

Scientific Article

Effectiveness of Primer and Bond in Sealant Retention and Caries Prevention

Ana Karina Mascarenhas, BDS, DrPH¹ • Huda Nazar, BDS² • Sabiha Al-Mutawaa, BDS, MSD³ • Pramod Soparkar, BDS, DMD⁴

Abstract: Purpose: The purpose of this clinical trial was to test the use of a primer and bonding agent to increase the retention of a fissure sealant in a group of Kuwaiti children. **Methods:** In 78 6- to 9-year-old children who required sealants in all 4 permanent first molars, sealants were placed in 2 teeth using a primer and bond (3M Scotch Bond) and in 2 teeth without primer and bond. Sealant retention was evaluated 1 and 2 years later. Sealant retention was scored as: (1) complete retention; (2) partial loss of sealant; and (3) complete loss of sealant. Caries was scored for those teeth in which the sealant was partially or completely lost. **Results:** At the 2-year examination, in teeth sealed with primer and bond: (a) 64% of the sealants were completely retained; (b) 23% were partially lost; and (c) 13% were completely lost. In teeth sealed without primer and bond: (a) 68% of the sealants were completely retained; (b) 20% were partially lost; and (c) 12% were completely lost. There was no difference in sealant retention ($P=.22$) and caries ($P=.56$) in teeth sealed with and without bond. In multivariate analyses after controlling for age, gender, tooth surface, and arch, no differences in sealant retention and caries were seen. **Conclusion:** If a proper technique is used in sealant placement, primer and bond does not enhance sealant retention. (*Pediatr Dent* 2008;30:25-8) Received November 30, 2006 / Last Revision March 30, 2007 / Revision Accepted April 13, 2007.

KEYWORDS: SEALANTS, BONDING AGENT, RETENTION, CARIES, EFFECTIVENESS

Pit and fissure sealants have consistently been demonstrated to be an effective, efficient, and safe means of preventing pit and fissure caries in recently erupted teeth.^{1,2} Because sealants act as a physical barrier to decay, protection is determined by the sealant's ability to adhere to the tooth surface. Sealant protection is reduced or lost when part or the entire bond between the tooth and sealant is broken.^{3,4}

Success with pit and fissure sealants is very dependent on technique. While there is no guarantee that a sealant is going to survive on any particular surface for a specified period of time, studies show that correctly placed sealants are likely to be retained over a period of years rather than months, or weeks.^{5,6} Factors that affect sealant retention that have been reported in the dental literature are: (1) eruption status; (2) isolation; (3) tooth surface; and (4) arch.^{1,7,8} Increasing sealant retention is the key to caries prevention. Bonding agents have been recommended to increase sealant retention. In vitro studies have shown that, when used under sealants, bonding agents reduce microleakage, improve shear bond strength, and enhance the

vertical penetration of the sealant.⁹⁻¹¹ Previous clinical studies have shown that bonding agents reduce the risk of sealant loss for both occlusal and buccal/lingual sealants,^{12,13} while others found no benefit to using a bonding agent.^{14,15} In a 2002 review of the dental literature on pit and fissure sealants, Simonsen speculated that modern bonding agents could improve sealant retention because bonding agents had gone through improvements over the previous 20 years.¹⁶ Similarly, the Pediatric Restorative Dentistry Consensus Conference in 2002 also recommended that "bonded resin sealants" placed by appropriately trained dental personnel are safe, effective, and underused in preventing pit and fissure caries on at-risk surfaces.¹⁷ Clinical trials on the use of bonding agents in increasing sealant retention are limited, however, with the results inconclusive.

The effectiveness of sealants in preventing caries is known to depend on sealant retention. To increase the retention of the fissure sealants, a clinical trial using a primer and bond below the sealant was conducted in the School Oral Health Program Kuwait-Forsyth, Al-Ahmadi Governate, Kuwait. The aim of the present study was to evaluate in Kuwaiti children the effectiveness of sealants with and without the use of primer and bond. Sealant effectiveness was measured using sealant retention and caries prevalence in previously sealed teeth.

