Resin-modified Glass Ionomer Cement and a Resin-based Material as Occlusal Sealants: A Longitudinal Clinical Performance

Fabiana Sodré de Oliveira, DDS, MS Salete Moura Bonifácio da Silva, DDS, MS
Maria Aparecida de Andrade Moreira Machado, DDS, MS
Maria Francisca Thereza Borro Bijella, DDS, MS
José Eduardo De Oliveira Lima, DDS, MS Ruy César Camargo Abdo, DDS, MS

ABSTRACT

Purpose: The aim of this study was to compare retention, effectiveness in caries prevention and superficial characteristics in 2 different materials used as an occlusal sealant.
Methods: The sample consisted of 108 school children with a mean age of 7.5±1.25 years, in which 364 first permanent molars were divided into 6 groups: (1) group 1=Delton + rubber dam (used only for this group); (2) group 2=Delton + cotton rolls; (3) group 3=Prime & Bond 2.1 + Delton; (4) group 4=Vitremer with a 0.25:1 powder/liquid proportion; (5) group 5=Primer + Vitremer with a 0.25:1 powder/liquid proportion; and (6) group 6=Vitremer with a 1:1 powder/liquid proportion.
Results: After 12 months, the total retention rate for groups 6, 1, 2, 3, 4, and 5 was, respectively: 92%, 79%, 67%, 52%, 41% and 12%. For the 3 occlusal areas, retention was: 97%, 92%, 86%, 77%, 69%, and 36%. For the modified criterion, the proportion test showed a statistically significant difference ($P<.05$) between: groups 1 and 4; groups 6 and 2; and group 3, 4, and 5 with all others groups. Considering the total of 3 areas, there was a statistically significant difference ($P<.05$) between: groups 1 and 6 with groups 3 and 4; group 2 with group 4; and groups 6 and 5 with the others.
Conclusion: The resin-modified glass ionomer cement may be a promising alternative as an occlusal sealant. **(J Dent Child 2008;75:134-43)**

Received February 27, 2007; Last Revision June 21, 2007; Revision Accepted June 25, 2007.

KEYWORDS: PIT AND FISSURE SEALANT, RESIN-MODIFIED GLASS IONOMER CEMENT, RESIN-BASED SEALANT

Pit and fissure sealants have been an accepted caries preventive strategy since the 1970s[1] and have become the most effective noninvasive treatment to prevent or arrest occlusal caries.[2] According to a report from the Third National Health and Nutrition Examination Survey (1988-1991), however, fewer than 1 out of 5 children receive the benefits of this safe and effective preventive measure.[3]

Currently, there are 2 types of pit and fissure sealants available resin-based sealants and glass ionomer cements (GICs).[4] Most of the sealants available on the market a resin-based. The preventive benefits and retention of these sealants types are gained and maintained only as long as the sealants remain completely intact and bonded in place.[5]

Inadequate isolation and subsequent contamination are the most frequent reasons for sealant failure.[6,7] The erupting teeth are more likely to develop dental caries, however, due to favorable conditions for plaque accumulation.[8] Additionally, it is virtually impossible to use a rubber dam on these teeth. Therefore, the association of a bonding agent with the resin-based sealant or the sealing with GICs can be alternatives in those cases when adequate moisture control is not possible.

Dr. Oliveira is professor, Department of Pediatric Dentistry, Dental School of Federal University of Uberlândia, Uberlândia, Brazil; Dr. da Silva is assistant Professor, Drs. Machado and Bijella are associate professors, and Dr. Abdo is titular professor, all in the Department of Pediatric Dentistry, Bauru Dental School, University of São Paulo, São Paulo, Brazil. Correspond with Dr. Oliveira at fasoliv@yahoo.com.br

