

Six-year clinical evaluation of polyacid-modified composite resin used as fissure sealant

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The aim of this study was to evaluate retention and efficacy of polyacid-modified composite resin used as fissure sealant (Variglass V.L.C.) after six years. Three-hundred and seventy permanent first molars were sealed. After six years, 42.0% of the original group was re-examined and the sealant was found to be totally present in 3.4%, partially present in 16.2% and absent in 70.4% of the previously sealed occlusal surfaces. During the 6 years period, 9.5% of the sealed surfaces became carious, 25.0% were filled and 65.5% remained sound. Although the retention rate of the material has been very low, it appears to have prevented dental caries in 2/3 of the teeth evaluated after six years of placement.

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INTRODUCTION

In the last years, some studies have shown a decrease in caries incidence,^{1,2} mainly due to fluoride present in dentifrices and community fluoridated water. However, these fluoride therapies benefit primarily smooth surfaces³, while occlusal surfaces continue to be responsible for about 67% to 90% of the caries in children of 5-17 years of age.^{4,5,6}

The decrease in caries incidence has brought three clinical consequences: a) changes in pattern and in progression of the disease;³ b) concentration of caries lesions on occlusal surfaces, primarily in first and second

permanent molars; c) polarization of the disease in some groups (approximately 80% of caries is found in 20% of the population),⁷ who needs effective preventive methods to prevent occlusal caries.

Fissure caries has been a concern since the 1800s. However it was only in the 1970s, when using of resin-based materials and the development of sealants, that beneficial results were obtained.⁸⁻¹⁰ After glass ionomer cement was developed with anti-cariogenic, aesthetic and biocompatible properties, it started to be used as a fissure sealant as well as for other applications. Nevertheless, its retention to the enamel surface has been very poor.^{9,11-15}

With the aim of improving the characteristics of glass ionomers, resin-modified glass ionomers and compomers were developed at the end of the 1980s, which combined components of glass ionomer and composite resin to provide better aesthetic properties, less sensitivity to technique and a decrease of imbibition and syneresis. In 1994, McLean *et al.*¹⁶ classified these materials as follows: resin-modified glass ionomer and polyacid-modified composite resin.

The aim of this study was to verify the retention and efficacy of a polyacid-modified composite resin (Variglass V.L.C.) used as fissure sealant after clinical evaluations of 6 months, 1, 4 and 6 years of placement.

MATERIALS AND METHODS

Sample selection

The sample was composed of 185 school children (6-8 years old), with at least two sound and unsealed permanent first molars. They had to have lived in

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Table 1. Percentage of retention rate of Variglass used as fissure sealant after 6 months, 1, 4 and 6 years of clinical application.

| Retention rate | Evaluation period | | | | | | | |
|----------------|-------------------|-----|--------|-----|---------|-----|---------|-------|
| | 6 months | | 1 year | | 4 years | | 6 years | |
| | N | % | N | % | N | % | N | % |
| TR | 178 | 52 | 55 | 19 | 10 | 5 | 5 | 3.4 |
| R1 | 91 | 27 | 60 | 20 | 15 | 8 | 7 | 4.7 |
| R2 | 39 | 11 | 48 | 17 | 27 | 14 | 17 | 11.5 |
| TL | 35 | 10 | 127 | 44 | 135 | 73 | 119 | 80.4 |
| Total | 343a | 100 | 290b | 100 | 187c | 100 | 148c | 100.0 |

Results followed by distinct letters showed statistical difference with the Friedman Test ($p < 0.05$).

Table 2. Percentages of carious, filled and Carious+Filled teeth after 6 months, 1, 4 and 6 years of using Variglass as fissure sealant.

| Dental Condition | Evaluation Period | | | | | |
|------------------|-------------------|-----|--------|------|---------------|------|
| | Cariou | | Filled | | Cariou+Filled | |
| | N | % | N | % | N | % |
| 6 months | 0 | 0.0 | 0 | 0.0 | 0 a | 0.0 |
| 1 year | 0 | 0.0 | 2 | 0.6 | 2 b | 0.6 |
| 4 years | 11 | 6.0 | 19 | 10.0 | 30 c | 16.0 |
| 6 years | 14 | 9.5 | 37 | 25.0 | 51 d | 34.5 |

Results followed by distinct letters are showed statistical difference with the Chi-square test ($p < 0.05$).

Piracicaba (0.7ppm – F) since they were 2 years of age. Three-hundred and seventy teeth were sealed. The children were selected from a Dental Assistance program at the University of Campinas, Piracicaba, São Paulo, Brazil. The clinical procedures were conducted in the same location after the adults responsible for the children signed an informed consent for the treatment.

Clinical procedures of sealants application

Two dentists previously calibrated and assisted by dental hygienists carried out all clinical procedures.

Sealants were applied after occlusal surface prophylaxis. A relative isolation was accomplished with the use of cotton rolls, preventing the contamination by saliva.

Teeth were conditioned with 35% phosphoric acid gel, which was removed after thirty seconds with water spray. Cotton rolls were carefully substituted, preventing the contamination by saliva.

The manipulation of Variglass was made using a ratio of powder to liquid of 1:2. This ratio was used to obtain lower viscosity of the material, allowing it to flow into fissures. The material was inserted into fissures with a probe, reaching the entire extension and depth, next, the material was light-cured for forty seconds. Occlusal contacts were verified and adjusted, when necessary.

Clinical evaluations (retention and dental caries incidence) were done during 6 months, 1, 4 and 6 years.

