental restoration in the oral cavity. To record the children's dental caries experience, oral examinations were performed and bitewing radiographs were obtained at baseline or when the teeth were restored. The children were divided into two groups: group 1 included 53 children (with a total of 212 sound permanent first molars) without any past caries experience; group 2 included 27 children (with a total of 108 sound permanent first molars) with a previous caries experience involving any dental surface, except the permanent first molars.

A pink glass ionomer sealant (GC Fuji Triage; GC Corporation, Tokyo, Japan) and fluoride varnish (Durafluor; Dentsply, Rio de Janeiro, Brazil) were used. The pit and fissure sealant were applied in a single session for all children. The glass ionomer sealant was applied to the right maxillary and mandibular first molars. The fluoride varnish was applied to the left maxillary and mandibular first molars in three sessions.

Sealant placement

In a single session, the glass ionomer sealant was placed according to the technique described by Lindemeyer [20]. The first permanent molars were first submitted to prophylaxis with pumice, rinsed thoroughly with water and then dried. The material was applied under relative isolation (cotton rolls and portable saliva ejector) and triangular buccal isolation shields were positioned to retract the tongue and cheek. A cavity conditioner was applied (Cavity Conditioner; GC Corporation, Tokyo, Japan) to the occlusal and palatine surfaces of the maxillary molar and to the occlusal and buccal surfaces of the mandibular molar with a microbrush (Microbrush International) for 10 s. The tooth surface was gently dried with an air syringe to give a moist, glistening appearance.

The capsule containing the glass ionomer material was tapped on a hard surface 2- or 3-times to loosen the powder. The capsule was activated and then loaded back into the capsule applier by clicking the lever twice to prime the capsule before immediately extruding the glass ionomer onto the tooth. The material was inserted into all pits with a microbrush. The sealant was light cured for 40 s to hasten setting. To restore a glossy appearance, a drop of CG Fuji coat LC (CG Fuji coat LC; GC Corporation, Tokyo, Japan) was dispensed into a well and applied to the treated surface with a microbrush, before light curing was performed. The presence and retention of the sealant were evaluated with an exploration probe.

Application of fluoride varnish

The varnish was applied at the beginning of the study and then during the first and second period of evaluation (i.e. 0, 6 and 12 months). We used the application technique recommended by the manufacturer. The teeth were submitted to prophylaxis with pumice, rinsed and dried. Approximately 0.5 mL of varnish was dispensed into a small well. Cotton rolls were used to prevent moisture recontamination and the teeth were lightly dried with an air syringe. Subsequently, varnish was painted onto the teeth with a microbrush. The varnish set on contact with the slightly moist teeth. The varnish was applied to the occlusal and palatine surfaces of the maxillary first molars and to the occlusal and buccal surfaces of the mandibular first molars. The patients were instructed not to brush their teeth during the first 8 h after

varnish application and not to eat for at least 1 h after the application.

The fissure sealant and fluoride varnish were applied by a single operator (a responsible researcher) who was assisted by a dentist. The chi-square test was used to compare the relationship between the incidence of caries and previous caries experience for each evaluation period in the sealant and varnish groups. The level of significance was set at $p < 0.05$.

Evaluation

The clinical evaluation of dental caries and sealant retention was carried out after 6, 12 and 18 months. Only cavitated carious lesions in enamel and/or dentin tissue were considered for this analysis. Retention of the sealants at the specified time intervals was evaluated using Simonsen's [21] criteria.

The teeth were examined using the tactile-visual method (buccal mirror and explorer) under artificial light by the same two calibrated personnel (the researcher and the dentist) who applied the materials. Before the clinical evaluation, the treated teeth were submitted to professional prophylaxis with pumice, followed by rinsing and drying.

Results

At the start of the study, the materials were applied to 320 teeth (80 children), of which 299 teeth were available for the 18-month follow-up examination. The results of the application of the glass ionomer sealant and fluoride varnish to permanent molars obtained after 6, 12 and 18 months are shown in Table I. There were no significant differences in caries prevalence between the glass ionomer sealant and fluoride varnish.

Of the 299 teeth evaluated during the 18-month follow-up, 28 (9%) were found to be decayed. Of these, 15 teeth belonged to the glass ionomer sealant group and 13 belonged to the fluoride varnish group. With respect to sealant retention, six of the 15 decayed teeth did not show sealant retention, whereas nine showed partial retention.

