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Five-Year Evaluation of SS-Suction: A Moisture Control Innovation for Dental Sealant Application by Dental Nurses Without Assistants in Children Aged 6–8 Years

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Abstract:

Objective: This study aimed to evaluate the 5-year effectiveness of the SS-suction (moisture control device) in maintaining sealant retention and preventing dental caries when used without dental assistance.

Material and Methods: A retrospective cohort study with a cross-sectional follow-up study was conducted among children who received pit and fissure sealants using the SS-suction in 2020. Data were collected using questionnaires and clinical examination forms. Quality control included validation and reliability testing of the questionnaire and examiner calibration.

Results: A total of 105 children were examined at the 5-year follow-up, including 157 teeth, with an average of 1.5 teeth examined per child. This corresponded to follow-up rates of 58.7% for participants and 59.0% for teeth. Sealant retention outcomes showed 11.5% full retention, 59.2% partial loss, and 29.3% total loss. Caries was detected on 14.0% of sealed surfaces, while 86.0% remained caries-free. Binary logistic regression revealed that teeth with total sealant loss were 5.9 times more likely to develop caries (p-value<0.05). Additionally, children with a plaque index ≥2 were 4.8 times more likely to have caries than those with lower scores (p-value<0.05). Furthermore, females were 3.7 times more likely to develop dental caries than males (p-value<0.05). No significant associations were found with oral hygiene practices or daily consumption of snacks and sweetened beverages.

Conclusion: This study shows better retention over a 5-year period than other studies conducted within the country. This suggests that the SS-suction can assist dental nurses with moisture control and sealant quality for long-term caries prevention.

Keywords: children, dental nurse, retention, sealant, suction

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Introduction

Dental caries is one of the most significant global oral health challenges. In Thailand, it has been recognized as the most prevalent oral health condition among the population[1]. According to the 9th National Oral Health Survey conducted in 2023, the prevalence of dental caries among 5-year-old children was 72.1%, with a mean decayed, missing, and filled teeth (DMFT) score of 4.6. Among 12-year-old children, the prevalence was recorded at 49.7%, with an average DMFT score of 1.2[2]. Dental caries has also been shown to negatively impact both functional and psychosocial domains, including chewing ability, emotional well-being, social interaction, and overall quality of life[3,4] . The survey further reported that 22.4% of 5-year-olds had experienced severe tooth pain, which interfered with eating and sleeping. In addition, 36.4% of 12-year-olds reported experiencing tooth pain, and 12.2% were absent from school due to receiving dental treatment[2]. Sealant application is a well-established method for dental caries prevention.

In Thailand, the pit and fissure sealant program has been implemented to reduce the incidence of dental caries in permanent molars among children aged 6 to 12 years. Sealant application involves placing the material into pits and fissures to seal deep anatomical grooves, thereby improving cleanability and reducing susceptibility to dental caries. The effectiveness of sealants in caries prevention largely depends on their retention. A previous study demonstrated that tooth surfaces with fully retained sealants can achieve up to 100% protection against dental caries[5]. Successful sealant retention is highly dependent on moisture control during the procedure. Therefore, it is recommended that sealant application be performed with chairside assistance, which has been shown to increase the retention rate by up to 2.3 times compared to procedures performed without assistance[6]. However, due to a shortage of dental assistants in subdistrict health promotion hospitals[7], dental treatments, including sealant application, are often performed without chairside support.

To address this challenge, Sukanya and colleagues developed an oral moisture control device, known as SS-suction, designed to ensure effective moisture control in the absence of chairside assistance. This device helps retract the tongue and cheek while also suctioning saliva, which can help control moisture and provide dental nurses with a free hand to hold instruments when working alone. The device was specifically developed for use in children aged 6–8 years, the primary target group of Thailand's pit and fissure sealant program. The SS-suction device underwent safety testing in both laboratory and clinical settings[8]. It was also used in pit and fissure sealant procedures for children aged 6–8 years, with sealant retention evaluated at 3 months. The results showed a full retention rate of 79.4%[9]. In Thailand, studies have found sealant retention rates at both three and six months. Two three-month studies differed from this SS-suction research in their design, objectives, and materials, making a direct comparison to its three-month findings in Thailand not possible[10,11]. When compared to other studies with six-month follow-ups, retention rates of 41.2%, 45.6%, and 61.8% were found[12,13,14]. In this study, we found a better full retention rate than all three of those other studies.

