

The Effectiveness of a School-Based Sealant Program and Common Failures in Southern Thailand

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Abstract

The purposes of the present study were 1) to evaluate the effectiveness of a school-based sealant program in different settings, and 2) to examine the most common failures of the school-based sealant program. The design was a follow-up study of the school-based sealant program. Twelve contracting units of primary care and 1,703 children with 4,121 teeth were included. Sealant retention and caries on sealed surfaces were examined for 6 months after sealant application. Full sealant retention was 41.2 % and caries on sealed surfaces presented 4.1 %. The hospital-based service provided 1.56 times more full sealant retention than the mobile service. However, there was no significant effect of such setting services towards caries on sealed surfaces. The most common failures were partial retention with ledge and caries present, loss of sealant on poor oral hygiene surfaces, loss of sealant at the cervical part of the buccal groove of lower molars, and loss of sealant at the distal groove of the occlusal surface of lower molars. In conclusion, the quality of school-based sealant services should be improved, especially mobile dental services, and the most common failure causes should be reviewed.

Key words: Dental sealant; Effectiveness; Hospital-based service; Mobile service

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Introduction

Dental caries is a dominant chronic disease worldwide, especially in lower-middle and upper income countries.¹ Thailand also has a high prevalence of childhood caries, with the percentage of dental caries in permanent teeth of 12-year-old children increasing steadily from 45.8 % in 1987 to 52.3 % in 2002.² In order to cope with this problem, the school dental sealant program, which is recommended by the American Association of Community Dental Programs,³ was launched in 1999. Community sealant programs, in particular school sealant programs, have been successfully employed in many countries over long periods.⁴⁻⁶ In Thailand, such programs have been implemented in many areas in order to increase access to sealants. However, the outcomes of the use of sealants have generally been unsatisfactory.⁷⁻¹¹ To improve the school-based sealant program, sealant effectiveness was evaluated and most common failure scenarios were examined, from the previous study's suggestion.¹²⁻¹³

Since access to dental service, especially in children, is low,² dental services for children are served in hospitals and also mobile or school settings. The mobile service has been implemented at schools for basic dental services such as sealants, fillings, extractions, scaling and fluoride treatment. The equipment was transported by a van and a temporary clinic was set up for 1 - 2 days in each school. The effect of the setting towards the number of fillings on different caries experiences was reported recently.¹² Few studies have demonstrated the effect of different dental service settings.

The purposes of the present study were to evaluate the effectiveness of the school-based sealant program in different settings, and to examine the most common failures of the school-based sealant program.

Materials and Methods

This study was the first phase of the audit and feedback project conducted during October

2009 to May 2010. The design was a follow-up study on a routine school-based sealant program. The application of sealant was carried out according to the manufacturer's instructions. The school sealant program was launched as usual by dental personnel in Contracting Units of Primary Care (CUP). The follow-up for retention of sealant and caries on sealed surfaces was performed for 6 months after application.

The study setting was in Songkhla, one of the urbanized provinces in the southern part of Thailand. There are 17 CUPs which have implemented the sealant program. The target population of the sealant program was first grade primary school children who had fully erupted and caries-free first permanent molar teeth. Multi-stage random sampling was employed. All sealant children were included in the study. Twelve CUPs were randomly selected. All eligible sealed children with parental or guardian consent were included. The total number of children was 1,703 children with 4,121 examined sealant teeth.

Data on factors related to the sealant application condition included setting (hospital/mobile), gender (male/female), position of teeth (upper/lower), children cooperation (yes/no), and oral hygiene (good/fair). The children cooperation was classified as "yes" when the procedure ran smoothly and the child followed the provider's suggestion. Data was collected by trained dental nurses who applied the sealant in the sealant record form.

Data for oral hygiene was based on the debris index of Simplified Oral Hygiene Index,¹⁴ while data for sealant retention was classified as fully retained and partial or total loss of sealant based on Simonsen's criteria,¹⁵ and data for caries on a sealed surface was classified as 'yes' or 'no'.¹⁶ The examination was carried out under field conditions using a standard oral health examination set consisting of a dental chair, operating tool, artificial light, mouth mirror, standard explorer, and periodontal probe. Prior to examination, reproducibility of examination results

were tested over two examinations, 3 days apart, on 15 children. The kappa value was 0.75 for retention of sealant.

The most common failures were partial retention with ledge and caries present, loss of sealant at poor oral hygiene surfaces, loss of sealant at distal end of the buccal groove of lower molars and loss of sealant at distal groove of the occlusal surface of lower molars.

The first failure was defined as loss of some sealant and pit/fissure exposed with ledge presence when exploring with sharp probe and loss of tissue beyond the boundaries of pits and fissures on occlusal surfaces and lesions contain demineralized dentine, usually light brown, and have soft texture when explored with gentle pressure with blunt probe (Fig. 1).

