

Clinical Study of a Polyacid-Modified Resin Composite-Based Fissure Sealant in Young Permanent Molars

Maryam Talebi*, Fatemeh Mazhari*, Ali Reza Sarraf*, Sina Sanaie Zaker**

ABSTRACT

Background: Treating caries-susceptible pits and fissures with resin sealants enjoys wide acceptance as a preventive strategy. The aim of this study was to evaluate the one-year clinical performance of a polyacid-modified resin composite material (Dyract) in comparison to a composite resin material (Helioseal F).

Methods: Using a half-mouth design, 100 sealants were placed on the sound first permanent molars of 50 children aged between six and 10 years. Half of the teeth (n = 50) were sealed with Dyract and half (n = 50) with Helioseal F. Teeth were evaluated at baseline, 3, 6 and 12 month intervals. The qualities of the restorations were evaluated in accordance with modified U.S. Public Health Service (USPHS) codes and WHO criteria for the presence of dental caries. The data were analyzed according to the Mann-Whitney test and the spearman correlation.

Results: There were no statistical differences between the two examined groups, considering marginal integrity, retention and caries. There also appeared to be no statistical difference between the standards in different ages (six-eight years and eight-ten years) and the two arches ($P > 0.05$). Decayed/Missing/Filled Teeth index (DMFT) had convert relation with retention and marginal integrity in both materials.

Conclusion: In this study there was no clinical difference between the two sealants. Polyacid Modified Resin Composite (PMRC) materials have low wear resistance compared to resin composite, but the two curing reactions that occur in PMRC materials might have improved their mechanical retention in the long term. Therefore, further study on these characteristics is recommended.

Keywords: Composite resins, compomers, pit and fissure sealants, retention.

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Introduction

During recent decades, dentistry has experienced outstanding scientific advances in restorative materials and techniques. They have allowed more efficient oral health management with greater emphasis on prevention.¹ It is likely that the most caries-susceptible period for a first molar tooth concerns the 1.0-1.5-year-long eruption phase. At that period, the enamel is not fully matured, the child and parents often do not know that a new tooth is emerging and it is usually difficult for the child to clean the erupting tooth surfaces.² Pit and fissure sealants are the most effective means of reducing caries risk that arise from these sites. In order to maximize the caries-preventing effect of fissure sealants, fluoride incorporation into these materials

has been considered.³ The original inclusion of fluoride into Bis-GMA or resin sealants resulted in very low levels of fluoride availability and release compared to other dental materials, such as glass ionomers. Since addition of fluoride has no detrimental effect on sealant retention, it is certainly appropriate to use fluoride-containing sealants.³ Helioseal F is a filled material with fluoride release. Polyacid Modified Resin Composite (PMRC), introduced in the early 1990s, has been developed as a direct esthetic restorative material that combined the desirable properties of light-curing composite with those of fluoride-releasing glass-ionomer cement.⁴ A reduction of approximately 60% of secondary caries formation occurs

*Assistant Professor, Department of Pedodontics, School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran.

**Dentist, Mashhad University of Medical Sciences, Mashhad, Iran.

*Correspondence to: Maryam Talebi, Assistant Professor, Department of Pedodontics, School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran. E-mail: taleby_m@yahoo.com

with the use of the fluoride-releasing sealant compared with conventional sealant material. In addition, primary caries formation in surface enamel adjacent to the fluoride-releasing sealant shows about a 35% reduction in lesion depth, indicating an enhanced degree of caries resistance.⁵ Several studies reported physical properties of the PMRC materials similar to those of the resin composite.^{6,7} The aim of this study was to evaluate the one-year clinical performance of one polyacid-modified resin composite material (Dyract) in comparison to composite resin materials (Helioclear F). This clinical study evaluated the retention, marginal integrity and caries-preventing effects of these materials.

Materials and Methods

Sample selection

In this clinical, interventional study, the sample subjects were children between six and ten years of age who were referred to the Department of Pediatric Dentistry in Mashhad Dental School during the years 2005-2006. This clinical study was carried out, bearing the following criteria in mind:

Patients had their permanent first molars fully erupted.

At least two first molars were required for sealant placement, in the mandible or maxilla.

The permanent molars were free of occlusal caries, and had deep, narrow, I-shaped fissures. Parental informed consent was obtained.

