Evaluation of Initial Caries Score and Caries Incidence in a Public Health Sealant Program: A Retrospective Study

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Abstract

Purpose: The purpose of this study was to investigate the relationship between: (1) children’s caries score (dmft, DMFT) at the time of sealant placement; and (2) “success” (measured as being caries-free) of that tooth at follow-up visits.

Methods: An existing database of over 38,000 sealants (10,038 children) placed between 1997 and 2002 by the Jefferson County Health Department’s Community Based Sealant Program, Birmingham, Ala, was used in the analysis. Only children returning for follow-up visits after the initial placement of the sealants were included in this study, resulting in 6,452 sealants (2,097 children). Logistic regression analysis was performed to determine the differences in sealant success between children with a dmft score of 0 vs a dmft score of >0 at baseline, and a DMFT score of 0 vs a DMFT score of >0 at baseline.

Results: In the permanent and primary dentitions, those who had no caries at the time of sealant placement (dmft/DMFT=0) had a significantly higher success of sealants during years 1 to 5 compared to those with a caries score of greater than 0 (dmft/DMFT>0; P<.023, P<.002, respectively).

Conclusion: Children with previous caries experience may be at a higher risk for sealant “failure” (measured as caries on a tooth surface previously sealed) after 1 year and, therefore, may require more diligent sealant maintenance. (Pediatr Dent 2006;28:420-424)

Keywords: Sealants, caries, sealant program

Accepted by the dental community. Among the reasons for the aforementioned are:
1. the need for maintenance;
2. possible nonreimbursement from insurance companies; and, contrary to Mertz-Fairhurst et al’s findings
3. concern that sealed undetected caries may progress.⁴,⁵ Furthermore, sealants may not be cost-effective in all children. Those with a high risk of caries could gain the most from having sealants placed.⁶ Alabama Medicaid data indicate that the proportion of underprivileged children who receive sealants is 22%.⁷ In Alabama, placement of sealants reduced the cost of future restorative care in low-income minority children by $16 per child.⁸

Risk factors for caries include: (1) previous and existing dental caries; (2) diet with high exposure to sugars; (3) children from low-income families; and (4) low fluoride intake.⁹,¹⁰ In 1994, the workshop on guideline for sealant use recommended that patients with teeth with morphological characteristics (ie, deep pits and fissures) should also be candidates for sealants. Data from the Third National Health and Nutrition Examination Survey, which collected data from 1988-1994, showed that 80% of all caries in children 5 to 17 years old occurred in only 25% of the population.¹¹ These children are considered “high risk,” and the major-

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Received September 26, 2005     Revision Accepted March 28, 2006
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visit were included in the analysis.

for the purpose of this study only the child’s first and second

3. had at least 1 occlusal sealant placed on a permanent

2. were examined twice by the school-based sealant pro

1. ranged in age from 5½ to 15 years old;

urban schools in the metropolitan Birmingham, Ala, area.

sample. The data were restricted to information from the

JCHD’s systems information office selected children for the

Institutes of Health standards, performed all examina

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ship between children’s caries score (dmft, DMFT) at the
time of sealant placement and “success” of that tooth (succ
cess referred to as being caries-free) at follow-up visits.

Methods

Data obtained during routine dental examinations of chil

The Jefferson County Health Department (JCHD) in

Birmingham, Ala, developed a program to place sealants

in urban schoolchildren in the county. At the initial visit,

oral health data were collected and sealants were placed on

noncarious, sealable permanent first molars. The children

were then seen for recall visits in subsequent years when

the program returned to the schools. Although it is well
documented that a history of dental caries is a risk factor

for future caries, it can be hypothesized that previous caries

in primary and permanent teeth could also be a risk factor

for sealant failure.

The purpose of this study was to investigate the relation-

ship between children’s caries score (dmft, DMFT) at the
time of sealant placement and “success” of that tooth (succ
cess referred to as being caries-free) at follow-up visits.

After parental consent, the dentist examined the child

with a mirror, light, and no. 5 explorer. If the PFM was
caries free and sealable, the hygienist was directed to place

the opaque sealant. All hygienists participating in the seal-

ant program had a bachelor’s degree in dental hygiene and

were assigned to the sealant program placing sealants 5
days a week during the school year. Periodic random seal-

ant retention checks were conducted, and all sealants were

checked by the supervising dentist on site after placement

that day.