Since their introduction, GICs have been successfully employed in several clinical situations. The adhesion of the cements to untreated enamel and dentin under moist conditions, biocompatibility with tooth tissues and the potential for fluoride release and the introduction of stronger and more resistant resin-modified GICs, are the main reasons for their wide use as restorative and bonding materials, especially in pediatric dentistry.[9] Many studies have evaluated different materials and techniques with GICs.[1,5,9-32] The use of these cements as pit and fissure sealants, however, is not encouraging in terms of retention.[4,32,33]

More recently, studies[34-41] have shown improved results when an intermediate bonding layer was applied between the enamel and a resin-based sealant, after contact of the etched enamel with saliva. In addition to microleakage reduction,[36,39,40] this technique also reduced the negative effects of the contamination on bond strength.[34]

According to the results of a systematic review,[4] the effectiveness of resin sealants in reducing caries is clear, but data on glass ionomers are less convincing. In another systematic review, Mejàre et al[42] concluded that there is incomplete evidence that fissure sealing with GICs has a caries-preventive effect. On the other hand, Beirute et al[43] concluded that there is no evidence that either resin-based or glass ionomer sealant material is superior in preventing caries development in pit and fissures over time. In their review, Feigal and Donly[44] stated that glass ionomer materials can be used as transitional sealants and may prove to be effective longer-term pit and fissure sealants.

Therefore, the purpose of this study was to evaluate and compare a resin-modified GIC and a resin-based sealant with or without an associated bonding agent, according to the following aspects; retention, effectiveness in preventing caries, marginal characteristics, and superficial characteristics.

METHODS

Approval for the trial was obtained from the Ethics Committee of Bauru Dental School, University of São Paulo, São Paulo, Brazil, where this study was developed. Requirements for inclusion in the trial were a written consent from the parents and/or guardians and at least 2 permanent first molars without cavitation per child.

A total of 108 children with the mean age of 7.5±1.25 years (range=5 years to 10 years, 11 months) were recruited from the patient pool of the pediatric dental clinic. The teeth were selected after a prophylaxis with an air-polishing prophylaxis unit (Profident, Dabi-Atlante S.A., Ribeirão Preto, São Paulo, Brazil and 2 bitewing radiographs were taken to evaluate the presence of occlusal or proximal caries lesions.

A chemically cured resin-based sealant (Delton, Dentsply Ind Com Ltda, Rio de Janeiro, Brazil) was used with and without a bonding agent (Prime & Bond 2.1, Dentsply Ind Com Ltda). A resin-modified glass ionomer (Vitremer, 3M Dental Products, St Paul, Minn) was also used in 2 different powder/liquid proportions: (1) 0.25:1 (with and without primer) and (2) 1:1 (without primer).

The distribution of each child into 1 of the 6 groups followed a planned design according to similar DFS and DMFS indexes, number of the teeth (permanent maxillary right and left first molars and permanent mandibular right and left first molars), and their level of eruption. A multivariate analysis of variance (MANOVA) was applied to the results of the indexes, adopting a 5% significance level. The total sample was composed of 364 teeth, with at least 50 teeth per group. A split-mouth design was not used in this study. Therefore, each child received a material or a technical variation correspondent to one group.

For all the groups, the sealant was applied after a prophylaxis with an air-polishing jet (Profident, Dabi-Atlante S.A., Ribeirão Preto, São Paulo, Brazil), followed by etching with phosphoric acid gel (37%) (Dentsply Ind Com Ltda, Petrópolis, Rio de Janeiro, Brazil) for 15 seconds, rinsing for 30 seconds with water, and drying. A rubber dam was only used in group 1. The other groups received the sealing under careful relative isolation using cotton rolls.