Separate analysis of the treatments showed that 12 (4%) of the 320 evaluated teeth (six in the glass ionomer sealant group and six in the varnish group) had carious lesions after 6 months, with all of them occurring in the mandibular molar. In the second evaluation period, 13 teeth were decayed, of which eight teeth belonged to the glass ionomer sealant group and five belonged to the varnish group. The mandibular molars were the most affected, with 10 carious lesions, whereas only three carious lesions were identified in the maxillary molars. In the last assessment period, only three teeth were decayed: two in the glass ionomer sealant group and one in the varnish group. Of these, two lesions occurred in maxillary molars and one in the mandibular molar.

After 18 months, carious lesions were more frequently observed on the occlusal surface ($n = 16$), followed by the buccal surface ($n = 15$). Only three teeth showed carious lesions on more than one surface.

Table II shows the relationship between previous caries experience and the type of treatment performed. The results obtained after the three evaluation periods indicated a larger number of permanent molars with carious lesions in children of group 2. This difference was statistically significant. The incidence of dental caries was higher during the first evaluation period in group 2, with 10 decayed molars being detected, whereas seven and three decayed molars were detected during the second and third evaluation periods, respectively. This incidence was 2, 6 and 0, respectively, for group 1.

The glass ionomer sealant retention rates in the mandibular and maxillary teeth are shown in Table III. Most teeth showed partial retention after the three evaluation periods, irrespective of the dental arch. At the 18-month follow-up examination, 95 teeth (69%) showed partial retention, 42 (30%) showed complete absence of the sealant and only one tooth showed complete retention of the sealant.

Discussion

This clinical trial was carried out to compare the caries-preventive effect of a glass ionomer, designed as a pit and fissure sealant, and fluoride varnish

Table I. Carious and sound first permanent molars according to the type of treatment at 6, 12 and 18 months follow-up.

Time (months)	Treatments	Sound	Caries	Total	p*
6	Sealant	154 (96%)	6 (4%)	160	0.9912
	Varnish	153 (96%)	6 (4%)	159	
12	Sealant	139 (91%)	14 (9%)	153	0.5539
	Varnish	140 (93%)	11 (7%)	151	
18	Sealant	136 (90%)	15 (10%)	151	0.7329
	Varnish	135 (91%)	13 (9%)	148	

*Chi-square test.

Table II. Carious and sound first permanent molars according previous caries experience at 6, 12 and 18 months follow-up.

Time	Group	Sound	Caries	TOTAL	p^*
6 months	1	210 (99%)	2 (1%)	212	0.0006
	2	97 (91%)	10 (9%)	107	
12 months	1	201 (96%)	8 (4%)	209	< 0.0001
	2	78 (82%)	17 (18%)	95	
18 months	1	198 (96%)	8 (4%)	206	< 0.0001
	2	73 (78%)	20 (22%)	93	

*Chi-square test.

applied to the surfaces of recently erupted permanent first molars. Comparative studies with these two materials are very scarce in the literature. Moreover, our study evaluated these two materials in different groups of children, i.e. children with and without caries experience. An important methodological aspect of this present investigation needs to be discussed. There wasn't a positive or a negative control group. As the goal of this study was compare two important methods of approach for prevention on newly erupted permanent molars, i.e. fluoride varnish and glass ionomer sealant, recognized for their ability to release fluoride, both materials were applied in the same child, to be compared under the same oral conditions, thus was not necessary to include a positive control group.

Erupting teeth can be exposed to prolonged acid attack under the operculum with no chance of re-mineralization occurring for many months and, sometimes, well recognized resin-based sealant are not indicated because of the sensitivity of the technique does not allow its application with saliva contamination. Glass ionomer sealant and fluoride varnish have potential advantages over resin sealants, including their ability to be used in areas of minimal isolation. In addition, we used two groups of children with and without caries experience to evaluate the influence of the oral health of the child on the occurrence of new episodes of dental caries, so that one group was the control of another.

The results of the present study showed that the fluoride varnish and glass ionomer sealant were similar in terms of their ability to prevent caries over the evaluation period. Most studies in the literature have compared resin-based sealants and fluoride varnish. Bravo et al. [22] compared a resin-based sealant and fluoride varnish over a 48-month period and observed that the two materials had similar effectiveness with regard to caries prevention. The same authors performed a 5-year randomized study and obtained results indicating that the resin-based sealant was more effective than the fluoride varnish [23].

Barja-Fidalgo et al. [24] recommend the use of a high-viscosity glass ionomer cement sealant, particularly when the tooth cannot be adequately isolated, such as in the case of newly erupted molars, as in our study. Taifour et al. [25] used a glass ionomer sealant designed for restoration and found no carious lesions after a period of 12 months in newly erupted permanent molars of children with a high risk of caries.

