

Assessment of Retention Rates and Clinical Benefits of a Community Sealant Program

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Abstract

Purpose: The purposes of this study were to: (1) evaluate the retention rates of occlusal sealants in children in an urban school-based sealant program run by a County Health Department in Alabama; and (2) assess the clinical benefits of this sealant program by comparing caries experience of a group of participants and nonparticipants.

Methods: The records of 2,097 children (mean age=8.1±1.6 years) who received sealants and had at least 1 follow-up examination were analyzed to determine the outcome of sealed and nonsealed surfaces of permanent first molars (PFM). Additionally, 103 fifth-grade students who did and did not participate in the sealant program (P=participants; NP=nonparticipants) were examined by a masked examiner who recorded their PFM condition.

Results: Sealants placed by the County Health Department had a retention rate of 71% over an average of 1.6±0.7 years (range=0.5-4.4 years). The patient's age at the initial visit appeared to be the only factor that influenced retention. On average, participants had at least 1 PFM that remained caries-free, compared to nonparticipants (permanent decayed, missing, and filled teeth [DMFT] in NP=1.5±1.4, P=0.5±0.8; $P<.016$).

Conclusions: Retention rates for occlusal sealants in this public health program were similar to those reported in previous clinical studies. Furthermore, children who had sealants had significant protection from occlusal decay up to grade 5. (*Pediatr Dent* 2005;27:212-216)

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Dental sealants have been available in dentistry for over 30 years. Their protective effect on the pits and fissures of erupted molars appears to be more significant than other preventive approaches (ie, fluoride).¹ Although pits and fissures of molars make up only 13% of the surface area of teeth, they account for 88% of total caries in children. Therefore, the importance of placement and retention of sealants is crucial.² As a preventive measure, dental sealants have been shown to be a cost-effective material that can easily be applied on caries-susceptible tooth surfaces by both dentists and hygienists.³⁻⁵

Before sealants were widely available and used, it was accepted that most occlusal surfaces would become carious within a 10-year period following their eruption.⁶ Although this statement does not apply to current trends; caries still remains the most common childhood disease. Data collected throughout the country show that the distribution of caries, both treated and untreated, is not equal among population groups.⁷ National data indicate that 80% of dental caries found in children is concentrated in 25% of the child population.⁸ This population, termed "high-risk," includes children—particularly African Americans—with a cariogenic diet, low-fluoride intake, dental caries history, infrequent dental visits, and low socioeconomic status. This population has also been shown to be the least likely to obtain preventive care for surfaces at risk.⁹⁻¹¹ In this regard, non-Hispanic Caucasian children received twice as many sealants as African American children.^{2,9}

The Jefferson County Health Department (JCHD) sealant program has been working with Birmingham, Ala inner city schools for over 17 years. A team consisting of 1 dentist

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and 2 or 3 hygienists visit 1 or 2 elementary and/or middle schools per week over the course of the academic calendar year. All children in visited schools can participate; the program is intended, however, to focus on those at higher risk. The dentist examines children who have appropriate parental consent and then refers those that require sealants to hygienists. All examination and treatment records as well as follow-up data are recorded and maintained in a central electronic database.

The purposes of this study were to:

1. evaluate the outcome of a sealant program in a school setting that was part of a public health program—treatment and follow-up records were reviewed to determine the sealant retention and clinical outcomes;
2. examine a group of nonparticipants (NP) and participants (P) of the sealant program to determine differences in the permanent decayed, missing, and filled teeth (DMFT) index of their permanent first molars (PFM).

Methods

The University of Alabama at Birmingham (UAB) Institutional Review Board (IRB) and the JCHD Ethics Board approved this study, which was conducted prior to the time HIPPA regulations went into effect. The study was divided into 2 parts:

1. Part I (retrospective study) focused on the performance of sealants provided by the JCHD sealant program by primarily assessing sealant retention and changes in DMFT indices for PFMs.
2. Part II (cross-sectional study) examined children who had participated in the sealant program and compared them to an age- and race-matched sample of children from the same school who had never been involved with the JCHD sealant program.

Retrospective study of the JCHD sealant program

Data obtained during routine dental examinations of children who had participated with the JCHD sealant program was used for this analysis. The information was available in the JCHD electronic database that included the years 1997 through 2002 and consisted of 38,798 dental examinations. The data included information on patient demographics, treatment, DMFT, primary decayed, missing, and filled teeth (dmft) index, and other assessments relevant to the patient's condition at the time of the examination. JCHD dentists, who are calibrated on a yearly basis according to National Institutes of Health standards, performed all examinations.

