

A comparison of retention and the effect on caries of fissure sealing with a glass-ionomer and a resin-based sealant

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Abstract – Objective: To compare the retention and the caries preventive effect of a glass-ionomer developed for fissure sealing (Fuji III[®]) and a chemically polymerized resin-based fissure sealant (Delton[®]). **Design:** A split mouth randomized design using contralateral teeth. **Setting:** WHO Regional Demonstration, Training and Research Center for Oral Health, Damascus, Syrian Arab Republic. **Sample and methods:** 179 children, 7 years old at the start of the study, were recruited from schools close to the Center. Only children with at least one pair of permanent first molars that were caries free or only had incipient lesions were included in the study. Follow-up examinations for sealant retention were done after 6 months, 1 year, 2 years and 3 years. The number of children available for reexamination was 129 (after 6 months); 121 (after 1 year); 115 (after 2 years) and 116 (after 3 years). Four dental hygienists were trained in the sealant procedures and did approximately one fourth of the sealants each. **Results:** After 3 years the glass-ionomer sealant was completely lost in almost 90% of the teeth compared to less than 10% of the resin sealed teeth. After 3 years the relative risk of a tooth sealed with glass-ionomer over that of a tooth sealed with resin was 3.38 (95% CL: 1.98; 5.79). This finding was consistent over type of tooth. **Conclusions:** The glass-ionomer sealant tested in the present study had poorer retention and less caries protective effect than the resin-based sealant used.

Key words: fissure sealing; glass ionomer; split mouth; clinical trial; caries

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Fissure sealant materials were originally only resin-based (chemically or light cured), but recently the retention and caries preventive effect of glass-ionomer materials have also been tested. The advantage of using glass-ionomer for fissure sealing is that the retention of the material is less dependent on complete moisture control. The number of reports on trials in which the two materials have been tested within the same trial is, however, limited (1–7). A common finding is a lower retention rate of glass-ionomer sealants compared to resin-based sealants, while the findings on the effect on caries are less conclusive. Sealants are usually considered a method to prevent the initiation of new caries lesions.

However, since recent data have shown that the effectiveness of sealants in controlling caries can be increased by selecting teeth with incipient caries lesions (8) it was decided to include teeth with incipient caries lesions in the present study.

The purpose of the present study was to compare the retention and the effect on caries of a glass-ionomer and a resin-based fissure sealant.

Material and methods

The study was conducted in the WHO Regional Demonstration, Training and Research Center for Oral Health in Damascus, Syrian Arab Republic.

Table 1. Criteria used for diagnosis of occlusal caries

Diagnosis	Criteria
Sound	the fissure is absolutely clean, without discoloration, cavitation, filling or other carious defects
Initial caries	white, yellow or brown discoloration of the fissure, but no sticking of the probe on careful, but gentle probing
Manifest caries	probe sticks on careful, but gentle probing

This Center is under the Ministry of Education and has the responsibility for developing and implementing oral health preventive services for school-children in the country. The program was approved by the Ministry.

Study population

The children were 7 years old at the start of the study (2nd grade) and recruited from schools close to the Center. Only children with at least one pair of permanent first molars eligible for sealing according to the criteria described below were included in the study. At the time the study was being planned (early 1994) there was only limited information available in the literature on the relative caries preventive effect of sealing with the two materials. It was estimated that 15% of the surfaces sealed with a resin material would decay over the 3-year period that the study was to run. It was furthermore decided that the study should be able to detect a relative risk of new cavitated caries lesions in the glass-ionomer sealed teeth compared to the resin-sealed teeth of

2 for $\alpha=0.05$ and $\beta=0.20$. This would require a sample size of approximately 100 subjects. In order to allow for an expected large loss of participants due to the weak infrastructure, 170 children were originally enrolled in the study. Follow-up examinations for were done after 6 months, 1 year, 2 years and 3 years. A preliminary report has been presented on the results after 2 years (9). The number of children available for re-examination was as follows: 129 (after 6 months); 121 (after 1 year); 115 (after 2 years) and 116 (after 3 years).

Study design

The study was conducted according to a split mouth design using contralateral teeth. In each child random numbers were used to decide which tooth should be sealed with the resin material and which tooth should be sealed with glass ionomer.

Diagnostic methods and criteria

The children were examined during the first months of 1995 for caries by one of the authors (N.S.) using criteria which allowed a separate diagnosis of clinically non-cavitated lesions to be made, as shown in Table 1. Probing was performed with a sharp dental probe using very slight pressure. Equipment for radiographic examination was not available. Sealant status was recorded as complete retention, partial retention and complete loss. All examinations were done in the clinical facilities of the Center with the child seated in a dental chair, with good operating light and using probe and drying with compressed air.