Methods

This clinical trial was conducted in the School Oral Health Program Kuwait-Forsyth and was approved by the program's

¹Dr. Mascarenhas is associate professor and Director, Division of Dental Public Health, Boston University School of Dental Medicine, Boston, Mass; ²Dr. Nazar is Chairperson, Al-Ahmadi School Oral Health Program, Kuwait-Forsyth, Al-Ahmadi, Kuwait; ³Dr. Al-Mutawaa is Superintendent of Oral Health, Hawally, Kuwait; and ⁴Dr. Soparkar is Senior Clinical Investigator, Forsyth Institute, Boston. Correspond with Dr. Mascarenhas at karinam@bu.edu

human assurance committee. The study was conducted in 4 primary schools, 1 boys' school, and 3 girls' schools. Inclusion criteria for this study were having 4 sound permanent first molars. Children in these schools were screened to identify those with 4 sound permanent first molars. Children with stained and incipient carious lesions were excluded from the study. Seventy-eight 6- to 9-year-old children were eligible to be in the study. The children's parents had previously signed informed consent for treatment.

A split-mouth study design was used. Two permanent first molars—1 in each arch—were sealed using primer and bond (test group), and the other 2 first molars were sealed without primer and bond (control group). The teeth were randomly assigned to test and control groups. Sealants were applied by 4 trained and experienced dentists from Al-Ahmadi Governate. The sealant technique used was the same for each tooth. The tooth was: (1) isolated using a rubber dam; (2) cleaned with pumice using a rubber cup and rinsed well; (3) etched with etching gel (3M Scotchbond, 3M-ESPE, St. Paul, Minn) for 15 seconds; (4) rinsed thoroughly with water for 15 seconds; and (5) dried.

If the tooth was a test tooth: (1) 3M Scotchbond Multipurpose Plus System primer and bond (3M-ESPE St. Paul, Minn.) was then applied; (2) primer and bond was thinned out using an air syringe and photopolymerized for 20 seconds; (3) Delton Plus fissure sealant was then applied (Dentsply, York, Penn) along the pits and fissures according to the manufacturer's instruction and photopolymerized for 20 seconds.

The sealed area was checked with an explorer for complete coverage and retention. A total of 312 permanent first molars were sealed: 156 test teeth using primer and bond; and 156 control teeth sealed without using primer and bond. Sealants were applied to occlusal and buccal/lingual surfaces.

All children with sealed teeth were recalled 1 and 2 years later. The sealants were evaluated for retention, extension of coverage, and caries. All examinations were done by a single examiner who was blinded to the treatment provided. The criteria in Table 1 were used to score sealant retention.

Score	Criteria
Score 1	Sealant completely covering all buccal pits and palatal fissures
Score 2	Sealant partly covering a sound tooth
Score 2b	Sealant partly covering a carious tooth
Score 3a	Sealant completely lost and tooth is sound
Score 3b	Sealant completely lost and tooth is carious

Statistical analyses

Data were entered into a specially designed data entry program using Epi-Info v. 2000 (Centers for Disease Control and

Prevention, Atlanta, Ga). New variables, such as arch, caries status, and sealant retention were derived using Epi-Info. Sealant retention at last evaluation was measured by 2 variables:

1. sealant retention—proportion of sealants categorized as:
 - a. completely retained (score 1); and
 - b. not retained (scores 2a to 3b); and
2. sealant status—proportion of sealants categorized as:
 - a. completely retained (score 1);
 - b. partially lost (scores 2a and 2b); and
 - c. completely lost (scores 3a and 3b).

