Scientific Article

Comparison of air abrasion versus acid etch sealant techniques: six-month retention

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Abstract

This study compared two techniques for placing sealant in an elementary school setting. Eighty-five children in grades 1 to 4 in two schools were assigned randomly to two sealant treatment groups: 1) acid etch technique (AE), and 2) air abrasion with no acid etch (KCP-1000). Noncarious, nonfilled occlusal, distolingual and buccal pit surfaces of first permanent molars were sealed. A total of 300 teeth received sealants, and 230 were evaluated at 6 months. Rates of complete sealant retention at 6 months were: occlusal surfaces, 97% for AE and 96% for KCP-1000; distolingual surfaces, 82% for AE and 49% for KCP-1000; and buccal surfaces, 77% for AE and 7% for KCP-1000. Differences in complete retention at 6 months between AE and KCP-1000 were not significant for occlusal surfaces ($P = 0.14$) but were significant for buccal and distolingual surfaces ($P < 0.0001$). Results suggest that sealants placed with air abrasion have retention rates for occlusal surfaces similar to AE. More research is needed to identify factors contributing to low retention rates on other surfaces for KCP-1000. (Pediatr Dent 19:258–61, 1997)

Findings from the National Institute of Dental Research (NIDR) National Survey of Schoolchildren (1986-87) revealed nearly 88% of the decay experienced by U.S. children was located in the occlusal surfaces of their teeth and other pit and fissure sites.[1] Sealants have been shown to be a highly effective technique for preventing pit and fissure caries, and more than 25 years of research has demonstrated pit and fissure sealants to be safe and economical in preventing tooth decay.[2-9]

While the acid etch method of preparing teeth for sealant application has been used extensively, it is a technique-sensitive process and involves several time-consuming steps. Improper application can substantially reduce the rate of retention and therefore the effectiveness of sealants.[10] Concern has been expressed that the traditional acid etch technique for sealant placement does not allow for complete cleaning of the pits and fissures prior to sealant placement.[11-13] This may lead to entrapment of organic plug material, which could become problematic if sealant wear over time re-exposes these areas to the oral environment. Concern has also been expressed that the traditional acid etch technique for sealant placement can lead to inadvertent sealing over of undiagnosed caries.[14, 15]

A new method for sealant application using air-abrasive technology is less technique sensitive, eliminates several steps necessary in the traditional technique, and therefore may reduce placement time.[16, 17] Air-abrasive technology, although recently refined (and relatively untested in clinical settings), also offers several other potential advantages over the acid-etch technique. Air abrasion allows for total cleaning of the grooves prior to sealant placement. The abrasive particles used in air abrasion effectively remove organic plug material from the grooves and allow for deeper penetration of the sealant material into the grooves. Because of air-abrasion's ability to clean pits and fissures thoroughly, this technique actually may be able to help detect caries.[16]

A limited number of laboratory studies have compared the bond strength and the microleakage obtained by bonding sealant or composite to acid-etched and air-abraded enamel.[18-23] These studies have reported mixed results, but at least two studies have suggested equal or greater bond strength for air abrasion compared to acid-etch.[18, 19] In vitro studies have shown that there is more microleakage when air abrasion is used to prepare a tooth for sealant placement than when acid etch is used.[21, 23] Despite these findings, several authors have advocated the use of air abrasion alone (without acid etch) prior to sealant placement.[24, 25] No clinical studies involving air abrasion and sealants or composites have appeared in the literature. The purpose of this study was to compare two techniques for sealant placement: 1) the traditional acid etch technique; and 2) an air-abrasive technique using the KCP-1000 (American Dental Technologies, Southfield, MI). This paper reports the 6-month results for retention of sealants placed in a school-based setting using air-abrasive technique versus those obtained using the acid-etch technique.

Methods and materials

Eighty-five school-children in grades 1 to 4 attending two public elementary schools in Muscatine, Iowa, were included in the study. The two schools were cho-

sen because a high percentage of their students were from low-income families as indicated by eligibility to participate in the free and reduced-cost lunch program (studies have shown low income to be associated with increased risk for dental caries).[26] Grades 1 to 4 were selected for this study based on recommendations from previous studies concerning the optimal age groups for children participating in school-based sealant programs.[26,27]

Of 181 children in grades 1 to 4 attending the two schools, 151 children (30 did not have parental consent) received a dental screening exam using a portable dental chair, headlamp, mirror, and explorer. Forty-two children who received a screening exam were not eligible for the sealant study due to exclusion criteria. Of the remaining 109 students who were eligible for participation in the sealant study, 85 children received sealants. Eligible children who did not receive sealants were either absent on the days that sealants were placed or did not have appropriate signed parental consent.

Because only first permanent molars were sealed in this study, the number of teeth sealed per eligible participant ranged from one to four, with the majority of subjects (63 of 85 children) having four teeth sealed. Two discrete surfaces per tooth were eligible for sealant placement: the mesiocclusal pit and distolingual groove of maxillary first permanent molars and the occlusal surface and buccal pit of mandibular molars (the maximum number of surfaces sealed per child was eight). All noncarious, nonsealed and nonrestored eligible surfaces were sealed, with the exception of buccal pit surfaces, which were sealed only when the surface contained a noncoalesced groove or pit area (about half met these criteria).

