12-2020

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Community Dentistry and Oral Epidemiology, Vol. 48, No. 6 (December 2020): 487-492. DOI.

Dental Sealants and Restorative Treatment for First Molars Among Medicaid Enrollees

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Abstract

Objectives

To assess the association between dental sealant placement and subsequent restorative treatment of permanent first molars over time.

Methods

We analysed Wisconsin Medicaid claims data from 2001 to 2009 for children aged 6-16 years. Children entered the study cohort at age 6 and were censored if Medicaid eligibility was lost for >31 days. A fixed effects analysis via a Cox proportional hazards model, stratified by individual, was used to estimate the time-averaged and time-dependent effects of sealant placement on dental treatment defined as any restorative, endodontic or surgical procedure.

Results

A total of 185,262 children with permanent first molars who turned 6 years enrolled in Medicaid were examined. Sealant placement was higher for teeth #16 and 26 (5.42 and 5.46 per 100 person-years (100PY), versus 5.29 and 5.31/100PY for #36 and 46, respectively. The average rate for restorative treatments had the opposite pattern, with lower rate for teeth #16 and 26 (1.78 and 1.72/100PY) versus teeth #36 and 46 (2.14 and 2.12/100PY), respectively. In the fixed effects regression model, the hazard of dental treatment was substantially lower after sealant placement on a tooth, with time-averaged hazard ratio HR = 0.23 (95% CI 0.21-0.25, $P < .001$) versus before sealant. The largest effect was in the first year after sealant placement (HR = 0.13, 95% CI: 0.11-0.14), which decreased over time (HR = 0.50, 0.59 and 0.74 in years 2, 3 and 4, respectively), and was not statistically significant in later years.

Conclusions

This study demonstrates that permanent first molar sealant placement delayed subsequent dental treatments in children enrolled in Medicaid.

1 INTRODUCTION

Dental caries a common, complex and chronic disease disproportionately affects children and adolescents from low-income families, racial/ethnic minorities and those enrolled in Medicaid.[1] Dental sealant a thin plastic coating bonded into the deep grooves, pits and fissure surfaces of premolar and molar teeth can be placed at a dental clinic and in school-based sealant programmes using portable equipment. They prevent plaque accumulation including the growth of bacteria that is responsible for dental caries (tooth decay) development and progression.[2, 3] Studies demonstrate the efficacy, cost-effectiveness and benefits of dental sealants as a population-based preventive measure for dental caries; however, they remain underutilized especially for Medicaid enrollees.[3, 4] In addition, there is limited information on the extent sealants delay the receipt of subsequent dental care in permanent first molars.

The most susceptible teeth and surfaces to dental caries are the pits and fissures of permanent first molars.[5] One report documents that children from low-income families are 2 times more likely to have untreated cavities than children from higher income families and they are also less likely to have received dental sealants in permanent first molars.[3] Another report states that for every tooth sealed

there is a savings of $11 in dental treatment costs.[4] Dental sealants have the potential to lower caries formation in pits and fissures by 60 per cent in two to five years.[6] Despite these findings, information on the association between dental sealant placement and subsequent dental care of permanent first molars is understudied among Medicaid enrollees. Medicaid is a state and federal funded programme that provides dental and medical coverage for eligible low-income adults, elderly, pregnant women, children and people with disabilities in the United States.[7] Importantly, Wisconsin Medicaid provides comprehensive dental care for enrollees that includes 100% coverage for preventive dental care.

In 2006, the Wisconsin Medicaid programme changed its policy to allow dental hygienists in school-based settings to become Medicaid certified providers for dental sealant placement.[8] This policy change was associated with increased rates of visits to dentists and hygienists for dental sealant placements; however, this study did not assess dental sealant placement and subsequent restorative treatment of permanent first molars.[8] Dasanayake et al reported that restorative care was associated with lower cost among Medicaid enrollees with dental sealants ($50) versus those without sealants ($79).[9] Sen et al examined Alabama Medicaid dental claims data on whether early or regular preventive dental visits reduced restorative or emergency dental care and costs for low-income children. Authors concluded that they were uncertain whether preventive dental visits reduce restorative or emergency care.[10] So far, these studies demonstrate mixed findings on the association between dental sealant placements and receipt of subsequent restorative treatment in permanent molars. In addition, few studies have attempted to document that preventive dental care reduces restorative dental expenditures.[16] Our study examined the association between dental sealant placements and subsequent restorative, endodontic or surgical treatment of permanent first molars over time in children enrolled in Wisconsin Medicaid.