The same equipment was used for the polymerization of the bonding agent, primer, and Vitremer (Optilux, Demetron Research Corporation, Danbury, Conn). The light intensity (550 mW/cm^2) used was checked using a radiometer (model no. 100 curing radiometer P/N 10503, DFL Ind Com S.A., Rio de Janeiro, Rio de Janeiro, Brazil) at the beginning of each work day. All the sealants were applied by only one operator. The occlusion was not checked, as unfilled resin sealants or GICs have been found to wear into occlusion without harmful consequences.[17] The descriptions of the 6 groups was as follows:

1. Groups 1 (Delton + rubber dam) and 2 (Delton + cotton rolls): Delton was applied according to the manufacturer's instructions.
2. Group 3 (Prime & Bond 2.1 + Delton): A layer of bonding agent was applied for 20 seconds with a brush, air-thinned for 5 seconds, and cured for 10 seconds. Delton was applied over the bonding agent layer, according to the manufacturer's instructions.
3. Group 4 (Vitremer 0.25:1): The material was diluted to achieve a more fluid consistency, according to the following proportion—one quarter of the recommended amount of powder for each drop of liquid. To obtain this proportion, a full scoop of powder (Vitremer) was weighted 10 times (Analytic Balance Model PL 3002, Mettler Toledo, Greinfensee, Switzerland). The mean value (0.14629 g) was divided by 4 to obtain the amount of powder to be used (0.037 g). Then, another plastic scoop was prepared with sand paper discs (Soft Lex, 3M do Brasil Ltda, São Paulo, Brazil) to contain the exact amount of powder before mentioned, thereby standardizing a new powder/liquid proportion. This fluid material was inserted into the fissures with an explorer and cured for 40 seconds.

4. Group 5 (Primer + Vitremer 0.25:1): The primer was applied with a brush (KG Brush–KG Sorensen Ind Com Ltda, Barueri, S.P., Brazil) for 30 seconds, air-dried for 15 seconds, and cured for 20 seconds. Vitremer application was similar to group 4.
5. Group 6 (Vitremer 1:1): The powder/liquid proportion recommended by the manufacturer was used. The material was inserted into the fissures with a metallic spatula (Thompson no. 9–Dental MFG Co, Missoula, Mont., USA) and cured for 40 seconds.

It was not possible to blind the examiners to the materials, since Delton and Vitremer are visually distinct from each other. A blind examination was possible, however, considering the technique's variation for each one of the materials.

The sealant retention, (total=TR; partial=PR; and lost=L) was evaluated at 6 and 12 months by 2 calibrated examiners working together using criteria modified from Ryge and Snyder[45] (Table 5). The retention by area at mesial-occlusal (MO), central-occlusal (CO), and distal-occlusal (DO) areas was also evaluated.[46] The sealants were checked clinically by visual inspection with good operating light, using a probe and drying with compressed air. Intra- and interexaminer reproducibility for the sealing retention and superficial characteristics was standardized during reexamination of approximately 20% of the sealed teeth using Cohen's kappa test[47]. The results were analyzed by means of Tukey's multiple comparison test[47] with a 5% significant level.

RESULTS

For the retention, inter- and intraexaminer reproducibility was 0.95 and 0.88 to 0.93, respectively. For the superficial characteristics, inter- and intra-examiner reproducibility was 0.889 and 0.80 to 0.85, respectively.

At the commencement of the study, sealants were applied to 108 children, 98 of whom were available for the 6-month follow-up examination and 88 of whom returned after 12 months. Consequently, 329 and 293 teeth were evaluated, respectively, at these 2 occasions.

The retention for all the groups using modified criterion or the areas criterion is shown in Tables 1 and 2, respectively.

Table 1. Retention Rates (%) after 6 and 12 Months by Modified Criterion (Ryge and Snyder[45])*

Groups	N (tooth)	6 mos (%)			12 mos (%)		
		A	B	C	A	B	C
1	34	94	6	0	79	21	0
2	51	90	10	0	67	33	0
3	48	73	27	0	52	48	0
4	51	82	18	0	41	59	0
5	60	30	70	0	12	88	0
6	48	100	30	0	92	8	0

** A=Alpha; B=Bravo; C=Charlie.*

Table 2. Retention Rates (%) for the 3 Areas (MO + CO + DO) After 6 and 12 Months*