However, to date, no study has examined the long-term retention of pit and fissure sealants with the use of SS-suction. Therefore, the present study aimed to evaluate the effectiveness of the SS-suction device, used without dental assistance, in preventing dental caries over a 5-year period.

Material and Methods

This study employed a retrospective cohort study with a cross-sectional follow-up design. The study population comprised children who had previously received pit and fissure sealants in 2020 as part of a study titled "The Effectiveness and Satisfaction of Moisture Control Innovation (SS-suction) for Dental Sealant in 6–8-Year-Old Children by Dental Nurse without Assistant." Participants in the

original study met the following baseline characteristics: (1) aged 6–8 years; (2) diagnosed with deep pits and fissures on mandibular first permanent molars requiring sealant application; (3) fully erupted molars; (4) intact tooth structure; (5) no underlying medical conditions; (6) cooperative during dental treatment; and (7) no lesions in the oral cavity or chin area[9] . The current study included the entire population from the original study, comprising 179 children and a total of 266 mandibular first permanent molars that had been sealed in 2020[9]. Participants were excluded if they: (1) had oral lesions that precluded dental examination or (2) had received re-sealant on the same tooth based on school dental records and participant recall. The follow-up methods were based on the original school setting.

Data were collected using questionnaires and clinical examination forms. The questionnaire, developed in the Thai language, obtained general demographic information and oral health behaviors, such as toothbrushing practices, use of fluoride toothpaste, and the frequency of consuming cariogenic foods. The clinical examination forms included: (1) a dental caries assessment based on the diagnostic criteria proposed by Ismail[15] ; (2) an evaluation of sealant retention using Simonsen's criteria[16] ; (3) an oral health status assessment modified from the World Health Organization's Oral Health Survey (2013)[17]; and (4) a dental plaque assessment using the Debris Index of the Simplified Oral Hygiene Index (OHI-S) (Green JC, Vermillion JR)[18].

The content validity of the questionnaire was reviewed by three experts, and revisions were made according to their recommendations. Reliability was assessed using the test-retest method, yielding a Kappa value of 0.98. Dental examiners were calibrated according to standardized procedures under the supervision of a specialist in preventive dentistry from the Faculty of Dentistry, Prince of Songkla University. Both intra-examiner and inter-examiner calibrations were conducted to ensure measurement consistency, with Kappa values greater than 0.8 in both cases. The pilot study was conducted on 15 children aged 11–12 years to assess the reliability of the questionnaire. The cases were diverse, covering a range of outcomes for a variety of tooth types, including full retention, partial retention, and total missing.

Oral examinations were conducted at schools by two dentists. A blunt-ended dental explorer was used only when necessary, such as in cases of suspected caries, to gently remove plaque or food debris. All findings were recorded on examination forms by research assistants. Prior to the clinical examination, students were asked to complete a self-administered questionnaire. For analysis, sealant retention was categorized into two groups: total loss and preventive retention (full retention and partial loss, which reflect the sealant remained intact). Proper oral hygiene, defined as brushing teeth daily using fluoride toothpaste, was classified as proper or improper. The consumption of snacks and sweetened beverages was categorized as daily or non-daily. The plaque index was divided into two groups: ≥2 and <2. Gender is divided into male and female. Teeth are divided into tooth 36 and tooth 46. The age groups were divided into two categories: 12–13 and 10–11 years old. Binary logistic regression was applied to examine the factors associated with dental caries in teeth that had been sealed using the SS-suction device.

Data were analyzed using IBM SPSS Statistics, Version 29.0.0.0 (241). The research project was approved by the Human Research Ethics Committee of the Faculty of Dentistry, Prince of Songkla University, under protocol number EC6706-033.