2 METHODS

We conducted secondary analyses of an existing data set. The Wisconsin Medicaid claims data for children enrollees who turned 6 years old from January to December of 2001-2009 were analysed. The claims data are from the Electronic Data Systems of Medicaid Evaluation and Decision Support (MEDS) database for the state of Wisconsin. Medicaid eligibility periods were available, along with exact commencement and cessation dates for each enrollee, so person-level lengths of eligibility were calculated with a precision of 1 day. The primary outcome variable was restorative care. The independent variables were age, sex, race/ethnicity, date of service, tooth type (1st molars) and dental sealant claim. The Medical College of Wisconsin and the Marquette University Institutional Review Boards approved the study as exempt.

2.1 Statistical analysis

Children entered the study cohort at age 6 and were censored if Medicaid eligibility was lost for >31 days. Patient demographic characteristics (race/ethnicity, age, gender) were summarized using counts with percentages. The rate of dental procedures was computed overall and by specific tooth as the ratio of the total number of claims with the specific procedure divided by the total tooth-years of follow-up (1 tooth-year is 1 tooth followed up for 1 year).

A fixed effects analysis via a Cox proportional hazards model stratified by individual was used to estimate the time-averaged and time-dependent effects of sealant placement on treatment

procedures. The unit of analysis was a tooth, with age at first restorative, endodontic or surgical procedure claim as the potentially censored outcome. For the time-averaged effect, a single time-dependent covariate indicating 'after sealant' status was added to the model, while for the time-dependent effect separate effects were included for each year after the sealant application for up to 4 years. The effect of the sealant was compared between racial/ethnic groups by including interaction terms. The fixed effects approach treats each patient as his/her own control and adjusts for all measured and unmeasured within-patient variables that are stable over time, such as sex, race/ethnicity, overall socio-economic status or overall propensity to visit a dentist. An alpha level of 0.05 was used throughout to indicate statistical significance.

3 RESULTS

Table **1** shows the demographic characteristics of the 185,262 children who turned 6-year-old while enrolled in Medicaid during 2001-2009, who constituted the study cohort. The largest racial/ethnic subgroup was non-Hispanic White, with approximately equal gender split. More children became eligible in the later years of the study.

TABLE 1. Study population by race/ethnicity, gender and year of child entry into the cohort for enrollees in Wisconsin dental medicaid (bracket contains per cent)

Characteristics	**Cohort N = 185,262 (%)**
Race/Ethnicity	
Hispanic	26 087 (14.1)
Non-Hispanic Black	41 080 (22.2)
Non-Hispanic White	86 367 (46.6)
Other/unknown	31 728 (17.1)
Gender	
Female	89 743 (48.4)
Male	95 519 (51.6)
Year of Entry into Cohort	
2001	8 932 (4.8)
2002	17 716 (9.6)
2003	19 444 (10.5)
2004	21 117 (11.4)
2005	22 226 (12.0)
2006	22 638 (12.2)
2007	23 226 (12.5)
2008	23 863 (12.9)
2009	26 100 (14.1)

Table **2** shows the rates at which different procedures were performed for all permanent first molars. Sealant placement was higher for the maxillary permanent first molars, teeth #16 and 26, at 5.42 and 5.46 per 100 person-years, versus 5.29 and 5.31 100-person year for the mandibular permanent first molars, #36 and 46, respectively. The average rate for restorative treatments was at a lower rate for

teeth #16 and 26 (1.78 and 1.72/100 person-years) versus teeth #36 and 46 (2.14 and 2.12/100 person-years), respectively.

TABLE 2. Rate of sealant placement, restorative procedures, endodontic procedures, surgical procedures and all dental procedures per 100 person-years of follow-up by tooth type

Variables	Total	Tooth #16	Tooth #26	Tooth #36	Tooth #46
Sealants					
Rate	5.37	5.42	5.46	5.29	5.31
Restorations					
Rate	1.94	1.78	1.72	2.14	2.12
Endodontic					
Rate	0.02	0.01	0.01	0.02	0.02
Surgery					
Rate	0.04	0.03	0.03	0.04	0.04
All Treatments					
Rate	1.98	1.81	1.76	2.18	2.16

Table **3** shows the result of the fixed effects regression model: the hazard of treatment was substantially lower after sealant placement on a tooth, with time-averaged hazard ratio HR = 0.23 (95% CI 0.21-0.25, $P < .001$) for sealed versus not sealed. The largest effect was seen in the first year after sealant placement (HR = 0.13, 95% CI: 0.11-0.14), but the effect decreased over time (HR = 0.50, 0.59 and 0.74 in years 2, 3 and 4, respectively), and it was not statistically significant after 4 years.