Sealant placement

Two types of fissure sealants were used in this study: a) Dyract seal (Dentsply Detrey, Konstanz, Germany), a polyacid-modified resin composite applied in combination with the total seal technique;

b) Helioclear F (Ivoclar vivadent, Schaan/Liechtenstein), a fluoridated Bis-GMA sealant, used as a control. The teeth to be sealed were cleaned with a bristle brush rotating on a low-speed hand piece with irrigation, and then were isolated with a rubber dam. The occlusal surfaces were prepared, using the invasive technique described by Garcia-Godoy 1994.⁸ During each appointment, patients received all sealants required for their teeth. The sealants were applied randomly to the right/left side of the maxilla/mandible. The sealant application protocol is detailed as follows: the conventional acid etch-rinse technique for both materials was used (30-second phosphoric acid 36% and 15-second water rinse, air dry). The sealant materials, application and light cured for 40 seconds. Bonding agents were not used. The curing unit used in this study, the Astralis 3 curing light (Ivoclar vivadent, Austria) had a light output of $> 500 \text{ mw/cm}^2$. The sealing area was checked with an explorer for complete coverage and retention. The occlusion was checked with articulating paper. Before leaving, the patients were given diet advice and also instructed on brushing with fluoridated toothpaste.

Sample size

Like a similar study⁹, 27 children were determined for the sample size. For better evaluation, the sample size was increased to 50 children (100 teeth).

Evaluation

The patients were scheduled for evaluation visits at three, six and 12 months. The sealants were evaluated in terms of retention, presence of caries and marginal integrity.

Table 1. Distribution of retention rates in the study.

Score	3 rd month		6 th Month		12 th month	
	Dyract	Helioclear	Dyract	Helioclear	Dyract	Helioclear
1	46 (92.0)	43 (86.0)	45 (90.0)	43 (86.0)	44 (88.0)	40 (80.0)
2	4 (8.0)	6 (12.0)	5 (10.0)	6 (12.0)	6 (12.0)	9 (18.0)
3	0 (0.0)	1 (2.0)	0 (0.0)	1 (2.0)	0 (0.0)	1 (2.0)
Total	50 (100)	50 (100)	50 (100)	50 (100)	50 (100)	50 (100)
	Z = 1.15, P = 0.24		Z = 0.9, P = 0.36		Z = 1.5, P = 0.13	

Table 2. Distribution of marginal integrity scores in the study.

Score	3 rd month		6 th Month		12 th month	
	Dyract	Helioseal	Dyract	Helioseal	Dyract	Helioseal
1	46 (92.0)	42 (85.7)	45 (90.0)	40 (81.6)	45 (90.0)	40 (81.6)
2	4 (8.0)	7 (14.3)	5 (10.0)	6 (18.4)	5 (10.0)	9 (18.0)
3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	50 (100)	49 (100)	50 (100)	49 (100)	50 (100)	49 (100)
	Z = 1, P = 0.31		Z = 1.2, P = 0.20		Z = 1.2, P = 0.2	

Marginal integrity: 1 = present, 2 = partially present, 3 = lost.

Presence of caries: 1=present or 2=absent.

The marginal integrity of sealants was evaluated using the USHPS system.¹⁰

Alpha = Excellent margin with no evidence with a small crevice detected.

Bravo = An acceptable marginal with a small crevice detected.

Charlie = Unacceptable margin with larger crevice present.

The Mann Whitney test and spearman correlation were used to evaluate whether there were statistically significant differences between the fissure sealant materials. The α value was set at 0.05.

Results

A total of 100 teeth (62 maxillary and 38 mandibular) were sealed with either Dyract seal (n : 50) or Helioseal F (n : 50). The teeth were evaluated postoperatively at three, six and 12 months. Tables 1, 2, 3 and 4 show the results obtained with respect to each evaluation parameter. The Dyract seal showed complete retention on teeth with 92%, 90%, and 60% at three, six and 12 months evaluations, respectively.

The corresponding Helioseal F rates were 86%, 86% and 80% for the same evaluations, respectively. The differences for each evaluation period were statistically insignificant ($P > 0.05$). All the teeth sealed with both materials were carries-free at three-, six- and 12-month evaluations. Dyract seal showed complete marginal integrity on teeth with 92%, 90%, and 90% at three, six and 12 month evaluations, respectively. The corresponding Helioseal F rates were 85.7%, and 81.6% for the same evaluations, respectively.

Table 3. Decayed/Missing/Filled Teeth index correlation with retention rates in the study.