Results

A total of 105 children were examined at the five-year follow-up, including 157 teeth, with an average of 1.5 teeth examined per child. This corresponded to follow-up rates of 58.7% for participants and 59.0% for teeth. Loss to follow-up was attributed to factors such as school transfers, lack of parental consent, and re-sealant application on the same tooth (Figure 1).

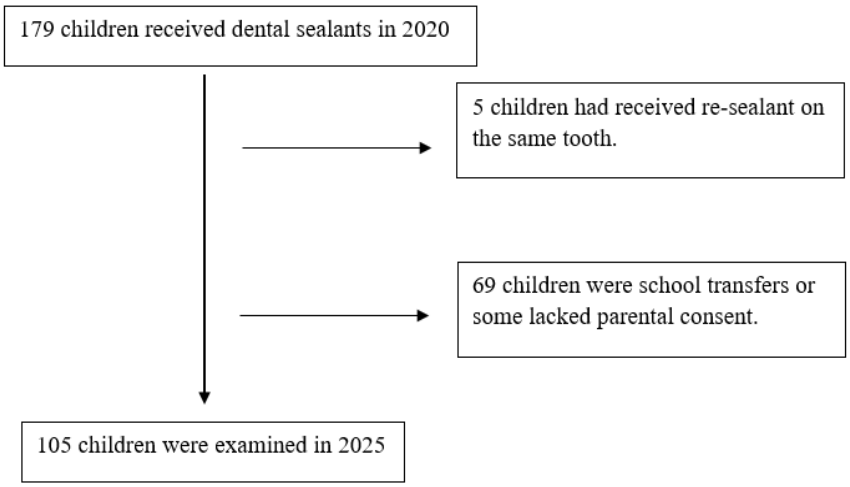

Figure 1 Factors contributing to loss to follow-up

The participants were children aged 10–13 years, comprising 42.9% males and 57.1% females. The majority of children either had no caries or had 1–2 decayed teeth, each accounting for 34.3% of the sample. Regarding the retention of pit and fissure sealants applied using the SS-suction device, 11.5% of sealants had full retention, 59.2% exhibited partial loss, and 29.3% experienced total loss. When analyzed by surface location, 44.6% of occlusal surfaces demonstrated full retention, compared to 19.1% of buccal surfaces. In terms of tooth position, the mandibular left first permanent molar and the mandibular right first permanent molar demonstrated full retention rates of 13.7% and 9.5%, respectively (Table 1). When categorized based on the presence of remaining sealant material, 70.7% of teeth retained some sealant, while 29.3% showed total loss. Among the surfaces where sealants had been applied, 86.0% of teeth were caries-free, whereas 14.0% had developed caries.

For plaque index, 46.6% of children had a score below 2, while 53.4% had a score of 2 or higher. In terms of behavior, 83.8% of children did not consume sweetened beverages or snacks on a daily basis. Additionally, 39.0% of children demonstrated proper oral hygiene behavior, defined as brushing teeth daily using fluoride toothpaste, assessed via a questionnaire (Table 1). Furthermore, the results revealed that total sealant loss was significantly associated with caries development. Teeth with total sealant loss were 5.9 times more likely to develop caries compared to those with remaining sealant, and this difference was statistically significant. A statistically significant association was also observed between caries and plaque levels; children with a plaque index score of ≥2 were 4.8 times more likely to have caries than those with a score <2. Upon analyzing the relationship between genders, it was found that females had a 3.7 times higher chance of developing dental caries than males, with statistical significance.

Of note, oral hygiene practices and daily consumption of snacks, age group, tooth position, and sweetened beverages were not significantly associated with caries occurrence (Table 2).

