

Resin composite sealant vs. polyacid-modified resin composite applied to post eruptive mature and immature molars: two year clinical study

Neşe Yakut* / Hayriye Sönmez**

The aim of this study was to evaluate the effect of the post eruptive enamel maturation on the durability of polyacid-modified resin composite (PMRC; Dyract Seal) and resin composite (Fissurit F) sealant and understanding the effect of posteruptive enamel maturation on the sealant retention. To determine the possible effect of the enamel maturation to the sealant retention, the success of the sealants applied to the newly erupted mandibular first molars of the 6 to 7 years old children, who were in the fourth or fifth eruption stage according to Dennison's classification were compared with the sealants applied to first mandibular molars which were in the mouth at least for two years of the 9 years old children. The molars of the younger children were accepted as immature and the elders were posteruptively mature. The sealant retention was evaluated for two years. At the end of two years the retention rates of Dyract Seal were significantly lower. Maturation has no effect on the sealant retention. Dyract Seal application after NRC conditioning is not recommended.

J Clin Pediatr Dent 30(2): 215–218, 2006

INTRODUCTION

Fissure sealants have played a part on the preventive programs and have proven effective in reducing occlusal caries. As the occlusal caries are mostly seen during the post eruptive three years, the “Council of Dental Research Policy” recommends sealants to be applied as soon as possible after the eruption of the teeth.¹ In a study Swango and Brunelle reported that by age 8 about 20% of the occlusal surfaces of the permanent first molars presented caries and they concluded that the sealants should be placed as earlier as possible.²

Wagoner reported that the enamel of the newly erupted tooth is immature and is hypomineralized so they are at a greater risk of caries during the first 2 to 4 years after the eruption.³ Galil and Gwinnet after the SEM examination of the fissures of the newly erupted

teeth, reported that the residual ameloblasts in the fissures could create a disadvantage for the retention of the sealants applied during the early eruption stages.⁴ The examination of the enamel surface of the third molar before emerging into the oral cavity showed that the enamel is porous with a variety of diffusion pathways into the subsurface enamel.⁵⁻⁷ Some other investigators reported that the hypomineralized enamel is relatively higher in fissure areas of the immature teeth.^{8,9,10} The changes occurring in the micromorphology of the enamel during the few years after the eruption is called post eruptive maturation. The exchange and the diffusion of the minerals into the enamel decrease the pore volume and make it more resistant against the acid attacks.^{11,12}

Although numerous reports are documented and discussed on fissure sealants, there is a lack of information between the sealant retention and enamel maturation.¹³ The studies evaluating the retention rates of the sealants suggested that the material applied on the first or second molars at the early eruption age showed more failure than those placed in older children.¹⁴⁻¹⁶ This may be due to the maturation of the tooth enamel or any other factor like saliva contamination, etc.

The aim of this clinical study is primarily to evaluate the efficacy of the enamel maturation on the success of the sealant retention and secondarily to compare the retention rates of the resin based (Fissurit F) and polyacid modified resin composite (PMRC) based (Dyract Seal) materials applied on the first molar teeth soon

* Neşe Yakut, DDS, PhD, clinician, Department of Pedodontics, Public Dental Health Clinic of Ankara Hospital, Ankara, Turkey

** Hayriye Sönmez, DDS, Professor, Department of Pedodontics, School of Dentistry, Ankara University, Ankara, Turkey

Send all correspondence to: Dr. Hayriye Sönmez, 232 Sol 1519, Yıldız, Ankara Turkey

Voice: + 90 312 212 62 50/ 211

Fax: +90 312 212 39 54

E-mail: hayriyesonmez@hotmail.com

after eruption (immature) and, two or three years after eruption (post eruptively mature).

MATERIALS AND METHODS

Thirty (30) children 6 to 7 years old and 30 children 9 years old, who attended to the Pediatric Department of Dental Faculty of Ankara University, were included in this study. Informed consents and the approval of the ethics committee were obtained. To be included in this study, each child had to have sound contralateral first mandibular molars with deep fissures. In the 6 year old children, newly erupted mandibular first molars were in the fourth or fifth eruption stages according to Dennison's classification. In the 9 year old children the mandibular first molars were fully erupted and had been in the oral cavity for two or three years. The treated molars of the 6 years old children were accepted as immature and the 9 years aged children as post eruptively mature.