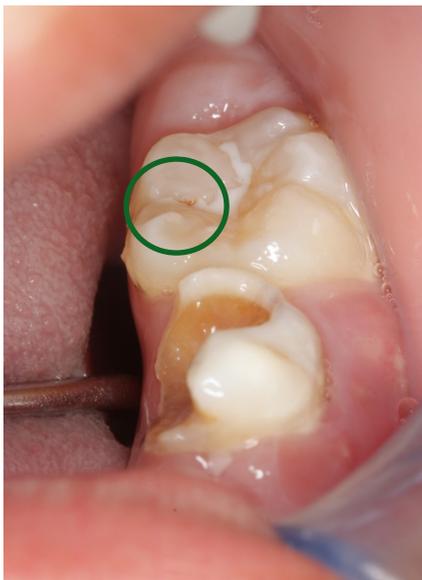


Figure 1 Partial retention with ledge and caries present

The second failure was partial loss or total loss of sealant retention and presence of poor oral hygiene and poor oral hygiene measured by presenting of soft debris covering more than 2/3 of the exposed tooth surface (Fig. 2).



Figure 2 Loss of sealant and poor oral hygiene

Loss of sealant at distal end of the buccal groove of lower molars was no sealant remained at the distal end of the buccal groove (Fig. 3). The characteristic of the last common failures was no sealant remained at the distal groove of the occlusal surfaces of lower molars (Fig. 4).



Figure 3 Loss of sealant at cervical part of buccal groove of lower molars



Figure 4 Loss of sealant at distal groove of occlusal surface at lower molars

The data analysis was conducted using the R program, version 2.12.0¹⁸ employing descriptive statistics and logistic regression. The descriptive statistics derived from the data included frequencies and percentages. Logistic regression was used to assess the effect of the setting. The dependent variables in the regression analysis were sealant retention and caries on sealed surfaces, and the main independent variable was the setting controlled for children's characteristics.

The research protocol was approved by the Ethics Committee of the Faculty of Dentistry, Prince of Songkla University (No.0521.1.03/211). After examination, oral health education was provided and caries cases were referred to responsible CUPs for further treatment.

Results

The children's characteristics relating to the service setting are presented in Table 1. As can be observed from Table 1, most of the children were male, had high caries experience and fair oral hygiene. Most of the sealed teeth were in the lower jaw. Two thirds of them were sealed in a mobile setting. There was significant difference in the characteristics of children including gender and caries experience in a hospital and mobile setting. The sealant retention and caries on sealed surfaces were also different across settings.

Table 2 shows the odds ratios (OR), 95 % CI and *p*-values from logistic regression with sealant retention as the dependent variable. The hospital-based setting provided 1.56 times greater full sealant retention than the mobile setting. The characteristics that significantly increased sealant retention were being male, lower teeth and good oral hygiene.

Table 1 Baseline characteristics and sealant effectiveness of 4,121 examined sealant teeth

Characteristics	Setting (frequency (%))		<i>p</i> - value
	Mobile (N = 2,647)	Hospital (N = 1,474)	
Gender			
Male	1,492 (56.4)	732 (49.7)	
Female	1,155 (43.6)	742 (50.3)	< 0.001**
Caries experience in primary teeth			
Low (dmft ≤ 4)	513 (19.4)	210 (14.2)	
High (dmft > 4)	2,134 (80.6)	1,264 (85.8)	< 0.001**

Table 1 (Continued)

Characteristics	Setting (frequency (%))		p - value
	Mobile (N = 2,647)	Hospital (N = 1,474)	
Tooth position			
Lower	1,521 (57.5)	870 (59.0)	0.340
Upper	1,126 (42.5)	604 (41.0)	
Oral Hygiene			
Good	1,155 (43.6)	667 (45.3)	0.326
Fair	1,492 (56.4)	807 (54.7)	
Sealant retention			
Complete	990 (37.4)	708 (48.0)	0.001**
Partial and total loss	1,657 (62.6)	766 (52.0)	
Caries on sealed surface			
Yes	125 (4.7)	47 (3.2)	0.018*
No	2,522 (95.3)	1,427 (96.8)	

* $p < 0.05$ ** $p < 0.001$

Table 2 Results of logistic regression of the effects of setting on sealant retention, controlled for children's characteristics

Variables	Sealant retention: frequency (%)		Adjusted OR (95 % CI)	p - value
	Complete (N = 1,698)	Partial and total loss (N = 2,423)		
Setting				
Hospital	708 (48.0)	766 (52.0)	1.56 (1.43 to 1.69)	< 0.001**
Mobile	990 (37.4)	1,657 (62.6)	1	
Gender				
Male	950 (42.7)	1,274 (57.3)	1.21 (1.08 to 1.34)	0.003*
Female	748 (39.4)	1,149 (60.6)	1	
Tooth position				
Lower	1,074 (44.9)	1,317 (55.1)	1.30 (1.16 to 1.43)	< 0.001**
Upper	624 (36.1)	1,106 (63.9)	1	

Table 2 (Continued)

Variables	Sealant retention: frequency (%)		Adjusted OR (95 % CI)	p - value
	Complete (N = 1,698)	Partial and total loss (N = 2,423)		
Oral hygiene				
Good	870 (47.7)	952 (52.3)	1.53 (1.40 to 1.66)	
Fair	828 (36.0)	1,471 (64.0)	1	< 0.001**

Reference level of sealant retention = loss of retention

* $p < 0.05$ ** $p < 0.001$

Table 3 shows the results from logistic regression with caries on sealed surfaces as the dependent variable. It can be seen that hospital-based service gave 1.57 times greater of non- carious surfaces than the mobile service. Low caries experience children tend to have less caries on sealed surfaces compared to high caries experience children.