Groups	N (areas)	6 mos (%)			12 mos (%)		
		TR	PR	L	TR	PR	L
1	102	98	1	1	92	5	3
2	153	95	5	0	86	13	1
3	144	88	12	0	77	21	2
4	153	93	7	0	69	31	0
5	180	60	40	0	36	58	6
6	144	100	0	0	97	3	0

** TR=total retention; PR=partial retention; L=lost*

The total retention (Alpha) showed significant differences at both evaluation periods. At 6 months, there was a significant difference between: (1) group 5 with all of the other groups; and (2) group 6 with groups 3 and 4. At 12 months, there was a significant difference between: (1) group 5 with all of the other groups; (2) group 6 with groups 2 and 3; and (3) group 4 with groups 1 and 6.

Considering the total retention for the 3 areas together, a significant difference was demonstrated at 6 months

*Table 3. Evaluation of Clinical Aspects of the Sealed Teeth (%) After 6 Months by Modified Criterion (Ryge and Snyder [45])**

Groups	N (tooth)	Secondary caries				Marginal discrepancy			Marginal discoloration			Superficial texture				Superficial discoloration			
		A	B	C	D	A	B	C	A	B	C	A	B	C	D	A	B	C	D
1	34	100	0	0	0	88	12	0	100	0	0	91	9	0	0	82	18	0	0
2	51	100	0	0	0	90	10	0	100	0	0	96	4	0	0	80	20	0	0
3	48	100	0	0	0	73	27	0	100	0	0	92	8	0	0	90	10	0	0
4	51	100	0	0	0	88	12	0	76	24	0	8	92	0	0	80	20	0	0
5	60	100	0	0	0	37	63	0	88	12	0	8	90	2	0	78	22	0	0
6	48	100	0	0	0	100	0	0	98	2	0	0	98	2	0	92	8	0	0

** A=ALPHA; B=BRAVO; C=CHARLIE; D=DELTA.*

*Table 4. Evaluation of Clinical Aspects of the Sealed Teeth (%) After 12 Months by Modified Criterion (Ryge and Snyder [45])**

Groups	N (tooth)	Secondary caries				Marginal discrepancy			Marginal discoloration			Superficial texture				Superficial discoloration			
		A	B	C	D	A	B	C	A	B	C	A	B	C	D	A	B	C	D
1	34	100	0	0	0	32	68	0	100	0	0	88	9	3	0	20.59	70.59	8.82	0
2	51	94	2	2	2	59	41	0	100	0	0	78	22	0	0	43.14	54.90	1.96	0
3	48	96	0	4	0	50	48	2	96	2	2.08	69	31	0	0	50	43.75	6.25	0
4	51	100	0	0	0	39	59	2	75	25	0	8	90	2	0	60.78	39.22	0	0
5	60	96	2	0	2	10	85	5	85	15	0	8	90	2	0	45.00	45.00	10	0
6	48	100	0	0	0	50	50	0	67	33	0	19	81	0	0	68.75	29.17	2.18	0

** A=ALPHA; B=BRAVO; C=CHARLIE; D=DELTA.*

between: (1) group 1 with group 3; (2) group 6 with group 2; (3) group 3 and group 4; and (4) group 5 with all of the other groups. A significant difference was also demonstrated at 12 months between: (1) group 1 and group 6 with groups 3 and 4; (2) group 2 with groups 4 and 6; and (3) group 5 with all of the other groups. Concerning the 3 retention categories (TR, PR, L), no statistically significant difference was found between each one of the 3 areas at 6 and 12 months. While there was no prevalent area with TR on both evaluation periods, the L was most prevalent in the MO area, although it was not statistically significant.

No sealed teeth developed pit or fissure caries during the first 6 months of the study (Table 3). After 12 months, 7 dental caries lesions were detected in groups 2, 3 and 5, but the difference among them was not significant. Two of these lesions reached dentin in groups 2 and 5 (Table 4).