TABLE 3. Results of the fixed effect analysis of the yearly effect of dental sealant on the hazard of dental treatment and the time-averaged effect obtained from a separate model fit

Predictor/ Comparison	Hazard Ratio	95% Lower Confidence Limit for Hazard Ratio	*P-value*
Tooth #			
#26 vs #16	0.93	0.90, 0.96	<.0001
#36 vs #16	1.25	1.21, 1.29	<.0001
#46 vs #16	1.24	1.20, 1.28	<.0001
Time period			
0-<1 year after sealant vs before sealant	0.13	0.12, 0.14	<.0001
1-<2 years after sealant vs before sealant	0.50	0.43, 0.57	<.0001
2-<3 years after sealant vs before sealant	0.59	0.49, 0.71	<.0001
3-<4 years after sealant vs before sealant	0.74	0.58, 0.95	.0200
4+ years after sealant vs before sealant	0.88	0.67, 1.16	.3775
Time-averaged			
After vs before sealant	0.23	0.21, 0.25	<.0001

Table **4** shows the fixed effects analysis based on time-averaged effect of sealants by race/ethnicity—a similar effect was observed in all groups ($P = .17$ for interaction).

TABLE 4. Fixed effects analysis: Time-averaged effect of sealants by tooth type and race/ethnicity on the hazard of dental procedure received

Comparison	Hazard Ratio	95% Lower Confidence Limit for Hazard Ratio	*P-value*
Tooth #26 vs #16	0.931	0.901, 0.961	<.0001
Tooth #36 vs #16	1.253	1.215, 1.292	<.0001
Tooth #46 vs #16	1.239	1.202, 1.277	<.0001
Hispanic, after vs before sealant	0.285	0.220, 0.368	<.0001
Non-Hispanic Black, after vs before sealant	0.226	0.170, 0.300	<.0001
Non-Hispanic White, after vs before sealant	0.219	0.197, 0.243	<.0001
Other/unknown, after vs before sealant	0.257	0.215, 0.307	<.0001

Figure **1** shows the year-specific effects of sealant placement by race/ethnicity. It also reveals similar trends in all groups.

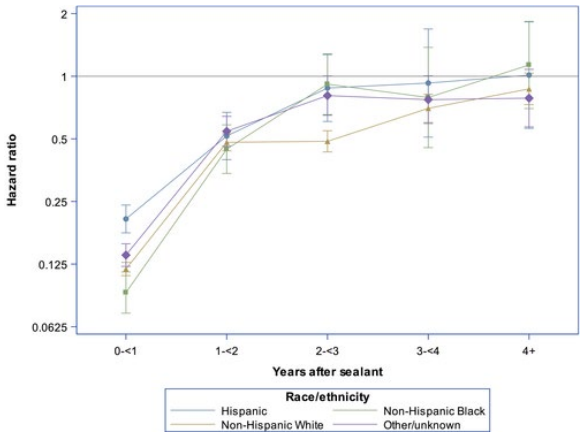

FIGURE 1 The estimated reduction in the hazard of dental treatment by time after sealant placement with standard error bars

4 DISCUSSION

A number of findings emerged from our secondary data analysis of the relationship between dental sealant placements and subsequent restorative care of permanent first molars. First, we observed that over time, claims for dental sealant placements were highest on the right and left maxillary permanent first molars (tooth #16 and tooth #26). These were the same teeth found to have a lower average rate for restorative care. These findings reflect what is typically seen by clinicians who provide care to the Medicaid population and is consistent with those from an Iowa dental Medicaid claims study.[11].Our findings could also reflect differences in eruption times between upper and lower molars, although we were unable to demonstrate these relationships based on the data available from our database.