Retention	rs	P-value
RD ₃	0.183	0.2
RD ₆	0.18	0.19
RD ₁₂	0.26	0.06
RH ₃	0.28	0.048
RH ₆	0.28	0.048
RH ₁₂	0.31	0.02

-R = Retention

-rs = Spearman Correlation

-3, 6, 12: Months of follow up

-D = Dyract

-H = Helioseal

Correlation between marginal integrity and retention with DMFT was significant in both materials. There were no significant differences between retention and marginal integrity in the two arches and also in different age groups (six-eight years and eight-ten years).

Table 4. Decayed/Missing/Filled Teeth index correlation with marginal integrity scores in the study.

Marginal Integrity	rs	P-value
MID ₃	0.21	0.12
MID ₆	0.29	0.03
MID ₁₂	0.29	0.03
MIH ₃	0.19	0.17
MIH ₆	0.2	0.15
MIH ₁₂	0.2	0.15

MI = Marginal Integrity

Discussion

In this study, the clinical efficacy of a polyacid-modified resin-composite based fissure sealant was evaluated on permanent first molars, which were prepared invasively prior to sealant application. Higher retention rates for fissure sealants have been reported where mechanical preparation of fissures had been carried out.¹¹⁻¹⁴ The most important advantage of the invasive technique is that it can be used as a diagnostic tool for the suspected fissures. It allows the clinician to clean the fissure entrance. In this study, we made use of the conventional etching method for both materials (phosphoric acid 36% and rinsing). Higher bond strength value has been reported by this method.¹⁵⁻¹⁹ The retention rate becomes a major point of concern when a study tests the clinical performance of a fissure sealant material.¹⁹⁻²⁴ In this study, there was no statistically significant difference for complete retention rates between materials. In other studies, higher retention rates have been reported in resin-composite based sealants and lower retention rates were in glass ionomer sealants. Use of polyacid-modified resin-composite based sealant has similar or slightly lower retention rates compared with resin-composite based sealants.^{14,19,20,23,24} The criteria for patient/tooth selection, the isolation technique used, the operative technique, the choice of materials and the clinical performance evaluation methods used have possibly been associated with the variation in results found among the studies. In this study, there was no significant difference between marginal integrity in materials. After a two-year follow up, Gungor and others reported that the Dyract seal and Delton Fs had similar marginal integrity.²² Fuks et al observed that using non-rinse conditioner with Dyract seal led to considerably lower shear bond strength values than using Dyract seal and Helioseal with phosphoric acid etching and rinsing.¹⁶ Marginal integrity of the Dyract seal was improved gradually. Low wear resistance of PMRC materials compared to resin composites might have helped the material itself wear away easily from the surface and create better marginal integrity over an extended period of time.^{13,20} After one year, the teeth sealed with Dyract seal and Helioseal F were found to be caries-free in our study. The patients were given diet advice and also instructed on brushing with fluoridated toothpaste. Other studies verified these results.^{14,17-19,21,22} These studies reported that resin-composite and PMRC

sealants had no significant difference in caries rate after one, two and three years follow ups. In our study, there was significant correlation between retention and marginal integrity with DMFT in children. Heyduck et al observed that fissure sealant was helpful for patients with low and medium dental caries.²⁵ Thus, diet advice and good oral hygiene are essential for the efficacy of sealants.

Conclusion

In this study, there was no clinical difference between the two sealants. PMRC materials had low wear resistance compared to resin composites, but two curing reactions that occurred in PMRC materials might have improved their mechanical retention in the long term. Therefore, more study on these characteristics is recommended.

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References

1. Corona SA, Borsatto MC, Garcia L, Ramos RP, Palma-Dibb RG. Randomized, controlled trial comparing the retention of a flowable restorative system with a conventional resin sealant: one-year follow up. *Int J Paediatr Dent* 2005; 15(1): 44-50.
2. Taifour D, Frencken JE, van't Hof MA, Beiruti N, Truin GJ. Effects of glass ionomer sealants in newly erupted first molars after 5 years: a pilot study. *Community Dent Oral Epidemiol* 2003; 31(4): 314-9.
3. Feigal RJ, Donly KJ. The use of pit and fissure sealants. *Pediatr Dent* 2006; 28(2): 143-50.
4. Duke ES. From composite resins to compomers: what have we gained? *Compend Contin Educ Dent* 1999; 20(2): 34-7.
5. Hicks MJ, Flaitz CM. Pit and fissure sealants and conservative adhesive restorations: scientific and clinical rationale. In: Pinkham J, Casamassimo P, Fields HW, McTigue DJ, Nowak A, Editors. *Pediatric Dentistry: Infancy through Adolescence*. St. Louis: Mosby; 2005.p. 555.
6. Attin T, Vataschki M, Hellwig E. Properties of resin-modified glass-ionomer restorative materials and two polyacid-modified resin composite materials. *Quintessence Int* 1996; 27(3): 203-9.
7. Abate PF, Polack MA, Macchi RL. Barcoll hardness of resin-modified glass-ionomer cements and a compomer. *Quintessence Int* 1997; 28(5): 345-8.