During the 5-year period from which the data were

obtained, 15 dentists participated in the JCHD sealant

program. Three of the dentists performing the exams ac-
counted for over 50% of the initial and final examination
data from the JCHD sealant program. The JCHD sealant

program used portable units with air/water syringes and su-
cission. High-speed evacuation, however, was not available in

these units. Moisture control was, therefore, achieved using

an air syringe and cotton rolls. The sealants were placed on

the tooth without air abrasion or enameloplasty.

The records of 2,097 children (6,452 sealants placed)

seen by JCHD over a period of 5 years were included in

this sample. The sample of children was then separated into

4 subgroups according to the time period between the first

and second examination (ie, 0.5 to >1 year, 1 to >2 years,

2 to >3 years, and ≥3 years).

At the follow-up visit, which ranged from 6 months to

5 years, PFM occlusal surfaces were classified based on the

observed condition of these teeth. The sealed teeth were
classified as:

1. “success” (those teeth that were sealed on the initial

visit, and appear as sealed, partially sealed, or caries

free on the second examination); or

2. “failure” (those teeth that were sealed on the initial

visit, but appeared as carious or restored on the second

examination).

If the previously sealed tooth was partially sealed or miss-
ing its sealant but sound, a new sealant was then placed on

that tooth. The caries index scores at the initial visit were

used to divide the children into 2 groups: (1) dmft=0 vs
dmft>0; and (2) DMFT=0 vs DMFT>0. For the purposes

of this paper, analyses were performed using Statistical Pro-
duct and Service Solution software (SPSS Inc, version 12.0
for Windows, Chicago, Ill). Analysis of variance and logistic

regression were used to determine if there was a difference

between the 2 groups (dmft=0 vs dmft>0, and DMFT=0
vs DMFT>0) regarding time between follow-up visits and

sealant success. Two-sided type I error was set at \( P<.05 \).

Results

The children in the original database were 80% African

American and 52% female, with a mean age of 8.3 (±2.7

SD). The children included in the final analysis were 97%

African American and 58% female, with a mean age of 8.4

(±1.6 SD), indicating minimal selection bias. Senior dental

students and hygienists participated in the sealant program,

but overall the hygienists placed 94% of the sealants (Table

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The hygienists and student had overall success rates 90% and 91% respectively at follow-up, indicating no difference in who sealed the child’s tooth. A test of examiner calibration of the 3 examiners resulted in a mean interexaminer correlation of 77%±8.5%. Intraexaminer scores revealed a correlation of 80%±5.75%, and the kappa scores for the session were 0.72.14

Regarding the initial caries score in the primary dentition, there was a significant difference in sealant failure (caries or restoration) between the groups (dmft=0 or >0; Figure 1). For the teeth available for examination during the first year, there was no difference between the 2 groups. As the time between follow-up visits increased, however, the difference became statistically significant (P<.002). After 1 year, those with a dmft score of 0 were less than half as likely to experience sealant failure as those with an initial caries score of dmft >0.

Similar results were observed when sealant failure was evaluated in the permanent dentition (Figure 2). After 1 year, there was a significant difference in sealant failure between the DMFT=0 and DMFT>0 groups (P<.023). Children with a follow-up visit of greater than 1 year with a DMFT score of 0 were approximately half as likely to experience sealant failure compared to children with a DMFT score of >0.

Each molar was also analyzed independently to assess for any trends related to the dmft and DMFT initial caries scores (Tables 2 and 3). For all PFMs, there was a significant difference between the dmft=0 vs dmft>0 and the DMFT=0 vs DMFT>0 groups regarding sealant success when all covariates were taken into consideration, including: (1) age; (2) race; (3) gender; and (4) time between follow-up visits. Table 3 illustrates that children with a DMFT=0 were more than 4 times more likely to have success of a sealant placed on the maxillary right PFM compared to children with a DMFT score of >0, possibly due to right-handed hygienists placing the sealants.

The specific condition of each PFM at follow-up visits was divided into 4 different categories: (1) sealed; (2) sound; (3) restored; and (4) decayed. Those with a dmft/DMFT score of 0 had more favorable results than the dmft/DMFT score of >0 (Figures 3 and 4). For the primary dentition caries score, there was a significant difference between the dmft=0 and dmft>0 groups in the condition after 1 year (P<.002). After 1 to 2 or more years, 15% of the children with caries at the initial exam had decay on the sealed molars, whereas only 9% of the children with no caries had decay on the sealed molars.