CLINICAL PROCEDURES OF SEALANT APPLICATION

Resin based (Fissurit F, Voco) and a Polyacid—modified resin composite (Dyract Seal, Dentsply/De Trey) sealant were applied on the occlusal surfaces of the mandibular first molar teeth symmetrically in the 6 to 7 year old and 9 year old children. Before the application of the material, the plaque and the debris on the occlusal surfaces were cleaned with pumice without fluoride. For all sealant applications careful moisture control was maintained by cotton roll isolation procedures and a chairside assistant. The sealants were applied by one operator as following:

Dyract seal

After drying the tooth, one drop of non-rinse conditioner (NRC) was applied on the occlusal surface for 20 seconds. The excess of the material was gently removed with a gentle stream of air and was not rinsed with water. One drop of Prime&Bond NT was applied to the fissures and left for 20 seconds. To remove the solvents the tooth was dried gently for 5 seconds with air spray. Then Dyract Seal was placed on the fissures and light cured with an halogen light curing unit (Hilux 2000 Curing Light) for 20 seconds.

Fissurit F

After drying the tooth, occlusal surface was etched for 30 seconds with 37% phosphoric acid gel, then rinsed for 15 seconds with an oil free water spray and dried for 5 seconds. Then the Fissurit F (Voco) was applied to the fissures and polymerized for 40 seconds with Hilux 2000 Curing Light.

The patients were sheduled for evaluation at 3, 6, 12 and 24 months. The criteria to evaluate the sealants were as total retention, partially lost or totally lost. During this study at each recall if a sealant was partially or totally lost the sealant material were reapplied using the same procedures. The results were statistically evaluated with z test.

RESULTS

Thirty children and sixty mandibular first molar teeth in each age group (6 to 7 and 9 years old), total of 60 children and one hundred twenty mandibular first molar teeth were evaluated in this study. The retention rates of the sealant materials are given in Tables 1 and 2.

The evaluation of the results at 3, 6, 12, and 24 months recall appointments showed the retention rates of Dyract Seal was significantly lower ($p \leq 0.05$) than Fissurit F in both immature (6 years old children) and mature (9 years old children) teeth.

When the results of the immature and mature teeth were compared, retention rates of the materials with mature teeth were higher than immature teeth, but not significantly different during the recall appointments ($p > 0.05$).

Re-treatment of the partially or totally lost sealants at the recall appointments increased the retention rates of the materials. The failure rates were higher in the third and sixth month appointments. 56.6% and 46.6% of the partially or totally lost Dyract Seal were reapplied at the third month recall for the immature and mature teeth respectively. In the same period the retreatment was 10.4% and 6.6% for the Fissurit F applied immature and mature teeth respectively. If the teeth that required treatment were considered as failure and removed from the study the results would be as Table 3.

Table 1. Distribution of the retention rates in 6-7 year old children

	3rd Month		6th Month		12th Month		24th Month	
	Dyract Seal	Fissurit F	Dyract Seal	Fissurit F	Dyract Seal	Fissurit F	Dyract Seal	Fissurit F
CR*	13 (43.3 %)	27 (90 %)	16 (53,3 %)	29 (96,6 %)	22 (73,3 %)	30 (100 %)	24 (80 %)	30 (100 %)
PL†	9 (30 %)	1 (3,3 %)	8 (26,6 %)	0 (0 %)	5 (16,6 %)	0 (0 %)	4 (13,3 %)	0 (0 %)
TL‡	8 (26,6 %)	2 (6,6 %)	6 (20 %)	1 (3,3 %)	3 (10 %)	0 (0 %)	2 (6,6 %)	0 (0 %)

* Complete Retention
 † Partial Lost
 ‡ Total Lost

Table 2. Distribution of the retention rates in 9 year old children

	3rd Month		6th Month		12th Month		24th Month	
	Dyract Seal	Fissurit F	Dyract Seal	Fissurit F	Dyract Seal	Fissurit F	Dyract Seal	Fissurit F
CR	16 (53,3 %)	28 (93,3 %)	17 (56,6 %)	29 (96,6 %)	23 (76,6 %)	30 (100 %)	26 (86,6 %)	30 (100 %)
PL	8 (26,6 %)	1 (3,3 %)	8 (26,6 %)	1 (3,3 %)	4 (13,3 %)	0 (0 %)	3 (10 %)	0 (0 %)
TL	6 (20 %)	1 (3,3 %)	5 (16,6 %)	0 (0 %)	3 (10 %)	0 (0 %)	1 (3,3 %)	0 (0 %)

* Complete Retention

† Partial Lost

‡ Total Lost

Table 3. Distribution of retention rates of teeth which showed total retention from the base-line

	6-7 years old children (unmatured group)		9 years old children (matured group)	
	Dyract Seal	Fissurit F	Dyract Seal	Fissurit F
CR	10 (33,3 %)	27 (90 %)	12 (40 %)	27 (90 %)
PL and TL	20(66.6 %)	3 (10 %)	18 (60 %)	3 (10 %)
Total	30	30	30	30

DISCUSSION

The histological investigations of the unerupted teeth showed a relatively high incidence of hypomineralized and porous enamel in the fissure areas than the smooth surface prior to the emergence into the oral cavity.^{4,6} During the first few years after eruption the enamel is matured post eruptively and the surface microstructure is modified with the environmental conditions. The occlusal pit and fissures of the molar teeth are especially caries susceptible during this period and treatment with the fissure sealants are widely accepted as a part of preventive programs. The greatest risk of sealant failure observed in the early age placements and the age of the patient has been directly correlated with the increased sealant retention. This finding may be due to various factors and maturation, or placement technique could be some of them.