Previously sealed surfaces that were restored during the span of the study were considered completely lost. A caries status variable was created by combining scores 2b and 3b. Descriptive analyses and bivariate analyses were first performed using Epi-Info. The chi-square and Fisher exact tests were used to evaluate the effectiveness of sealants with and without the use of primer and bond. Because of the split-mouth design, paired analyses were also performed using the McNemar test. Mantel-Haenszel matched odds ratios are also reported. Data were then exported to SAS (SAS Institute, Cary, NC) for further analyses. Conditional logistic multivariate regression analyses were performed to evaluate sealant retention and caries in teeth sealed with and without primer and bond controlling for: age at evaluation; gender; tooth surface; and arch. In the model for caries, sealant status was also used. A *P*-value <.05 was considered statistically significant.

	With Primer and Bond (%)	Without Primer and Bond (%)	<i>P</i> -value*
Completely retained	64%	68%	.22
Partially lost	23%	20%	.28
Completely lost	13%	12%	.43

**P*-values from Mantel-Haenszel chi-square.

Results

The gender distribution was 86% female and 14% male, with a mean age of 7.7 ± 0.7 (SD) years at the start of the study. At the end of 1 year: 80% of sealants were completely retained; 14% were partially lost; and 6% were completely lost. Nine percent of the previously sealed teeth became carious. At the 2-year examination: 65% of the sealants were completely retained; 23% were partially lost; 12% were completely lost. Twenty-six percent of the previously sealed teeth became carious.

Subsequent results for sealant retention and caries are reported for 2 years after sealant application. Table 2 reports sealant retention in teeth with and without primer and bond. Bivariate analyses showed that there were no statistically significant differences seen between teeth sealed with and without primer and bond. The proportions of sealants completely retained (*P*=.22), partially lost (*P*=.28), and completely lost

($P=.43$) were similar between the teeth sealed with and without primer and bond. In teeth sealed with primer and bond: 64% of the sealants were completely retained; 23% were partially lost; and 13% were completely lost. In teeth sealed without primer and bond: 68% of the sealants completely retained; 20% were partially lost; and 12% were completely lost.

No difference was seen in caries prevalence between teeth sealed with and without primer and bond ($P=.56$). Of those with primer and bond, 24% were carious, and of those without primer and bond 26% were carious. No differences in sealant retention by arch were seen in teeth sealed with and without bond. Occlusal sealants with no bond, however, were 5.5 times more likely to be completely retained than those sealed with bond.

Paired analyses (Table 3) that account for the split-mouth study design again showed no differences in sealant retention and caries in teeth sealed with and without a bond.

In conditional logistic multivariate analyses (Table 4) modelling for sealant retention, after controlling for age, gender,

tooth surface and arch, no difference in sealant retention was seen in teeth sealed with and without primer and bond ($p=.77$). In conditional logistic multivariate analyses predicting caries (Table 5), no difference in caries was seen in teeth sealed with and without primer and bond ($p=.99$). Age, gender, tooth surface, and arch were not statistically significantly associated with sealant retention or caries in this study.

Discussion

This clinical study examined the effectiveness of sealants placed with and without primer and bond on caries-free permanent first molars in school children in a public program. Effectiveness was measured using sealant retention and prevention of caries in previously sealed teeth. Complete sealant retention in this study at the end of 2 years was about 66%. This is similar to that seen in other sealant studies,^{15,18,19} but lower than the 5% to 10% sealant loss per year that is generally accepted.³ The criteria used, however, were stringent. When less stringent criteria are used and the 21% of sealants that were partially retained are included as retained, the retention rate is no different than that seen in other studies.⁷

Although the present study was conducted in a population with a relatively high level of occlusal caries, and in an age group in which the recently erupted permanent first molars are at high risk of developing dental caries, a surprising finding was that no differences were seen in sealant retention in sealants placed with and without primer and bond. These findings are comparable with those performed by Boksman and colleagues that showed no differences in sealant retention rates when Scotchbond 2 and Universal Bond was used,¹⁴ and that by Pinar and colleagues when One Coat Bond was used.¹⁵