8. Garcia-Godoy F, de Araujo FB. Enhancement of fissure sealant penetration and adaptation: the enameloplasty technique. *J Clin Pediatr Dent* 1994; 19(1): 13-8.
9. Pereira AC, Pardi V, Mialhe FL, Meneghim MC, Ambrosano GM. A 3-year clinical evaluation of glass-ionomer cements used as fissure sealants. *Am J Dent* 2003; 16(1): 23-7.
10. Koch MJ, Garcia-Godoy F, Mayer T, Staehle HJ. Clinical evaluation of Helioseal F fissure sealant. *Clin Oral Investig* 1997; 1(4): 199-202.
11. Gray GB. An evaluation of sealant restorations after 2 years. *Br Dent J* 1999; 186(11): 569-75.
12. Lygidakis NA, Oulis KI. A comparison of Fluoroshield with Delton fissure sealant: four year results. *Pediatr Dent* 1999; 21(7): 429-31.
13. Salama FS, Al Hammad NS. Marginal seal of sealant and compomer materials with and without enameloplasty. *Int J Paediatr Dent* 2002; 12(1): 39-46.
14. Gungor HC, Altay N, Batirbaygil Y, Unlu N. In vitro evaluation of the effect of a surfactant-containing experimental acid gel on sealant microleakage. *Quintessence Int* 2002; 33(9): 679-84.
15. Cehreli ZC, Altay N. Three-year clinical evaluation of a polyacid-modified resin composite in minimally invasive occlusal cavities. *J Dent* 2000; 28(2): 117-22.
16. Fuks AB, Eidelman E, Lewinstein I. Shear strength of sealants placed with non-rinse conditioning compared to a conventional acid etch-rinse technique. *ASDC J Dent Child* 2002; 69(3): 239-42, 233.
17. Lampa E, Brechter A, van Dijken JW. Effect of a nonrinse conditioner on the durability of a polyacid-modified resin composite fissure sealant. *J Dent Child (Chic)* 2004; 71(2): 152-7.
18. Youssef MN, Youssef FA, Souza-Zaroni WC, Turbino ML, Vieira MM. Effect of enamel preparation method on in vitro marginal microleakage of a flowable composite used as pit and fissure sealant. *Int J Paediatr Dent* 2006; 16(5): 342-7.
19. Yakut N, Sonmez H. Resin composite sealant vs. polyacid-modified resin composite applied to post eruptive mature and immature molars: two year clinical study. *J Clin Pediatr Dent* 2006; 30(3): 215-8.
20. Luca-Fraga LR, Pimenta LA. Clinical evaluation of glass-ionomer/resin-based hybrid materials used as pit and fissure sealants. *Quintessence Int* 2001; 32(6): 463-8.
21. Autio-Gold JT. Clinical evaluation of a medium-filled flowable restorative material as a pit and fissure sealant. *Oper Dent* 2002; 27(4): 325-9.
22. Gungor HC, Altay N, Alpar R. Clinical evaluation of a polyacid-modified resin composite-based fissure sealant: two-year results. *Oper Dent* 2004; 29(3): 254-60.
23. Puppini-Rontani RM, Baglioni-Gouveia ME, deGoes MF, Garcia-Godoy F. Compomer as a pit and fissure sealant: effectiveness and retention after 24 months. *J Dent Child (Chic)* 2006; 73(1): 31-6.
24. Poulsen S, Laurberg L, Vaeth M, Jensen U, Haubek D. A field trial of resin-based and glass-ionomer fissure sealants: clinical and radiographic assessment of caries. *Community Dent Oral Epidemiol* 2006; 34(1): 36-40.
25. Heyduck C, Meller C, Schwahn C, Splieth CH. Effectiveness of sealants in adolescents with high and low caries experience. *Caries Res* 2006; 40(5): 375-81.