A program designed specifically for this study at the JCHD's systems information office selected children for the sample. The data was restricted to information from the JCHD sealant program, and study subjects were selected according to the following criteria:

1. children ranging in age from 5 to 15 years;
2. children who were examined at least twice by the school-based sealant program between 1997 and 2002;

3. children with at least 1 occlusal sealant placed on a PFM on their first visit.

The records of 2,097 children seen by JCHD over a period of 5 years were included in this sample. PFM occlusal surfaces were then classified based on their reported condition of these teeth at the second visit, which was used to determine the tooth's retention and DMFT score. The sealed teeth were classified as:

1. retained (teeth sealed on the initial visit and which appeared as sealed or partially sealed on the second examination);
2. lost (teeth sealed on the initial visit, but which lost their sealants and appeared sound on the second examination);
3. failed (teeth sealed on the initial visit, but which appeared as carious, restored, or missing on the second examination).

The sample of 2,097 children was then separated into 4 subgroups according to the time period between the first and second examination (ie, 6 months to 1 year, 1 to 2 years, 2 to 3 years, and 3 or more years).

Cross-sectional study of participants and nonparticipants

Clinical examinations were performed on a group of healthy fifth-grade students who were enrolled from 3 schools that had previously participated in the sealant program. The examinations took place at the schools following written parental consent. All children in each fifth-grade section of the school received a consent form in a sealed envelope and were instructed to deliver it to their legal guardian. An incentive was provided to those children who were examined and was approved by the UAB and JCHD IRB.

Prior to examining subjects, the investigator was calibrated with JCHD staff by examining 20 children aged 6 to 8 years. For the purposes of this study, a correlation of 75% or higher was considered acceptable. The examiner was masked to the previous participation status of the child in the JCHD sealant program. The examination was performed using a mirror, No. 5 explorer, and artificial light. Only the condition of PFM's occlusal surfaces was recorded for purposes of this study.

The patient's information obtained during these examinations was later used to determine the children who had participated previously in the sealant program. Therefore, the NP group children were subjects with no prior contact with the sealant program, and P group children were defined as subjects who had been seen by the JCHD school sealant program and had at least one sealant placed on their PFMs.

Statistical analysis

SPSS (SPSS Inc, Chicago, Ill) was utilized in the data analyses. Chi-square and student's *t* test analysis were applied, and analysis of variance (ANOVA) was used to determine if significant differences existed between groups by evaluating as covariates: (1) the initial age at sealant placement; (2) gender; and (3) tooth number. Statistical significance was determined at $P < 0.05$.

Results

Retrospective study of the JCHD sealant program

The demographics of the 2,097 children who met the inclusion criteria are presented in Table 1. The follow-up period ranged from 6 months to 4.4 years, with a mean follow-up time of 1.6 ± 0.6 years. A decline of approximately 10% in retention rates per year was noted as a consistent trend (Figure 1). From a total of 8,388 (ie, $4 \times 2,097$) available PFM occlusal surfaces, 6,344 (77%) were sealed by the JCHD program at the initial visit. At the second visit, the overall retention rate of the sealed teeth was 72%, with another 17% of the surfaces appearing as sound (ie, no caries even if sealant retention was incomplete). The caries increment for the sealed PFMs was 11% over the same period of time. Of the surfaces that received no treatment ($N=1,926$), 508 appeared as sound according to examination records, while 143 appeared to be unerupted. This group's caries increment was 19%.

The initial PFM DMFT was evaluated as a factor related to outcome at the second visit. The initial mean PFM DMFT from the sample of 2,097 children was 0.43 ± 0.9 , and the final mean PFM DMFT for the same population was 0.7 ± 1.1 . The data also showed that 1,592 (76%) children had a PFM DMFT occlusal index of 0 on their initial exam. Upon the second visit, 75% of the 1,592 children maintained a PFM DMFT index of 0 (final mean PFM DMFT = 0.4 ± 0.8). Of these 1,592 children, 1,034 had 4 sealants placed on the first visit and 558 had less than 4 sealants placed.