These results are in contrast to the studies by Feigal et al, who reported increased sealant retention in teeth sealed using a primer and bond.^{12,13} One possible reason is that in the current study isolation was performed using rubber dam, while in the Feigal studies isolation was performed using cotton rolls.^{12,13} Furthermore, one of the Feigal studies purposefully contaminated the occlusal surface with saliva before applying the sealant.¹² Additionally, the bonding agents used in the studies differed, with Scotchbond Dual Care used in the 1993 study, and 3 single-bottle dentin bonding agents: (1) Prime & Bond (Dentsply Caulk, Milford, Del); (2) Single Bond (3M-ESPE, St. Paul, Minn); and (3) Tenure Quick (Den-Mat, Santa Maria, Calif). Feigal did report, however, that Scotchbond Multi-Purpose primer was detrimental to occlusal sealant success in his study, relating it to its water-based composition.¹³ This might also be the reason that the authors did not see any difference in the present study. The 3M Scotchbond Multi-purpose Plus primer and bond system used might not be compatible with Delton Plus sealants. Therefore, before recommending that bonding agents be used under sealants, the compatibility of the different bonding agents and sealants should be evaluated.

Table 3. MATCHED BIVARIATE ANALYSES FOR SEALANT RETENTION AND CARIES

Parameter	Odds Ratio	95% Confidence Interval	P-value*
Completely retained	1.29	0.8-2.1	.34
Partially lost	1.50	0.7-3.4	.36
Completely lost	1.16	0.6-2.2	.75
Caries	1.1	0.7-1.9	.80

*P-values from McNemar chi-square test.

Table 4. CONDITIONAL LOGISTIC REGRESSION MODEL PREDICTING SEALANT RETENTION

Parameter	Odds Ratio	95% Confidence Interval	P-value*
Age at application (ys)	1.0	0.9-1.1	.87
Gender (female)	1.04	1.0-1.3	.74
Arch (mandibular)	1.01	0.9-1.2	.91
Occlusal surface	1.03	0.9-1.2	.76
Bond (none)	0.98	0.8-1.6	.77

*P-values from conditional logistic regression.

Table 5. CONDITIONAL LOGISTIC REGRESSION MODEL PREDICTING CARIOUS TEETH

Parameter	Odds Ratio	95% Confidence Interval	P-value*
Age at application (ys)	1.03	0.9-1.2	.61
Gender (female)	1.13	0.9-1.5	.34
Arch (mandibular)	1.05	0.9-1.2	.58
Occlusal surface	1.10	0.9-1.3	.26
Bond (none)	0.99	0.8-1.8	.99

*P-values from conditional logistic regression.

This study also found no differences in caries prevalence in teeth sealed with and without primer and bond. No previous studies have evaluated caries in teeth sealed with and without primer and bond. Therefore, this study's results are the first to assess the true caries-preventive effectiveness of sealants placed with or without bonding agents.

No differences were seen in retention and caries by: age; gender; tooth surface; and arch. Some possible reasons that no differences were seen in this study are that all the sealants were placed with chairside assistance under optimal clinical settings using a rubber dam for moisture control and isolation.

Possible limitations of this study are the sample size of 78 children and the short duration of the study. The sample size in the current study, however, was higher than that in previous studies that evaluated the effectiveness of bonding agents, including the Feigal et al studies that showed favorable results.^{12,13} Similarly, the duration of previous bond studies was similar to that in the current study.^{12,15} Another limitation is that only the 3M Scotchbond Multipurpose Plus system was used as the bonding agent in this study. It is possible that other bonding agents and systems have better outcomes. Feigal and colleagues in their study showed that the single-bottle dentin bonding agents performed better than Tenure primer or Scotchbond Multi-purpose.¹³

The split-mouth design used in the current study is a strength and controls for patient factors such as patient behaviors, oral hygiene, diet, and other habits that could potentially affect sealant retention and caries rates. Another strength of the current study is that the authors measured the effectiveness of the sealant by its ability to prevent caries in the sealed surfaces of permanent first molars in children considered to be at high risk of dental caries. The primary reason sealants are placed is to prevent caries. Therefore, the effectiveness of a sealant program should be measured by its ability to prevent caries on the sealed surface. Other measures of sealant effectiveness are interim measures, such as the percentage of completely retained sealants, and the reapplication rates.