However, two studies evaluating the caries-preventive effect of fluoride varnish in permanent molars of children from socially deprived communities reported opposite results. In the study by Zimmer et al. [16], children received frequent applications of fluoride varnish for 4 years. The authors suggested that fluoride varnish might be effective in preventing caries. In contrast, Hardman et al. [18] applied fluoride varnish at 6-month intervals for 2 years and reported that the application of fluoride varnish cannot be recommended as a public health measure to reduce dental caries.

In the present study, the occlusal surface of the mandibular molars was the most affected by dental caries. This finding might be attributed to the position of the molar during eruption and the difficulty in cleaning this area during brushing. In contrast to

Table III. Retention rates of the fissure sealant in first permanent molars at 6, 12 and 18 months follow-up.

Time	Tooth	Sealant present	Sealant partial	Sealant absent	Total
6 months	16	2 (3%)	69 (86%)	9 (11%)	160
	46	11 (14%)	58 (72%)	11 (14%)	
12 months	16	1 (1%)	57 (75%)	18 (24%)	151
	46	2 (3%)	55 (73%)	18 (24%)	
18 months	16	0 (0%)	51 (68%)	24 (32%)	138
	46	1 (1%)	44 (70%)	18 (29%)	

Bravo et al. [26], who compared the efficacy of a resin-based sealant and fluoride varnish applied to the occlusal and smooth surfaces of permanent first molars after 24 months, we observed a larger number of carious lesions on the occlusal surface. According to Feigal [27], teeth that were sealed immediately after eruption required clinical monitoring and eventual reapplication of the material to prevent carious lesions.

Analysis of the occurrence of caries in relation to past caries experience revealed a higher prevalence of decayed teeth in group 2 over all the periods evaluated. The incidence of new carious lesions decreased during the last evaluation period in both groups. Owing to their past caries experience, the oral hygiene care of the patients in our study may have improved. These findings were corroborated by the results obtained during the last evaluation period, in which only three new carious lesions were observed.

Analysis of the efficacy of the two types of treatments (sealant and varnish) in relation to past caries experience showed that, in group 1, carious lesions predominated when the sealant was applied. However, in group 2, lesions were more frequent when the fluoride varnish was used. These results may indicate thatm, in patients with dental caries experience, the sealant is a more efficient mechanical barrier than fluoride varnish for the prevention of caries in newly-erupted permanent molars.

In the present study, the retention of the glass ionomer sealant was very low. After 18 months of evaluation, complete retention of the sealant was observed in only one (1%) of the 138 sealed teeth, whereas partial retention was observed in 95 (69%) teeth. However, it should be noted that only 13 (8%) teeth showed complete retention of the sealant after 6 months. This indicates that the first 6 months are crucial for monitoring sealant retention and may directly influence the occurrence of dental caries.

Similar results have been reported by Subramaniam et al. [12] who observed complete retention of the glass ionomer sealant in 27 (13%) teeth after 6 months, whereas this percentage decreased to 0.9% after 12 months. Poulsen et al. [28] also reported low rates of complete retention for a glass ionomer sealant after 6 (13%) and 36 months (10%). Rock et al. [11] did not observe complete retention of the sealant in any of the 162 sealed teeth after 6 months of clinical evaluation. In the three studies cited here, ionomer and resin-based sealants were compared and it was found that the latter was always superior in terms of retention.

One of the factors explaining the poor retention of glass ionomer sealants is their fast setting reaction, which reduces penetration of the material into the fissure and consequently decreases its adhesive capacity. Given the sensitivity of the powder-liquid proportion, it is important to follow the manufacturer's recommendations, i.e. a small increase in the proportion of powder can produce a more viscous cement, which favors a faster setting reaction. It should be noted that a pre-dosed glass ionomer sealant was used in the present study, which may improve retention because it reduces the sensitivity of the technique.

Analysis of retention according to the sealed tooth revealed a slightly higher retention on mandibular teeth. Similar results have been reported by Rock et al. [11] and Subramaniam et al. [12]. This finding can be explained by the comparative ease of visualization of these teeth during application and better flow of the sealant on lower teeth.

Based on our results, it can be concluded that the caries-preventive effect of the glass ionomer sealant and fluoride varnish was very similar after 18 months. The incidence of caries was high in the group with previous caries experience. Retention of the glass ionomer sealant was very low, with the first 6 months after application being the critical period during which sealant loss occurred.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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