At the second examination, only 70% of the 558 children had maintained a PFM DMFT of 0, and their mean final PFM DMFT index was 0.5 ± 0.8 . Data from the sample of 1,034 children shows that 78% maintained a DMFT of 0 at the second appointment, with a final mean PFM DMFT of 0.3 ± 0.8 . When surface outcomes for the overall population (2,097 children) and this optimal sealant-placed subset of children (1,034) were compared, the data showed that the retention trend was similar.

Of the 4 groups evaluated according to the subject's age at the initial visit, subjects from the 6- to 8-year-old and 8- to 10-year-old group accounted for 42% and 37% of the population, respectively. Children with sealants placed between age 6 and 8 exhibited significantly higher retention rates ($P < .05$) when compared to the other 3 groups (Figure 1). The failure rate of sealants was also sig-

Table 1. Demographics of the Retrospective Study Participants ($N=2,097$)

Gender (%)	
Male	42
Female	58
Mean age (initial visit)	8.4 ± 1.6 y
Mean age (second visit)	10.2 ± 1.7 y
Race distribution (%)	
African American	97
Other Races	3
Mean DMFT (permanent) at initial age	0.76 ± 1.2
Mean DMFT (primary) at initial age	2.5 ± 1.5

nificantly different according to initial age at placement ($P < .05$), with the 6- to 8-year-old age group showing consistently lower failure rates.

Gender differences were noted on the initial distribution of children, since a larger proportion (58%) was female. When retention data was tabulated according to follow-up period, however, there were no significant differences ($P = .25$) in retention of sealants between male and female children.

Analysis of retention according to the tooth number resulted in the identification of inconsistent trends, where each follow-up group had a particular tooth that showed higher retention; the differences, however, were not significant ($P = .95$).

During the 5-year period from which the data were obtained, 15 dentists participated in the JCHD sealant

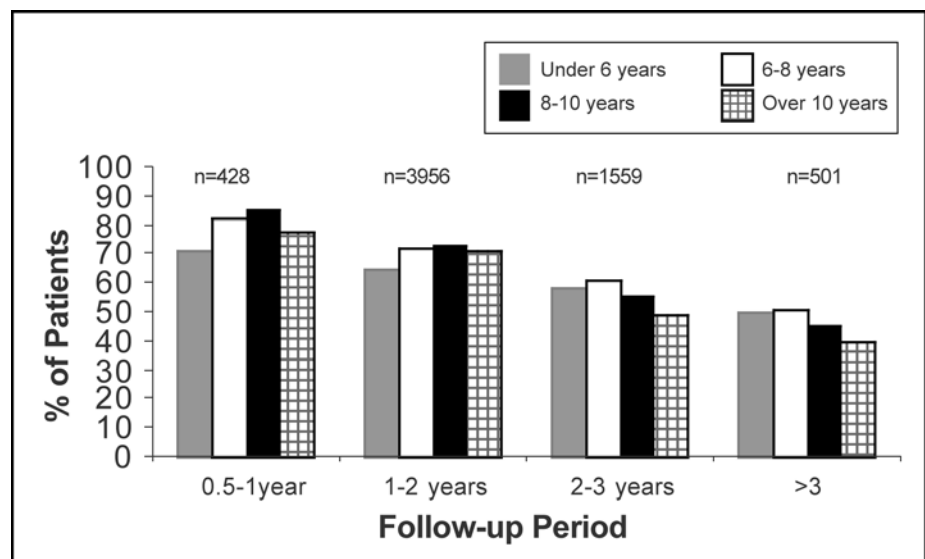


Figure 1. Retention rates by age. Percent retention rates over time of 6,444 sealants placed by the JCHD program according to age at initial visit, with N equal to the number of surfaces observed for each age group. The ages were divided into 4 groups: (1) under six; (2) 6-8; (3) 8-10; (4) over 10 years of age. The follow-up periods were 6 months to 1 year, 1-2 years, 2-3 years, and more than 3 years follow-up category. Overall, those in the 6- to 8-years-old group had a significantly higher retention rate ($P < 0.05$) over time compared with the other age groups.

Table 2. Demographics of Cross-sectional Study Participants (N=103)

Characteristic	Participant Group (P)	Nonparticipant Group (NP)
No.	42	52
Mean age (y)	11.3±1.7	11.4±0.5
Race distribution (%)		
African American	100	89
Other races	0	11
Gender (%)		
Male	50	44
Female	50	56

program. Three of these dentists accounted for over 50% of the initial and final examination data from the JCHD sealant program. Examiner calibration resulted in a mean interexaminer correlation rate of 77%±8.5. Intraexaminer scores revealed a correlation of 80%±5.75. The kappa scores for the session were 0.72.