Conclusion

When a proper technique is used in sealant placement, as in the current study, use of a primer and bond (Scotchbond Multipurpose Plus system) did not enhance sealant retention.

References

1. Waggoner WF, Seigal M. Pit and fissure sealants application: Updating the technique. *J Am Dent Assoc* 1996;127:351-61.
2. Ahovuo-Saloranta A, Hiiri A, Nordblad A, Worthington H, Makela M. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. *Cochrane Database Syst Rev* 2004;3:CD001830.
3. Feigal RJ. Sealant and preventive restorations: Review of effectiveness and clinical changes for improvement. *Pediatr Dent* 1998;20:85-92.
4. Llodra JC, Bravo M, Delgado-Rodriques M, Baca P, Galvez R. Factors influencing the effectiveness of sealants: A meta-analysis. *Community Dent Oral Epidemiol* 1993;21:261-8.
5. Simonson RJ. Retention and effectiveness of dental sealants after 15 years. *J Am Dent Assoc* 1991;122:34-42.
6. Wendt L-K, Koch G. Fissure sealant in permanent first molars after 10 years. *Swed Dent J* 1988;12:181-5.
7. Mascarenhas AK, Moursi AM. Use of fissure sealant retention as an outcome measure in a dental school setting. *J Dent Educ* 2001;65:861-5.
8. Cooney PV, Hardwick F. A fissure sealant piolet project in a third-party insurance program in Manitoba. *J Can Dent Assoc* 1994;60:140-5.
9. Borem LM, Feigal RJ. Reducing microleakage of sealants under salivary contamination: An in vitro study. *Pediatr Dent* 1994;25:283-9.
10. Symons AI, Chu CY, Meyers IA. The effect of fissure morphology and pretreatment of the enamel surface on penetration and adhesion of fissure sealants. *J Oral Rehabil* 1996;23:791-8.
11. Tulunoglu O, Bodur H, Uctasli M, Alacam A. The effect of bonding agents on the microleakage and bond strength of sealant in primary teeth. *J Oral Rehab* 1999;26:436-41.
12. Feigal RJ, Hitt J, Splieth C. Retaining sealant on salivary contaminated enamel. *J Am Dent Assoc* 1993;124:88-97.
13. Feigal RJ, Musherure P, Gillespie B, Levy-Polack M, Quelhas I, Hebling J. Improved sealant retention with bonding agents: A clinical study of two-bottle and single-bottle systems. *J Dent Res* 2000;79:1850-6.
14. Boksman L, McConnell RJ, Carson B, McCutcheon-Jones EF. A 2-year clinical evaluation of two pit-and-fissure sealants placed with and without the use of a bonding agent. *Quintessence Int* 1993;24:131-3.
15. Pinar A, Sepet E, Aren G, Bolukbasi N, Ulukapi H, Turan N. Clinical performane of sealants with and without bonding agents. *Quintessence Int* 2005;36:355-60.
16. Simonsen RJ. Pit and fissure sealant: review of the literature. *Pediatr Dent* 2002;24:393-414.
17. Donly K. Pediatric Restorative Dentistry Consensus Conference. April 15-16, 2002, San Antonio, Texas. *Pediatr Dent* 2002;24:374-6.
18. Anson RA, Full CA, Wei SHY. Retention of pit and fissure sealants placed in a dental school pedodontic clinic: A retrospective study. *Pediatr Dent* 1982;4:22-6.
19. Messer LB, Calache H, Morgan MV. The retention of pit and fissure sealants placed in primary school children by Dental Health Services, Victoria. *Aust Dent J* 1997;42:233-9.