Two dentists performed these evaluations. A clinical mirror and a probe (removing debris) were used with natural light. The exams took place at school playgrounds.

The 6-year clinical evaluation was approved by the University Institutional Review Committee. After six years 148 (40%) teeth were examined.

The criteria adopted to evaluate the retention of sealant were the following:

- Total Retention (TR): total retention of sealant on the occlusal surface;
- Partial Retention Type 1 (PR1): presence of sealant in 2/3 of the pit extension, with small fractures and losses of material.
- Partial Retention Type 2 (PR2): presence of sealant in 1/3 of the pit extension with fractures and losses of material.
- Total Loss (TL): absence of sealant on the occlusal surface of the teeth. The caries evaluation criteria were (adapted from Ketley & Holt¹⁷):
- No visible caries;
- Presence of microcavity (diameter ≤ 1.5 mm across fissure)
- Filled teeth.

The Friedman test was employed to compare the retention rates among the different evaluation times. The Chi-square test was used to compare caries prevalence (cariou and filled teeth - C+F) among the evaluations.

RESULTS

Table 1 shows the retention rate of the material: after 6 months of clinical evaluation 52% of the total placement remained; after the first year, 19%; after four years, 5%; and after six years, 3.4%. Regarding partial loss of sealant, the results (R1 e R2) after 6 months, 1, 4 and 6 years were 38%, 37%, 22% and 16.2%, respectively. There were statistical differences in relation to retention rates among the evaluations, except no significant difference was observed between the fourth and sixth year evaluations.

Regarding caries incidence (C) and filled teeth (F), the following results were observed: after 6 months neither filled nor carious teeth were found; after a year, 0.6% filled teeth and no carious tooth were found; after four years, 10.2% filled and 5.8% carious teeth were observed; and after six years, 25% filled and 9.5% carious teeth were observed (Table 2). Statistical differences were found among all evaluation periods when carious and filled teeth were evaluated.

DISCUSSION

In the last several years, many studies have demonstrated the possibility of utilizing hybrid materials as fissure sealants. However the current literature does not show research in which the clinical behavior of these materials during long periods was surveyed. This present study contributes to the literature by providing a longitudinal study of a hybrid material used as sealant.

In this study, the total retention rate obtained for this material (Variglass) was 19% after one year. This result differs from the results obtained by Winkler *et al.* (51% - resin modified glass ionomer - RMGI),¹⁸ Luca-Fraga & Pimenta (95.9% - polyacid-modified composite resin)¹⁹ and Vilella *et al.* (91.3% - RMGI),²⁰ but is similar to those found by Aranda and Garcia-Godoy (20% - RMGI)²¹ and Pereira *et al.* (31% - RMGI).¹⁴ The differences among retention rates can be explained by the material origin (different manufacturers, wear and fracture resistance); characteristics of the patient (age, cooperation, tooth location, eruption stage of the tooth) and the operator (material manipulation and skill in controlling moisture during placement).^{22,23} Winkler *et al.*,¹⁸ did not verify differences in resin-modified glass ionomer retention rates when compared to resin sealant after a year, however, they concluded that RMGI appeared to wear markedly after two years of clinical evaluation, which could be the reason for the low retention rate of the surveyed material.

After six years of clinical evaluation, only 3.4% of the sealant presented total retention when using Variglass. There are not long-term clinical studies in which polyacid-modified composite resin was applied, however other materials have been evaluated for long periods of time. Forss and Halme evaluated the

clinical retention of conventional glass ionomer cement and a resin used as occlusal sealant after seven years of placement and noticed 10.3% and 45.4% of total retention, respectively.⁹ Poulsen *et al.*, found about 90% total loss of conventional glass ionomer sealant and less than 10% total loss of light-cured resin based sealant, three years after placement.²⁴ Other research has shown differences related to glass ionomer material retention rate in shorter period of evaluations, such as Mills and Ball,²⁵ who appraised a silver glass ionomer cement that demonstrated 81% total retention after a year, while a similar research study demonstrated 23%.²⁶

In relation to the presence of caries, it was observed statistical differences among all periods of evaluation. The percentage of incidence of filled teeth was 2.6 times more than the incidence of carious teeth after six years. The suggestion that all filled teeth were carious before invasive treatment cannot be verified, thus, an uncertainty remains due to the possibility of over-treatment. Few professionals take continuing education courses in caries diagnosis, which often leads to unnecessary treatments such as restorations of lesions in enamel.²⁷ Thus, many dentists continue to base their practice on the philosophy of operative dentistry.

The present study did not evaluate a control group, however, in an epidemiological survey done in 2000 in Piracicaba, with children between 12 and 14 years of age (the same age range of this study), about 50% of first permanent molars were attacked by caries (F.C. Kozłowski, written communication, December, 2001), while in the present study about 34% were carious. These results cannot be extrapolated for this study, but they suggest that there was a true preventive effect of the material used.

Placement of fissure sealants have been more effective when children whose risk of carious development is higher or who have incipient caries on occlusal surfaces are treated.^{15,28} Pereira *et al.*,¹⁵ noted that children who presented active white spot lesions at baseline had a higher risk of carious development two years after the evaluation. Consequently the identification of risk predictors is important in order to increase the efficacy of the procedure and reduce costs, since only teeth with caries risk would be treated with a specific preventive procedure.

CONCLUSION

Polyacid-modified composite resin material presented a low retention rate in a six-year evaluation, nevertheless, the material had a satisfactory efficacy in caries prevention.

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