Study participants were assigned randomly to one of two treatment groups: 1) traditional sealant application using acid-etch technique; and 2) sealant application by air-abrasion (KCP-1000). Immediately after random assignment, all sealants were placed by the project's principal investigator, using a widely used, commercially available sealant product (Helioseal® by Vivadent). An opaque sealant was used to facilitate an accurate assessment of retention. All sealants were placed in the participating elementary schools, using portable dental equipment in March 1995.

The protocol for sealant placement using the acid etch technique was as follows: Each child was asked to "dry brush" his/her teeth while waiting for sealant placement. Teeth then were etched with 37% phosphoric acid for 30 sec, rinsed for 15 sec and thoroughly air dried. A dry field was maintained utilizing cotton rolls and Dri-aids® (Yng Dental, St. Louis, MO). Sealant material was applied using a small brush (Benda-brush®, Centrix, Shelton, CT). All sealants were light cured for 20 sec.

The protocol for sealant placement using air abrasion was: After dry brushing, teeth to be sealed were air-abraded using the KCP-1000 (50 μ particles of alpha alumina at 160 psi) for 15 sec. As with the acid-etch group, cotton rolls and Dri-aids® were used to maintain a dry field, then the sealant was applied and light-cured for 20 sec. No etching liquid or water was used with the air-abrasion group.

In September 1995, 6-month follow-up examinations were conducted to determine sealant retention rates. A trained dental examiner who did not place any of the sealants and who was blinded to the sealant placement technique used conducted all the examinations. All follow-up examinations were conducted using a portable dental chair, a head lamp, mirror, and explorer. Sealants placed as part of this clinical trial were classified as either completely present, partially present, or completely missing, using criteria described by Simonsen.[2] Occlusal, distolingual, and buccal pit surfaces were scored separately. Distolingual scores included the distal pit and lingual groove considered together as one surface.

Data were entered and verified using SPSS for Windows™. The data were analyzed on the basis of categorical scores given to retention of sealants using chi-square analysis. P-values < 0.05 were considered statistically significant.

Results

Six-month retention rates for all sealants are presented in the Table. Sixty-six of the 85 subjects (77.6%) were available for this evaluation of sealant retention.

TABLE. SIX-MONTH RETENTION RESULTS BY SURFACE*, % (N)

	Occlusal		*Buccal Pit†*		*Distolingual Groove†*		*All Surfaces†*	
	Acid Etch	*KCP-1000*	*Acid Etch*	*KCP-1000*	*Acid Etch*	*KCP-1000*	*Acid Etch*	*KCP-1000*
Totally retained	97 (130)	96 (92)	74 (28)	7 (2)	82 (58)	49 (24)	89 (216)	68 (118)
Partially retained	2 (3)	4 (4)	8 (3)	7 (2)	14 (10)	49 (24)	7 (16)	17 (30)
Totally missing	<1 (1)	<1 (1)	18 (7)	86 (25)	4 (3)	2 (1)	4 (11)	15 (26)
Total	100 (134)	100 (96)	100 (38)	100 (29)	100 (71)	100 (49)	100 (243)	100 (174)

* Includes all sealants placed and examined at 6 months.

† Significant differences ($P < 0.0001$) between techniques based on chi-square analysis.

There was no significant difference in rates of complete retention on occlusal surfaces for the two treatment groups ($P = 0.14$). There were, however, significant differences for buccal and distolingual surfaces ($P < 0.0001$). Complete retention rates for buccal and distolingual surfaces were higher for the acid etch group than for the air abrasion group. Although complete retention rates for distolingual surfaces were substantially lower than for occlusal, the distal pit portions of these distolingual sealants were almost universally retained, and most of the loss was from the lingual grooves.

Discussion

Air abrasive technology for placing of sealants shows promise, primarily for sealants placed on occlusal surfaces. A concern is why the retention rates for buccal and distolingual surfaces placed in this study were so much lower for the air abrasion group, while occlusal surface retention was comparable to that achieved with acid etch. The higher failure rates for buccal and distolingual surfaces in the air abrasion group may be due to the lower shear bond strength and increased microleakage associated with this technique. The high retention rates for occlusal surfaces in the air abrasion group might be explained by the relative lack of shear forces to these surfaces. It is possible that, given more time, the occlusal surface sealants placed using air abrasion will begin failing at a rate higher than for the acid etch sealants. Other sealant studies have reported, however, that sealant failure is most likely to occur soon after placement, with the rate of sealant loss at 3 months being approximately double that of the subsequent loss occurring between 3 and 6 months.[28] Another possible explanation for the lower retention rates on buccal and distolingual surfaces using air abrasion might be inadequate modification of the enamel on these surfaces resulting in insufficient irregularities for sealant retention.

It is difficult to compare the findings of this study to those from other studies because different techniques were used and because retention rates for buccal pit surfaces have rarely been reported in the literature. In Simonsen's long-term evaluation of sealant retention and effectiveness, for example, buccal surfaces of mandibular molars were not scored (even when they had been sealed) because "many of the surfaces were smooth and difficult to assess".[2]

An additional factor to consider when contemplating the use of air abrasion for sealant placement is the cost of the air abrasion units themselves. Although it may decrease, the current cost of air abrasive units ranges from approximately $7,000 to $17,000.[25,29]

Conclusion

The main findings of this study are:

1. Six-month retention rates of occlusal surface sealants were comparable for both techniques.
2. Six-month retention rates of distolingual and buccal pit surfaces were significantly lower for air-abrasion sealants than for acid-etch sealants.
3. Further study into the air abrasive technique for sealant placement is warranted, as is longer-term follow-up of sealants placed in the current study.

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