Table 1. Sociodemographic Characteristics of Participants in the Jefferson County Health Department Sealant Program

<table>
<thead>
<tr>
<th>Variable</th>
<th>Original database n=10,038</th>
<th>Follow-up database n=2,037</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>80%</td>
<td>97%</td>
</tr>
<tr>
<td>Other</td>
<td>20%</td>
<td>3%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>52%</td>
<td>58%</td>
</tr>
<tr>
<td>Male</td>
<td>48%</td>
<td>42%</td>
</tr>
<tr>
<td>Age in ys at initial visit ±SD</td>
<td>8.3±2.7</td>
<td>8.4±1.6</td>
</tr>
<tr>
<td>Age in ys at second visit ±SD</td>
<td>-</td>
<td>10.2±1.7</td>
</tr>
<tr>
<td>Mean dmft at initial visit ±SD</td>
<td>1.8±2.5</td>
<td>2.5±1.2</td>
</tr>
<tr>
<td>Mean DMFT at initial visit ±SD</td>
<td>0.75±1.5</td>
<td>0.76±1.2</td>
</tr>
<tr>
<td>Average time in ys between visits (SD)</td>
<td>-</td>
<td>1.6±0.7</td>
</tr>
<tr>
<td>Sealant placement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hygienist</td>
<td>94%</td>
<td>-</td>
</tr>
<tr>
<td>Dental student</td>
<td>6%</td>
<td>-</td>
</tr>
<tr>
<td>Caries score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dmft=0</td>
<td>57%</td>
<td>45%</td>
</tr>
<tr>
<td>dmft&gt;0</td>
<td>43%</td>
<td>55%</td>
</tr>
<tr>
<td>DMFT=0</td>
<td>66%</td>
<td>64%</td>
</tr>
<tr>
<td>DMFT&gt;0</td>
<td>34%</td>
<td>36%</td>
</tr>
</tbody>
</table>

Figure 1. Caries score of primary dentition at time of sealant placement and percent of sealant failures at follow-up visits. During the follow-up periods of 1 to >2 years, 2 to >3 years, and ≥3 years, there was a significant difference between the 2 groups (P<.002).

Figure 2. Caries score of primary dentition at time of sealant placement and percent of sealant failures at follow-up visits. During the follow-up periods of 1 to >2 years, 2 to >3 years, and ≥3 years, there was a significant difference between the 2 groups (P<.023).
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Mandibular left PFM
1.89
Maxillary left PFM
4.38
Maxillary left PFM
2.57
1.62, 3.64
1.79
1.32, 2.46
1.08, 2.39
1.76
2.26
1.25, 2.46
2.04
2.75
1.83
4.58
1.42, 2.93
1.60
1.08, 2.15
2.56
1.80
Mandibular right PFM
17
1.53
Mandibular right PFM
Mandibular left PFM
3.16, 6.07
Makhija
1.88
1.76, 3.75

2. this population may also be less likely to receive treat-
1. caries prevalence is higher in communities with a low
Dentistry Demonstration Program found that:
The National Preventive
children who will benefit the most, specifically those with
are more likely to brush the right side of their mouth.
This could be
due to ease of isolation of that tooth or the fact that children
are more likely to brush the right side of their mouth.
Most community-based sealant programs try to reach
children who will benefit the most, specifically those with
the highest caries experience. The National Preventive
Dentistry Demonstration Program found that:
1. caries prevalence is higher in communities with a low
socioeconomic status; and
2. this population may also be less likely to receive treat-

Discussion
Several factors can affect sealant retention, such as: (1) in-
dividual tooth morphology; (2) caries risk; (3) dietary and
oral hygiene habits; and (4) placement technique. The overall results showed that, after the first year, the child’s
caries score at the time of sealant placement was associated
with sealant success and condition. Bravo et al have reported
that the early loss of sealants is mainly due to difficulties in
isolation and placement technique. In this study, there was
a significant difference between the child’s caries score
and sealant retention for the first year. Table 3 illustrated
that children with a DMFT score of 0 were more than 4 times
more likely to have caries-free teeth on the right maxillary
PFM than children with a DMFT score >0. This could be
due to ease of isolation of that tooth or the fact that children
are more likely to brush the right side of their mouth.