Second, we observed that the highest rates of treatment were for sealant placement on permanent first molars. This was followed by receipt of restorative care which was at least 40% lower for all teeth. This finding is consistent with that of Ismail and colleague that reported that they observed a significantly lower proportion of dental caries in sealed permanent first molars when compared to

unsealed permanent first molars.[12] Sen et al (2013) documented that preventive dental visits reduce restorative dental expenditures.[10] This finding demonstrates that placement of dental sealants in permanent first molars has the potential to reduce restorative treatment need and long-term associated costs from expansive, invasive dental procedures. In addition, one study reported that only 38.7% of children from low-income households and 47.8% of children from higher income households had sealants applied to their teeth.[4] This is despite the more than 40 years of professional recognition of the safety and effectiveness of dental sealants in preventing pits and fissure caries. In addition, this sealant utilization rate is low compared to established national goals such as the Healthy People 2020.

Third, compared to tooth #16, we observed that tooth #26 had lower rates and teeth #s36 and 46 had higher rates of receiving all dental procedures examined per 100 person-years. This effect was statistically significant based on the time-averaged hazard ratio comparing sealed versus nonsealed teeth. The largest effect was in the first year after sealant placement, and there was a decrease in restorative treatment needs to about 50% in years 2, 3 and 4, respectively. However, this was not statistically significant. Our findings demonstrate that sealants are of immense value and have the potential to reduce the need for subsequent restorative treatment especially in the first year. Although we did not examine the reasons behind the high susceptibility of teeth #s36 and 46 for dental procedures, we believe that most of the procedures received by teeth #s36 and 46 were likely due to dental caries. Macek et al analysed a nationally representative data set in an era of decline in dental caries prevalence over time. They reported that lower permanent first molars were the most susceptible teeth to dental caries in the entire dentition.[7] Bhardwai reported that mandibular first molars were the most susceptible teeth to dental caries in 6- to 12-year-old school children in Shimla city in Himachal Pradesh in India. [13] Our study suggests a need for dental sealant placement on mandibular permanent first molars especially as soon as they erupted into the oral cavity. At the same time, we recognize the existence of systematic reviews documenting the effectiveness of dental sealants in preventing dental caries.[14, 15] In addition, dental caries for the most part are in theory largely preventable, and dental sealants are an integral component of any dental caries control regimen.

Our study has some strengths and limitations that should be considered in the interpretation of our findings. It is population-based, and a fixed effects analysis was used to adjust for all measured and unmeasured time-invariant subjects to reduce the level of confounders and to eliminate many potential sources of bias. Our findings on tooth-specific dental caries susceptibility are important to clinicians, programme planners, school-based sealant programme providers and dental insurers, given the current discussion on value-based or bundle-payment systems in dentistry. This study provides an additional data point for dental insurers in their analysis to determine the most appropriate payment system in dentistry. Our study expands the research related to caries prevention in different permanent molars. It also serves as a useful source of reference for dental administrators in deciding when and which preventive strategy to employ for different population groups.[16]

In terms of the limitations, first, we used claims data and agree that it does not provide information about the timing of tooth eruption, or the type of sealant material used, so we are unable to fully calculate the period that the teeth were at risk before dental treatment or whether the type of sealant material used has any effect. Two assumptions were made in our approach to accommodate these

limitations: First, we assumed that all permanent first molars erupted after 6 years of age, that no procedures were performed on the studied teeth before entry into the study cohort, and that the relative timing of eruption of the permanent first molars was similar in each child and captured by the tooth-number effect in the fitted model. Second, we did not identify whether a tooth never erupted, but it was assumed that this was not the case based on the age of the study cohort. An additional limitation of the analytic approach is that only individuals with an event—those that had a restorative, endodontic or surgical procedure in at least one of their permanent first molars was informative for the fixed effects analysis. Similarly, children who had sealants placed on all teeth simultaneously did not contribute information for this analysis. Thus, the effective sample size and power for the analysis were lower compared to potential alternative analytical methods.

Our findings expand the literature and support the current evidence on the therapeutic value of dental sealants in reducing future operative treatment needs in children. They also support the effectiveness of sealants in preventing dental caries in the context of published literature to date. In addition, our data suggest the need for more research into the length of time required between first and subsequent dental sealant replacement. In conclusion, placement of dental sealants on permanent first molars has the potential to reduce the risk of subsequent restorative treatments in children enrolled in Medicaid. The risk reduction for subsequent treatment with dental sealants is largest during the first few years after the initial placement, with the effect disappearing by year 4.

ACKNOWLEDGEMENT

An abstract from the study was presented as a poster presentation at the International Association for Dental Research (IADR) meeting in July 2017. The project was supported by the National Institutes of Dental and Craniofacial Research grant # R03 DE024494 part of the National Institute of Health.