The materials used in this study are fluoride releasing conventional resin type (Fissurit F) and a polyacid-modified resin composite (Dyract-Seal). Another focus of this study was also to evaluate the efficacy of these materials. Nonrinse conditioners (NRC), as self etching and Prime & Bond NT were used prior to applying Dyract Seal. Fissurit F is a resin bond material, which is applied by conventional method after etching enamel with phosphoric acid. A previous study showed that some of the teeth with partial loss of the sealants left the tooth as equally susceptible to caries as an unsealed control tooth.¹⁷ Due to that, during this study, the sealants were reapplied when the sealant materials was totally or partially lost at each recall visits. Re-treatment increased the retention rates of the sealants in the present study. When the results of the third and twenty

fourth months of Dyract Seal were evaluated, it was observed that the retention rates were increased significantly from 43% to 80% for immature molars and 53.3% to 86.6% for mature molars. The retention of the Fissurit F also increased significantly in the same period due to the re-treatment procedures. Re-treatment rates were highest at the third and sixth months recall appointments and the need for re-treatment decreased gradually after the sixth months. This finding also confirms the importance of the periodic recall system for the highest retention in a preventive program. Straffon¹⁸ analyzed the clinical effectiveness of a sealant and requirements for re-treatment to maintain the optimum protection from caries and reported the importance of the re-treatment of the sealants especially during the sixth months after application.

In this study, any significant difference was not observed between the retention rates of the materials when compared due to the ages of the children. This may explain that the alterations occurring in the enamel during the posteruptive maturation is not a factor affecting the sealant retention. Previously reported direct correlation between the age of the patient and the failure rate of the sealant retention might be due to patient cooperation or saliva control rather than enamel maturation.¹⁹

If the re-treated teeth were considered as failures and were removed from this study the retention of the Dyract Seal would be only 33% for the immature and 40% for the mature teeth or even lower at the end of the twenty fourth months. Similarly the retention rates of the Fissurit F would be 90% for both immature and mature teeth. One study showed retention rates of the Dyract Seal and Delton Fs of 80% and 71.4% respectively after two years in a clinical study in which the invasive technique was used prior to the application of the sealant materials.²⁰ The retention rates of Dyract Seal in the present study would be lower than the mentioned study, if the teeth were not retreated. In the study of Gungör and colleagues, the utilization of the invasive technique prior to the sealant application is thought to increase the success of Dyract Seal. Fuks reported that a non-rinse conditioning with Dyract Seal showed a considerably lower bond strength value

than Dyract Seal applied with phosphoric acid and Heliobond.²¹ The conclusion of another *in vitro* study also showed that Dyract Seal applied with non-rinse conditioner (NRC) was not as successful as applied following phosphoric acid etching.²² Çehreli and Altay observed superficial demineralization of the enamel after a 20 second treatment with NRC.²³ Similarly Pashley and Tay reported shallow etching depth (100-nm) after treatment the buccal enamel with NRC.²⁴ The findings of the present study clinically supports the results of these *in vitro* studies as non-rinse conditioning and Dyract Seal is not as successful as conventional resin sealants. Recently, Lampa *et al.* investigated the effect of NRC on the durability of Dyract Seal and observed that the sealant retention loss were significantly higher than conventional resin sealant and PMRC sealant applied following phosphoric acid conditioned fissures.²⁵

An interesting finding in the present study was no caries was detected in both sealant materials applied mature and immature molars despite the low retention of Dyract Seal. This might be due to re-treatment of the fissure sealants, the frequent recall visits and oral hygiene education during the appointments. An *in vitro* study is being continued in order to investigate further the effects of maturation on the retention of the sealants.

CONCLUSIONS

This study showed that the posteruptive enamel maturation has no effect on the retention of the sealants. The retention of the conventional resin sealant (Fissurit F) is higher than NRC conditioned Dyract Seal in both mature and immature teeth. The re-treatment rate was highest at 3 and 6 months. During this study no caries was detected in the fissures of the Dyract Seal or Fissurit F applied molars. Dyract Seal with conditioning NRC is not recommended if re-treatment would not be performed at the recall visits.