Cross-sectional study

Out of 47 schools that have previously participated in the sealant program, 3 schools were randomly selected for the clinical examinations. The average number of fifth-grade students per school was 85, and participation rates in the study ranged from 27% to 68% (ie, returned consent forms). Following examination of all children, computer records were used to determine respective group assignment (ie, NP or P). One hundred three children were examined, and the demographics of each group are provided in Table 2.

DMFT index for the occlusal surface of PFMs (ie, 0-4 caries surfaces for each mouth) were significantly different between the P group (0.9±1.2) and the NP group (1.5±1.6; $P<.016$). Furthermore, as the PFM DMFT increased, the difference between each group became more apparent (Figure 2).

In the P group, 38 (75%) of the 51 children had an initial PFM DMFT index of 0, and the mean interval between sealant placement and this examination was 2.8±0.9 years. Twenty-eight (55%) children had a PMF DMFT of 0 and received 4 sealants at their initial contact with the sealant program. At the time of this examination, 64% of these 28 children had maintained a PFM DMFT of 0.

Discussion

One of the interesting findings was the initial age at placement of sealants, which averaged 8.4 years, coincided with a mean DMFT index of 0.8 and a mean dmft index of 2.5 (Table 1). One can argue that an earlier evaluation and treatment by JCHD could have a better outcome. This possibility is further supported by higher retention rates for those children who received sealants between 6 to 8 years of age (mean=7.1±0.5 years).

If the patient's age at the time of sealant placement had a direct influence on sealant retention, it is also likely that

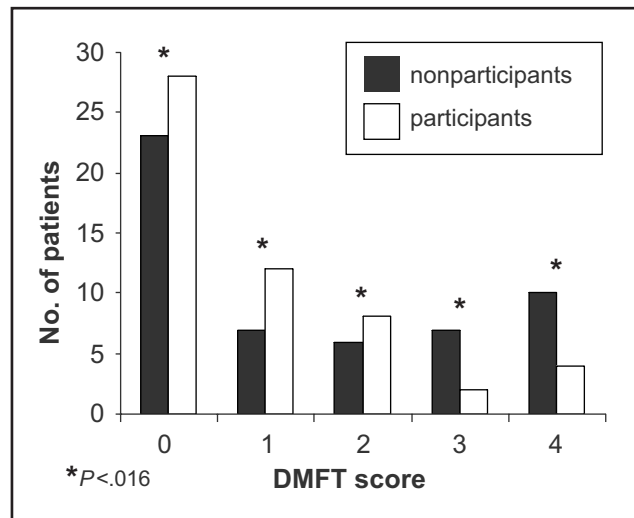


Figure 2. DMFT index of nonparticipants and participants. DMFT occlusal surface indices for permanent first molars between 52 nonparticipants and 51 participants. There was significant difference between the 2 groups ($P<.016$) for each DMFT score.

the initial condition of those surfaces to be sealed was also an important factor in determining sealant outcome. A limitation of this study is that the authors were unable to assess if the tooth eruption stage had an effect on retention. This is due to the fact the JCHD code utilized for sound teeth included the ones where only the cusp tip is visible. The "S3" code, which appeared on the JCHD examinations and was defined as a sound tooth, can also represent an unsealable tooth. This may explain why only 65% of children who had an initial PFM DMFT of 0 received 4 occlusal sealants on their PFMs. According to interviews with JCHD personnel, sealants are occasionally placed on partially erupted molars. If sealed, these surfaces may, in turn, appear as failed or lost sealants placed on initially sound teeth.

Since the primary intent of sealants placed by JCHD is to reduce the prevalence of pit and fissure caries in permanent first and second molars, retention can be considered an outcome parameter that will determine a sealant's potential success or failure. Many scientifically controlled studies have reported or reviewed properties of sealants such as wear rate, bond strength, and cost-effectiveness. Wendt et al reported sealant retention rates of 65% after 20 years in a retrospective study.¹² A study that reviewed retention rates at 6-month intervals reported over 75% of sealants as being retained over a period of 29.8±23 months.¹³

Finally, a study that observed retention of sealants placed in a school setting reported 67% complete retention and an additional 27% partial retention for permanent first molars over a 24-month period.¹⁴ Although the sample was significantly large in this study, there was no comparison to a controlled (nonsealed) group to assess benefit.