Table 2. Retention of sealant material according to type of sealant material and tooth type

		Fuji III®			Delton®		
		16 and 26	36 and 46	16, 26, 36 and 46	16 and 26	36 and 46	16, 26, 36 and 46
After 6 months	complete retention	11.97	14.29	13.06	87.18	93.33	90.09
	partial retention	35.90	38.10	36.94	10.26	2.86	6.76
	complete loss	52.14	47.62	50.00	2.56	3.81	3.15
After 1 year	complete retention	9.09	11.11	10.05	81.82	88.89	85.17
	partial retention	17.27	25.25	21.05	9.09	0.00	4.78
	complete loss	73.64	63.64	68.90	9.09	11.11	10.05
After 2 years	complete retention	5.88	12.22	8.85	78.43	82.22	80.21
	partial retention	9.80	7.78	8.85	11.76	1.11	6.77
	complete loss	84.31	80.00	82.29	9.80	16.67	13.02
After 3 years	complete retention	3.64	3.13	3.40	72.48	76.04	74.15
	partial retention	5.45	9.38	7.28	19.27	12.50	16.10
	complete loss	90.91	87.50	89.32	8.26	11.46	9.76

Reexamination for sealant status of approximately 10% of the study group showed that the examiner was able to reproduce retention status completely. The following Kappa values were obtained for caries: at baseline: 0.83; at final follow-up examination in 1998: 0.92.

Intervention

Four dental hygienists were trained in the sealant procedure. They worked in teams of two (one assisting the other) and did approximately one fourth of the sealants each. The sealants were placed within 2 months after the caries examination. The resin-based sealant material used was chemically polymerized Delton® (Ash Dentsply, York, PA, USA) and the glass-ionomer material was Fuji III® (GC Corporation, Tokyo, Japan). Teeth with sound fissures as well as teeth with initial lesions of the fissures were sealed. No re-sealing was done at the follow-up examinations.

Statistical analysis

Findings on retention of the two materials were tabulated according to type of tooth and length of follow-up period. The effect of the two materials on caries increment was compared by calculating relative risk (RR) (10) and its 95% confidence limits (CL) (11).

Results

Retention of Fuji III sealants was consistently lower at all follow-up examinations than retention of Delton sealants, irrespective of tooth type (Table 2). After 3 years the glass-ionomer sealant was completely lost in almost 90% of the teeth compared to less than 10% of the resin-sealed teeth.

After 3 years, a Fuji III-sealed permanent first molar was more than three times as likely to become carious as a Delton-sealed tooth (for all teeth:

RR: 3.38; 95% CL: 1.98; 5.79). The relative risk was lower for maxillary than mandibular permanent first molars, but not significantly so.

Discussion

The low retention rates found in the present study are in general agreement with all previous studies on glass-ionomer fissure sealants. On the other hand, retention rates of resin sealants after 2 years in the present study are comparable to those obtained after the same period of observation by Forss et al. (2), indicating comparable efficiency in the clinical technique. The clinical technique of applying glass-ionomer sealants is, however, slightly different from the technique used when applying resin-based sealants. The operators in the present study had many years' experience in applying resin-based sealants, while the application of glass-ionomer sealants was new to them. This may explain why the retention of the glass-ionomer sealant was considerably lower in the present study (9%) than in the Finnish trial (26%) (2).

The results of the present study on caries are not in agreement with previous studies that found either no difference (2, 5, 7) or a higher caries preventive effect (3) of the glass-ionomer sealant. Several explanations could be offered for this. One could be that the present study was conducted in a population with a relatively high level of occlusal caries and in an age group where the permanent first molars have erupted recently and are at high risk of developing caries. This may have made the present study more effective in detecting differences in caries preventive effect between the two materials and explain why our results are different from our Finnish colleagues'. However, data from the WHO global data bank (12) show that average DMFT levels for 12-year-olds in Syria are in the range of 1.9 and 2.5, corresponding to the "low"-caries category as defined by WHO (13). Furthermore, data collected by the WHO Regional Demonstration, Training and Research Center for Oral Health using WHO criteria (14) have found average DMFT values of 0.6–0.7 in groups of 6–7-year-old schoolchildren from Damascus (15). A direct comparison between caries levels in the present study and in previous studies is, however, not possible.

Finally, differences in the selection criteria for sealing teeth and the fact that Arrow et al. (3) used a different glass-ionomer material than the one used in this study may assist in interpreting differences in the results obtained. Obviously, more trials

Table 3. Distribution of pairs of teeth according to type of sealant material and caries development

Fuji III® Delton®	Sound		Caries		RR (95% CL)
	sound	caries	sound	caries	
16 and 26	93	3	11	2	2.60 (1.05; 6.46)
36 and 46	63	3	26	5	3.88 (1.98; 7.57)
all teeth	156	6	37	7	3.38 (1.98; 5.79)

appear to be needed to establish any differences in the effect on caries of the two materials.

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