ACKNOWLEDGEMENTS

This study was supported by TUBITAK with (SBAG-2362) 1005197 project number.

REFERENCES

1. Council of Dental Research. Cost effectiveness of sealants in private practice and standards for use in prepaid dental care. *J Am Dent Assoc.* 110: 103-7, 1985.
2. Swango PA, Brunelle JA. Age and surface-specific caries attack rates from the national dental caries prevalence study. *J Dent Res.* 62:270, abstract no. 909, 1983.
3. Waggoner WF. Managing occlusal surfaces of young permanent molars. *J Am Dent Assoc.* 122: 72-76, 1983.

4. Galil KA, Gwinnett AJ. Histology of fissures in human unerupted teeth. *J Dent Res* 54: 960-964, 1975.
5. Boyde A, Jones SC. Scanning electron microscopic studies of the formation of mineralized tissues; In: Slavkin HC, Bavetta LA (eds): *Developmental Aspects of Oral Biology*. New York, Academic Press pp 243-247, 1972.
6. Crabb HSM. The porous outer enamel of unerupted human molars. *Caries Res* 10: 1-7, 1976.
7. Fejerskov O, Josephsen K, Nyvad B. Surface ultrastructure of unerupted mature human enamel. *Caries Res.* 18: 302-314, 1984.
8. Gwinnett AJ. Normal enamel II. Qualitative polarized light study. *J Dent Res* 45: 261-265, 1966.
9. Fejerskov O, Silness J, Karring T, Løe H. The occlusal fissure of unerupted third molars as an experimental caries model in man. *Scand Dent Res* 84: 142-149, 1976.
10. Suga S. Enamel hypomineralisation viewed from the pattern of progressive mineralization of human and monkey developing enamel. *Adv Dent Res* 3: 188-198, 1989.
11. Wöltgens JHM, Bervoets TJM, Witjes F, Driessens FCM. Changes in the composition of the enamel of human premolar teeth shortly after eruption. *Arch Oral Biol* 26: 717-719, 1981.
12. Driessens FCM, Heijligers HJM, Borggreven JMPM. Posteruptive maturation of tooth enamel studied with electron microprobe. *Caries Res* 19: 390-395, 1985.
13. Simonsen RJ. Pit and fissure sealant: review of the literature. *Ped Dent* 24: 393-414, 2002.
14. Walker J, Floyd K, Jakobsen J. The effectiveness of sealants in pediatric patients. *J Dent Child* 63:268-270, 1996.
15. Dennison JB, Straffon LH, More FG. Evaluating tooth eruption on sealant efficacy. *J Am Dent Assoc.* 121: 610-614, 1990.
16. Rock WP, Bradnock G. Effect of operator variability and patient age on the retention of fissure sealant resin: 3 year results. *Community Dent Oral Epidemiol.* 9: 207-209, 1981.
17. Mertz-Fair Hurst EJ, Fair Hurst CW, Williams JE, et al. A comparative clinical of two pit and fissure sealants: 7-year results in Augusta, Georgia. *J Am Dent Assoc.* 109: 252-55, 1984.
18. Straffon LH, Dennison JB, More FG. Three-year evaluation of sealant: effect of isolation on efficacy. *J Am Dent Assoc.* 10: 714-717, 1985.
19. Feigal RJ, Musherure P, Gillespie B, et al. Improved sealant retention with bonding agents: a clinical study of 2-bottle and single-bottle systems. *J Dent Res* 79: 1850-1856, 2000.
20. Güngör HC, Altay N, Alpar R. Clinical evaluation of a polyacid-modified, resin composite fissure sealant: two year results. *Oper Dent* 29: 254-260, 2004.
21. Fuks AB, Eidelman E, Lewinstein I. Shear strength of sealants placed with non-rinse conditioning compared to a conventional acid etch-rinse technique. *J Dent for Child* 69: 239-242, 2002.
22. Eronat N, Bardakçı Y, Makbule S. Effects of different preparation techniques on the microleakage of compomer and resin fissure sealants. *J Dent Child* 10: 250-253, 2003.
23. Çehreli ZC, Altay N. Effects of nonrinse conditioner and 17% ethylenediaminetetraacetic acid on the etch pattern of intact human permanent enamel. *Angle Orthodont* 70:22-27, 2000.
24. Pashley DH, Tay FR. Aggressiveness of contemporary self-etching adhesives. Part II: etching effects on unground enamel. *Dental Mater* 430-444, 2001.
25. Lampa E, Brexter A, Dijken JWV. Effects of nonrinse conditioner on the durability of a polyacid-modified resin, composite fissure sealant. *J Dent for Child.* 71:152-157, 2004.