Table 4 and Figures 1 - 4 show the most common failures found in the school-based sealant program. Four characteristics of the most common failures were loss of sealant on poor oral hygiene surfaces, loss of sealant at the cervical part of the buccal groove of lower molars, loss of sealant at the distal groove of the occlusal surface of lower molars, and partial retention with ledge and caries present.

Table 3 Results of logistic regression of the effects of setting on caries on the sealed surface, controlled for children's characteristics

Variables	Caries on sealed surfaces				Adjusted OR (95 % CI)	p - value
	Frequency (%)					
	Caries (N = 172)	No caries (N = 3,949)				
Setting						
Hospital	47 (3.2)	1,427 (96.8)	1.57 (1.23 to 1.91)			
Mobile	125 (4.7)	2,522 (95.3)	1		0.010*	
Caries experience in primary teeth						
Low	12 (1.7)	711 (98.3)	3.03 (2.44 to 3.63)			
High	160 (4.7)	3,238 (95.3)	1		< 0.001**	

Reference level of caries on the sealed surface = caries on sealed surfaces

* $p < 0.05$ ** $p < 0.001$

Table 4 Summary of most common failures

Failure types	Calculation	Frequency (%)
1. Partial retention with ledge and caries present	Percentage of failure type 1 among number of total and partial sealant loss	125/2,423 (5.2 %)
	Percentage of failure type 1 among number of caries on sealed surfaces with partial sealant loss	125/141 (88.7 %)
2. Loss of sealant at poor oral hygiene surfaces	Percentage of failure type 2 among number of total and partial sealant loss	1,471/2,423 (60.7 %)
3. Loss of sealant at the cervical part of the buccal groove of lower molars	Percentage of failure type 3 among number of sealed lower molars	763/2,391 (31.9 %)
4. Loss of sealant at distal groove of the occlusal surface of lower molars	Percentage of failure type 4 among number of sealed lower molars	389/2,391 (16.3 %)

Discussion

Based on the study's findings, the hospital-based setting had a greater positive effect on sealant retention and caries, however, the effect was not so high. The four types of most common failures of the school-based sealant program found were loss of sealant on poor oral hygiene surfaces, loss of sealant at the cervical part of the buccal groove of lower molars, loss of sealant at the distal groove of the occlusal surface of lower molars, and partial retention with ledge and caries present.

From a previous publication in the Journal of Oral science,¹² hospital-based settings increased more coverage of secondary prevention than school-based settings among school children, which affected the number of decay, missing and filling in permanent teeth (DMFT). In that study, they did not include any primary prevention or the effect of quality of the services.¹⁹ In this study, sealant performed in hospital-based settings had more effectiveness

than sealants performed at schools in mobile settings. This finding might be explained by more dental equipment facilities in hospital equipment, which may also reflect good moisture control conditions. In order to increase access and effectiveness of the sealant program for school children, the strategy for improving sealant effectiveness in a mobile setting or the strategy to increase hospital access of school children should be considered.

The most common failures of the school-based sealant program reflect the cause of the failures. Results from the knowledge management solving workshop conducted among dental providers¹³ mentioned these common failures as their input. The causes of the failures included poor oral hygiene of sealed teeth, difficult to clean before sealing, partial eruption of sealed teeth especially incomplete exposure at the end of the buccal groove, high caries risk and uncontrolled caries risk of children, and ineffective sealing technique. The Key Performance Indicator (KPI) which was set for quantity

of the program –“50 % of the first grade children to be sealed” was also burden to the provider to fulfilled and then had the effect to the quality of the program. A study of the eruption pattern²⁰ found that only 57 % of first grade children had all first permanent molars sufficiently erupted for sealing. Moreover, in the context where high caries prevalence was found, the provider might seal teeth in improper conditions such as insufficient tooth eruption.

The sealing program alone cannot alleviate the dental caries problem; an effective sealant program must be combined with an effective preventive strategy such as a tooth brushing program with fluoride toothpaste. The factors related to sealing techniques and policy should also be revised.

Conclusion

There was significant effect of setting services towards sealant retention but there was no effect toward caries on sealed surfaces. The most common failures were partial retention with ledge and caries present, loss of sealant on poor oral hygiene surfaces, loss of sealant at the distal end of the buccal groove of lower molars, and loss of sealant at the distal groove of the occlusal surface of lower molars. In conclusion, the quality of school-based sealant services should be improved, especially mobile dental services, and the most common failure causes should be reviewed.

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