There are several factors affecting sealant retention. Variables such as individual tooth morphology, caries risk, oral hygiene habits, and placement technique can directly affect the outcome of sealed surfaces. Although many well-controlled studies have reported the effect of these variables

on sealant outcome, few studies have large samples of children in clinical programs. The JCHD sealant program currently uses portable units that provide air/water syringes as well as suction; high-speed evacuation, however, is not available in any of these units. Moisture control is, therefore, achieved by using an air syringe and cotton rolls. The fact that the retention rates observed in this study can be compared to those observed in a more controlled clinical trial is an important finding.

Fifteen dentists have participated in this sealant program since 1997, which may result in differences in clinical judgment for examinations and treatment; the JCHD, however, calibrates its dentists on a yearly basis. Furthermore, for part II of the study, JCHD dentists and the primary investigator (CD) had acceptable interexaminer correlation with 2 of 3 primary dentists from the JCHD sealant program.

The JCHD sealant program's overall benefits are documented by the results of comparing dental conditions of participating children with an age- and race-matched sample from their own school. A limitation of this study, however, was the fact that some of the NP and P children may have received preventive care outside the JCHD sealant program, even though this is unlikely due to their lower economic status. Retention rates observed in the P group were also consistent with those from the sample of 2,097 children.

Conclusions

This study's results suggest that sealants applied by the JCHD have acceptable retention rates. Children who have participated in this program also have fewer caries in PFMs, which is maximized by receiving 4 sealants on their first visit. Children who participated in the JCHD sealant program had significantly lower ($P < .016$) PFM DMFT scores than children who did not participate in this public health program. Further analysis of the existing database is required to determine the cost effectiveness of this program.

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References

1. Singh KA, Spencer AJ, Armfield JM. Relative effects of pre- and posteruption water fluoride on caries experience of permanent first molars. *J Public Health Dent* 2003;63:11-19.
2. Rethman J. Trends in preventative care: Caries risk assessment and indications for sealants. *J Am Dent Assoc* 2000;131:8S-12S.
3. Adair SM. The role of sealants in caries prevention programs. *J Calif Dent Assoc* 2003;31:221-227.
4. Lavonius E, Kerosuo E, Kervanto-Seppala S, Halttunen N, Vilkkuna T, Pietila I. A 13-year follow-up of a comprehensive program of fissure sealing and resealing in Varkaus, Finland. *Acta Odontol Scand* 2002;60:174-179.
5. Weintraub JA, Stearns SC, Rozier RG, Huang CC. Treatment outcomes and costs of dental sealants among children enrolled in Medicaid. *Am J Public Health* 2001;91:1877-1881.
6. Feigal RJ. The use of pit and fissure sealants. *Pediatr Dent* 2002;24:415-422.
7. Dasanayake AP, Li Y, Wadhawan S, Kirk K, Bronstein J, Childers NK. Disparities in dental service utilization among Alabama Medicaid children. *Community Dent Oral Epidemiol* 2002;30:369-376.
8. Kaste LM, Selwitz RH, Oldakowski RJ, Brunelle JA, Winn DM, Brown LJ. Coronal caries in the primary and permanent dentition of children and adolescents 1-17 years of age: United States, 1988-1991. *J Dent Res* 1996;75:631-641.
9. Dasanayake AP, Li Y, Philip S, Kirk K, Bronstein J, Childers NK. Utilization of dental sealants by Alabama Medicaid children: Barriers in meeting the year 2010 objectives. *Pediatr Dent* 2001;23:401-406.
10. NCHS. *Healthy People 2000 Review, 1998-99*. Hyattsville, Md: Public Health Service; 1998.
11. Dasanayake AP, Li Y, Kirk K, Bronstein J, Childers NK. Restorative cost savings related to dental sealants in Alabama Medicaid children. *Pediatr Dent* 2003;25:572-576.
12. Wendt LK, Koch G, Birkhed D. On the retention and effectiveness of fissure sealant in permanent molars after 15-20 years: A cohort study. *Community Dent Oral Epidemiol* 2001;29:302-307.
13. Mascarenhas AK, Moursi AM. Use of fissure sealant retention as an outcome measure in a dental school setting. *J Dent Educ* 2001;65:861-865.
14. 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;42:233-239.