Marginal discrepancies were present in all the groups. At 6 months, group 5 showed the greatest number of teeth with marginal discontinuity (63%), corresponding to less than 50% of the original contour, while group 6 presented no cases. Group 5 showed a significant difference ($P<.05$) with all the groups. Group 6 showed a significant

difference with groups 3, 4, and 5 (Table 3). After six months, all the groups showed an increase in the number of teeth with marginal discrepancies. Only 6 teeth (10%) of group 5 showed the original contour. This result was significant when compared to groups 2, 3, 4, and 6 (Table 4).

At 6 months, only the teeth sealed with the resin-modified GIC showed marginal discoloration. Discoloration was more prevalent in group 4 (24%) followed by group 5 (12%). A significant difference was shown between: (1) group 4 with groups 1, 2, 3, and 6; and (2) group 5 with groups 2 and 3 (Table 3). At 12 months, while group 3 showed marginal discoloration only in 2 teeth, the greatest occurrence was for group 6 (33%), with a significant difference between: (1) groups 4 and 6 with group 1 and 2; and (2) groups 3 and 5 with groups 1 and 2 (Table 4).

Alterations of superficial texture were observed only for the teeth sealed with the resin-modified GIC at 6 and 12 months. The differences between groups 4, 5, and 6 compared with groups 1, 2, and 3 were statistically significant (Table 3), with an improvement for group 6 (Table 4) at the second evaluation.

At 6 months, no significant differences in superficial discoloration were detected among the groups (Table 3). At 12 months, however, groups 4 and 6 showed the greatest number of teeth without superficial discoloration, with a statistically signicant difference between them with group 1 (Table 4). Figures 1 to 3 show clinical photographs of some sealings at 12 months.

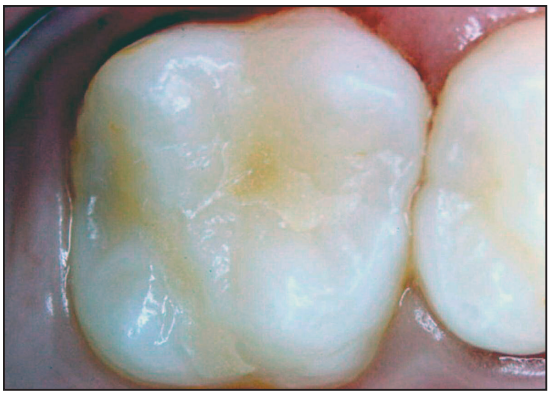

Figure 2. Primer + Vitremer 0.25:1 at 12 months.

Figure 3. Vitremer 1:1 at 12 months.

DISCUSSION

Sealants are an essential component of a modern, science-based, prevention-oriented practice.[48] Applied during childhood, they have a long-lasting caries-preventive effect.[49] They are more effective when placed in patients with risk factors for occlusal caries.[50-54] The strategy of sealing both high- and low-risk teeth further improved outcomes, but at an additional cost when compared to risk-based placement only.[55] As observed by Bhuridej et al,[56] permanent first molars with sealants received less subsequent restorative treatment than those without sealants. According to Badovinac et al,[57] the use of the dmfs + DMFS >0 criterion may help public health providers determine which children should receive sealants when resources do not allow the delivery of sealants to all children.

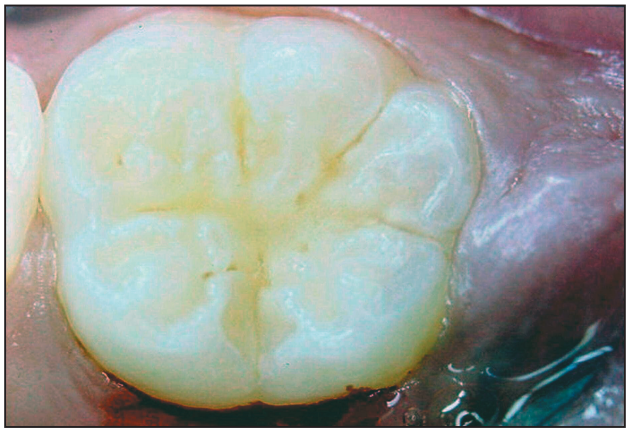

Figure 1. Delton + rubber dam at 12 months.