High-risk children include those with: (1) deep pits and
fissures; (2) a family history of caries; (3) early childhood
caries; (4) irregular dental visits; and (5) low fluoride ex-
posure. These factors should be taken into consideration
when placing sealants.

Once sealants have been placed, the role of recall visits
becomes critical. The sealed surfaces should be evaluated
within 1 year of application since most failures occur within
that time, mainly due to lack of moisture control. At that
time, if the sealant is partially or fully lost, another sealant
can be reapplied. According to Feigal, sealants have an
average failure rate of 5% to 10% per year. If no follow-up
is provided, the benefit of sealants is questionable since
the lack of maintenance could allow loss of protection
against caries. If subsequent follow-up visits are performed,
however, the success rate of a sealant increases to 80% to
90% after more than 10 years. Community-based sealant
programs are a necessity to help decrease the epidemic of
childhood caries because they serve high-risk children and
often provide follow-up visits to determine if reapplication
of sealants is needed. Therefore, children at higher risk
due to caries history who receive sealant maintenance will
benefit the most from sealant placement. This may lead to

Table 2. Crude Odds Ratio (OR) Comparing Children With an Initial Caries Score of dmft=0 vs dmft>0 and Sealed Permanent First Molar (PFM) Remaining Caries-free at Follow-up Visits

<table>
<thead>
<tr>
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<th>Maxillary right PFM</th>
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<th>Mandibular left PFM</th>
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</thead>
<tbody>
<tr>
<td>Crude OR</td>
<td>1.83</td>
<td>1.89</td>
<td>2.75</td>
<td>2.57</td>
</tr>
<tr>
<td>Adj OR*</td>
<td>1.53</td>
<td>1.80</td>
<td>2.56</td>
<td>2.42</td>
</tr>
<tr>
<td>Adj 95% CI*</td>
<td>1.08, 2.15</td>
<td>1.32, 2.46</td>
<td>1.76, 3.75</td>
<td>1.62, 3.64</td>
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*Adjusted odds ratio and 95% confidence interval (CI) for the children with all covariates (eg, age, sex, race, and time between visits) taken into consideration, using logistic regression. The reference category was children with a dmft=0.

Table 3. Crude Odds Ratio (OR) Comparing Children With an Initial Caries Score of DMFT=0 vs DMFT>0 and Sealed Permanent First Molar (PFM) Remaining Caries-free at Follow-up Visits

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</thead>
<tbody>
<tr>
<td>Crude OR</td>
<td>4.58</td>
<td>1.88</td>
<td>2.26</td>
<td>1.79</td>
</tr>
<tr>
<td>Adj OR*</td>
<td>4.38</td>
<td>1.76</td>
<td>2.04</td>
<td>1.60</td>
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*Adjusted odds ratio and 95% confidence interval (CI) for the children with all covariates (eg, age, sex, race, and time between visits) taken into consideration, using logistic regression. The reference category was children with DMFT=0.
optimal cost-effectiveness of this procedure and the public health sealant programs, thereby helping to prevent this most prevalent infectious disease of childhood.

The strengths of this study included a large sample size and the ability to perform follow-up evaluations for up to 5 years. This high number of follow-up visits allowed for accurate determination of sealant effectiveness. No high-speed evacuation was used during sealant placement, however, possibly hindering adequate tooth isolation. Possible “hidden caries” prior to sealant placement could have altered the results. Although multiple persons placed the sealants, they were periodically checked for retention and all sealants were checked prior to the child’s release. Calibration data were available for 3 of the 12 examiners (providing 50% of all examinations), although information on the other examiners was not available. The differences in management strategies in the children who returned for follow-up visits with restorations could not be adjusted for when conducting the analyses.

Conclusions

Based on this study’s results, the following conclusions can be made:

1. Children with existing caries are more likely to have sealants that turn into caries lesions after the first year of placement. Therefore, they need to be monitored more closely by dental professionals.

2. Although the ability of sealed teeth to remain caries free depends on various factors such as oral hygiene and diet, the patient’s caries index remains a determinant of the sealant’s overall success.

Acknowledgements

This study was made possible thanks to a grant from the Centers for Disease Control and Prevention (grant no. U48/CCU 409679 SIP9-99).

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