AUTHORS' CONTRIBUTION

All authors made substantial contributions to conception and design of the study. AV and AS have been involved in data extraction and data analysis. CO, BH, EO, RG, and AV, AS have been involved in data interpretation, drafting the manuscript and revising it critically and have given final approval of the version to be published.

References

1. Department of Health and Human Services (HHS) Rockville (MD): National Institutes of Health, National Institute of Dental and Craniofacial Research; 2000. Oral Health in America: A Report of the Surgeon General.
2. Community Preventive Services Task Force. *Preventing Dental Caries: School-based Dental Sealant Delivery Programs*. Atlanta, GA: US Department of Health and Human Services, Community Preventive Services Task
   Force; 2016. https://www.thecommunityguide.org/findings/dental-caries-cavities-school-based-dental-sealant-delivery-programsexternalicon. Accessed June 20, 2019
3. Center for Disease Control and Prevention (CDC). Dental Sealants Prevent Cavities: Effective protection for children. Available

at: https://www.cdc.gov/oralhealth/dental_sealant_program/index.htm. Accessed June 20, 2019
4. Griffin SO, Wei L, Gooch BF, Weno K, Espinoza L. Vital signs: Dental Sealant use and untreated tooth decay among US school-aged Children. *MMWR Morb Mortal WKly Rep*. 2016; **65**(41): 1141– 1145.
5. Ahovuo-Saloranta A, Hiiri A, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. *Cochrane Database Syst Rev*. 2008; CD001830.
6. Centers Medicaid.gov. Keeping America Healthy. Medicaid. Centers for Medicare & Medicaid Services. Available at: https://www.medicaid.gov/medicaid/index.html. Accessed March 20, 2020
7. Macek MD, Beltran-Aguilar ED, Lockwood SA, Malvite DM. Updated comparison of the caries susceptibility of various morphological types of permanent teeth. *J Public Health Dent*. 2003; **63**(3): 174– 182.
8. Okunseri C, Okunseri E, Garcia RI, Gonzalez C, Visotcky A, Szabo A. Impact of Wisconsin Medicaid Policy Change on Dental Sealant Utilization. *Health Serv Res*. 2018; **53**(1): 312– 325.
9. Dasanayake AP, Li K, Kirk K, Bronstein J, Childers NK. Restorative Cost Savings Related to Dental Sealants in Alabama Medicaid Children. *Pediatric Dentistry*. 2003; **25**(6): 572– 576.
10. Sen B, Blackburn J, Kilgore ML, Morrisey MA, Becker DJ, Caldwell C, Menachemi N. Effectiveness of Preventive Dental Visits in Reducing Non-Preventive Dental Visits and Expenditures. *Pediatrics*. 2013; **131**(6): 1107– 1113.
11. Bhuridej P, Damiano PC, Kuthy RA, Flach SD, Kanellis MJ, Heller KE, Dawson DV. Natural history of treatment outcomes of permanent first molars: a study of sealant effectiveness. *J Am Dent Assoc*. 2005; **136**(9): 1265– 72.
12. Ismail AI, Gagnon P. A longitudinal evaluation of fissure sealants applied in dental practices. *J Dent Res*. 1995; **74**(9): 1583– 1590.
13. Bhardwaj VK. Dental caries prevalence in individual tooth in primary and permanent dentition among 6–12-year-old school children in Shimla, Himachal Pradesh. *Int J Health Allied Sc*. 2014; **3**(2): 125– 128.
14. Ahovuo-Saloranta A, Forss H, Walsh T, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in permanent teeth. *Cochrane Database Syst Rev*. 2017; **7**:CD001830.
15. Wright JT, Tampi MP, Graham L, Estrich C, Crall JJ, Fontana M, Gillette EJ, Nový BB, Dhar V, Donly K, Hewlett ER, Quinonez RB, Chaffin J, Crespin M, Iafolla T, Siegal MD, Carrasco-Labra A. Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars: A systematic review of randomized controlled trials-a report of the American dental association and the American academy of pediatric dentistry. *J Am Dent Assoc*. 2016; **147**(8): 631– 645.e18.
16. Hannigan A, O'Mullane DM, Barry D, Schäfer F. Roberts AJ. A caries susceptibility classification of tooth surfaces by survival time. *Caries Res*. 2000; **34**(2): 103– 8.