Several aspects can influence the success or failure of sealants, such as patient or tooth characteristics, material used, application technique, and operator skill.[16,51,58,59]

Studies comparing the resin-based sealant and the GIC as a sealant frequently use a split-mouth design[1,11,13,15-17,19,23,32] to reduce the patient influence. This design was not employed in this study because 2 materials were evaluated as being associated or not with 2 bonding agents and 4 different techniques. Therefore, it was determined that only 1 variation should be placed per child. For this distribution, a similar caries index was considered, while noting that 15% of the children were participating in another clinical trial in which Vitremer and a composite-based material were being tested. Then, the premise that the placement of glass ionomer restorations would increase the fluoride concentration in saliva for a considerable period of time was considered.[60] It is known that a long-lasting and slow fluoride release system can be an effective caries preventive measure, according to Koch and Hatibovic-Kofman,[60] and could mask some differences between the materials in the same mouth.

The sealant application under optimal conditions is fundamental[2] (ie, higher failure rates are most likely due to inadvertent moisture contamination). Studies com-paring Delton applied with a rubber dam and cotton roll isolation demonstrated no significant difference in the retention rate.[58,61,62,63] According to the results of a systematic review,[64] the use of rubber dam did not affect retention of auto-polymerized resin-based sealants. In this study, the use of a rubber dam was also not necessary to improve Delton retention. Although the sealant application under cotton rolls is less comfortable for the young patient and requires more effort by the operator, the rubber dam isolation is recommended if a tooth is erupted enough to retain a clamp, and if the tooth is part of a quadrant requiring operative dentistry. Rubber dam isolation, however, is not recommended if used only for sealing, due to the frequent need of a local anesthetic for the placement of a clamp.[51,61] Moreover, waiting until a molar is fully erupted to apply a fissure sealant with a rubber dam may be costly, as teeth can develop dental caries during the eruptive phase.[58]

Table 5. Clinical Grades of the Sealings, According to a Ryge and Snyder[45] Modified Criterion

Category	Rating	Criterion
Retention	Alfa	No crevice detected by explorer
	Bravo	Partial exposure of a fissure
	Charlie	Complete loss of sealant
Secondary caries	Alfa	No caries (no softness, opacity or etch at margin)
	Bravo	Opaque and gentle catch
	Charlie	Discoloration and evident catch
	Delta	Cavitation in dentine
Marginal discrepancy	Alfa	Continuity with existing contour
	Bravo	Discontinuity along less than 50% of the margin with existing contour
	Charlie	Discontinuity along more than 50% of the margin with existing contour
Marginal discoloration	Alfa	No discoloration
	Bravo	Discoloration at the margin
	Charlie	Discoloration penetrating under the sealant
Superficial texture	Alfa	Smooth like enamel
	Bravo	Gentle catch
	Charlie	Rough surface
	Delta	Rough and marked surface
Superficial discoloration	Alfa	No discoloration
	Bravo	Gentle discoloration
	Charlie	Evident discoloration
	Delta	Rough discoloration

The efficacy of sealants in preventing caries has been asso-ciated with their long-term performance and retention rate. The most common evaluation of sealants follows 3 criteria: (1) complete retention; (2) partial retention; and (3) complete loss. Few studies use the retention evaluation by areas.[22,27,31,46] The area type of evaluation, however, permits a more clear analysis of both sealing retention and a localized incidence of caries, as well as their association.

Many studies have been conducted to investigate material or techniques that could minimize the difficulty of achieving adequate and necessary salivary control and also to increase the sealant-enamel bonding to enamel. The bonding agents were developed to enhance the adhesion of the resin to enamel. Some recent studies support the hypothesis that these materials show excellent adhesion to enamel and can overcome the negative effects of saliva contamination.[34-39] The results of this study, however, don't confirm those obtained by Feigal, et al.[35] When Delton was associated with a bonding agent (group 3), the TR—considering both evaluation criteria (Tables 1 and 2)—was inferior to that observed for the same material without adhesive, although the difference was not significant.

This result supports early findings from Boksman et al,[65] who did not verify a retention rate increase with a bonding agent, previous to resin-based sealant under rubber dam. Therefore, it seems that the contamination, if present or not, has not influenced the performance of the sealant-adhesive association. In this study, only one coat of the bonding agent was cured before the application of Delton, because the introduction of another step means greater child's cooperation—sometimes a

problematic situation in pediatric dentistry. This study's results also support findings from Pinar et al,[2] who reported no differences among the sealants, with and without a bonding agent, in relation to marginal integrity, marginal discoloration, and anatomic form.

The retention for resin-based sealants has been reported to be better then that for glass ionomer sealants.[1,12,16,23,33] In this study, Vitremer at the 1:1 powder/liquid proportion showed the highest retention rate for both evaluation systems at 6 and 12 months (Tables 1 and 2). Compared to groups 4 and 5, this performance may be related to some factors. As Vitremer was not fluid in group 6, its physical and mechanical properties were maintained, so its solubility was lessened. It was applied under pressure, reducing the formation of internal bubbles and, thus, the porosity that could be responsible for the weakness of the material. Nevertheless, it is also evident that the primer was responsible for the worst TR of group 5, causing interference of the Vitremer adhesion to the enamel. This result agrees with another study, in which primer was applied without a previous acid etching of the enamel.[22]

Acid etching of the enamel has a fundamental role in the retention of an adhesive material. Both in vitro[9] and in vivo[15,21,22,25,26] findings indicate that etching the occlusal surface enhances the GIC bonding to enamel. This improved performance has also been shown in studies with conventional[15,26] or resin-modified GICs[21,22,26] applied after etching, compared to those without acid etching.[5,12,18,23]

The association between Vitremer, in a 1:2 powder/liquid proportion, and primer resulted in a retention rate of 59% and 36% at 6 and 12 months, respectively.[20] These values were higher than those obtained in this study (30% and 12%) at the same evaluation periods, possibly due to the higher powder/proportion used and operator's skill in the use of a different clinical evaluation. With a 1:3 powder/liquid proportion, Villela[19] showed the same retention rate at 6 and 12 months, which was higher than that of this study. Nevertheless, in that previous study[19] the participants were older and the sealed teeth were premolars, which have been shown to have a retention rate typically higher than that for molars because of their occlusal surface anatomy and location in the mouth, which puts premolars under less masticatory effort.

The retention has also been evaluated considering 3 areas on the occlusal surface (mesial-occlusal, central-occlusal, and distal-occlusal) to detect those areas with the poorest adhesion. After 12 months, Valsecki et al[46] obtained a total retention rate of 83% for Delton, similar to this study's findings for group 2. While they found the smallest retention rate for the distal area, the current study could not detect a significant difference. In fact, the lowest retention detected in this study was for the DO and MO areas in both periods of evaluation. It must be emphasized that these observations considered the different areas with success (TR) and failure (PR/L) for all groups. For an erupting tooth, the DO area is the most complicated for moisture control and the MO area is the first in contact with the antagonistic tooth. Hence, these aspects can explain the retention that has been obtained. The CO area is more protected from occlusal contact and contamination, and, because it contains a greater thickness of material, looses the smallest amount of sealant.

In this study, the retention rate for group 4 at all of the 3 areas was 69% at 12 months, higher than 50% obtained in another study,[22] which applied the same material and technique, with the only difference being the age of the participants. Therefore, the observed difference in the retention rate probably was associated with the operator's skill and clinical experience.[22,51,59]

Some laboratory studies[66-69] that evaluated Vitremer at a 0.25:1 ratio have demonstrated interesting aspects with this consistency. Using this proportion, or the one recommended by the manufacturer's, the penetration of Vitremer into fissures, as well as the marginal microleakage, were similar.[68] Another aspect to be considered is the fluoride release. It was demonstrated[69] that Vitremer mixed to a 0.25:1 ratio showed a greater release of fluoride than when compared to the material used as indicated by the manufacturer (1:1). Although these laboratory and clinical results need further confirmation, they suggest Vitremer as a worthy alternative for sealing, increasing its application in children.

The present study's results on caries agree with previous studies[17,19] that found no significant difference between glass ionomer and resin-based sealants. Only at 12 months were caries observed in 7 teeth, of which 5 were sealed with resin-based sealants and 2 with the association of primer and Vitremer (0.25:1). Possibly this result of group 5 was related to it having the worst retention values.

As observed by Winkler et al,[17] the kind of failures presented by resin-based and glass ionomer sealings are different. The resin-based sealant appeared to be lost in chunks, leaving behind marginal irregularities. By contrast, the modified-resin GIC usually did not develop marginal discrepancies, but did appear to wear excessively. This is due to a significantly higher fracture toughness for the resin-modified glass ionomer and an increased wear rate resulting from tooth-brushing and sliding forces compared to the resin sealant.

The more frequent marginal discoloration exhibited by resin-modified glass ionomer sealants was characterized by a lighter contour. A dark shade (A3) and an excessive drying time were used for the clinical examination, which could have had an influence on this classification.

The greatest changes on superficial texture were also observed for the resin-modified GICs. The characteristics of the material, like porosity and protrusion of glass particles, can contribute to the material's ruggedness. For superficial discoloration, group 1 showed the greatest number of teeth with alterations. Although all the groups exhibited marginal and superficial alterations, the sealings had not been damaged.

Clinical studies using GIC as a sealant suggest that complete retention is not required for caries prevention.[1,5,12,16-21,27,28,29] Although it has been reported that the fissure sealed with a glass ionomer, even after a clinical appearance of complete loss,[70] is more resistant to demineralization in vitro than an unsealed fissure, it would be interesting to find if the material could show a complete retention. A resin-modified GIC used as a sealant was able to act as a physical barrier. There was a significant increase of the retention after the association of the cement with a previous acid etch of the enamel,[9,15,21,22,26] a situation that confirms the present study's data.

Generally, the retention rates of sealants are evaluated after only one application, and reapplication is not considered in cases of partial retention of the material. For those children with a high caries risk, however, the sealant's repair must be performed in the situations of lost or critical partial retention.[14,51]

At 12 months, no tooth (Table 1) and only a few areas (Table 2) showed a total loss of the sealant. Considering these results, all techniques could be classified as effective, respecting the clinical protocol of periodic returns for the sealant evaluation. More clinical longitudinal researches are necessary to compare the different sealing materials to prevent occlusal caries. The GIC—particularly the resin-modified GIC which associates a better resistance to abrasion, better adhesion to dental tissues, high retention rates, and cariostatic properties—represents an interesting alternative for sealing.

CONCLUSIONS

This study suggests that resin-modified glass ionomer cement may be an efficient and promising alternative as an occlusal sealant, although more long-term evaluation is necessary. Vitremer with the normal powder/liquid proportion (1:1) showed a better retention performance than that of Delton with cotton rolls, associated or not with a bonding agent. Prime & Bond 2.1 used as an intermediate layer did not increase the retention rate of Delton. Caries lesions were observed in only a few teeth, but there was no significant difference between the groups. Although the superficial and marginal alterations were observed in all the groups, the sealants were clinically acceptable after 12 months.

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