Table 1 Demographic characteristics of participants and sealant retention outcomes at 5-year follow-up

Characteristics	Frequency (%)
Gender	
Male	45 (42.9)
Female	60 (57.1)
Age (years)	
10	3 (2.9)
11	62 (59.0)
12	39 (37.1)
13	1 (1.0)
Overall caries status (All teeth)	
No caries	36 (34.3)
1-2 teeth	36 (34.3)
3-5 teeth	28 (26.7)
≥5 teeth	5 (4.7)
Retention (all teeth) N=157	
Full retention	18 (11.5)
Partial retention	93 (59.2)
Total missing	46 (29.3)
Occlusal N=157	
Full retention	70 (44.6)
Partial retention	35 (22.3)
Total missing	52 (33.1)
Buccal N=157	
Full retention	30 (19.1)
Partial retention	14 (8.9)
Total missing	113 (72.0)
Tooth 36 N=73	
Full retention	10 (13.7)
Partial retention	42 (57.5)
Total missing	21 (28.8)
Tooth 46 N=84	
Full retention	8 (9.5)
Partial retention	51 (60.7)
Total missing	25 (29.8)
Caries (sealed surface) (N=157)	
No caries	135 (86.0)
Caries	22 (14.0)
Plaque Index (N=103)	
<2	48 (46.6)
≥2	55 (53.4)
Intake of sugary drinks and snack foods (N=105)	
Non-daily	88 (83.8)
Daily	17 (16.2)
Oral hygiene behavior (N=105)	
Proper	41 (39.0)
Improper	64 (61.0)

Discussion

At the 5-year follow-up, 11.5% of sealed surfaces demonstrated full retention, while dental caries was found on 14.0% of the sealed surfaces. A similar full retention rate of 11.1% was reported in a previous 5-year follow-up study conducted in Thailand, in which sealant application was performed in a hospital setting with chairside assistance[19]. The comparable retention outcomes may suggest that the use of SS-suction without chairside assistance provides a similar level of moisture control effectiveness as procedures performed with chairside assistance. Moreover, the retention rate observed in this study was higher than those reported in other studies conducted in Thailand, which showed retention rates ranging from only 0.8–1.5%[20,21]. One study reported a 60-month retention rate of 20.8%, which is higher than that of the present study; however, it did not specify whether the retention was complete[22]. Therefore, a direct comparison between the two studies cannot be made. When comparing caries outcomes at 60 months post-sealant application, previous studies conducted in Thailand have reported caries rates ranging from 18.3% to 52.4%[19–22], which are higher than the caries rate found in the present study.

One study reported that partial retention and total loss of pit and fissure sealants did not differ significantly in their effectiveness in preventing dental caries[23]. Another study found that partially retained sealants were associated with lower caries rates than both unsealed teeth and teeth with complete sealant loss[15]. This may be influenced by the nature of the sealant loss. If the material fractures and leaves sharp margins, caries can develop beneath the sealant, which is considered a common mode of sealant failure[24]. However, in this study, most partially retained sealants were observed to have smooth surfaces, likely due to gradual wear from function. Previous research has indicated that long-term sealant failure is often due to occlusal wear from mastication[25,26]. Additionally, the low

Table 2 Binary logistic regression analysis of factors associated with dental caries in SS-Suction sealed teeth after a 5-year follow-up

Factors (Reference)	Adjusted OR	95% confidence interval	p-value
Total missing (Remaining sealant)	5.9	1.9-18.0	0.002
Improper oral hygiene behavior* (Proper oral hygiene behavior)	1.1	0.3-3.5	0.87
Daily consumption of snacks and sweetened beverages (Non-daily consumption of snacks and sweetened beverages)	0.2	0.02-2.1	0.19
Plaque index ≥2 (Plaque index <2)	4.8	1.4-16.5	0.012
Age 12-13 (Age 10-11)	0.4	0.1-1.4	0.16
Female (Male)	3.7	1.1-12.2	0.03
Tooth 46 (Tooth 36)	1.3	0.4-3.6	0.68

*Proper oral hygiene was defined as brushing teeth daily using fluoride toothpaste,
OR=adjusted ddds ratio

caries rate observed in teeth with complete sealant loss may be explained by the presence of resin tags remaining in the enamel, which are formed under good moisture control during the initial sealant placement[27]. However, this study reported a lower sealant retention rate compared to international studies, where 58.3-69.0% of sealants remained fully retained after five years. Additionally, the incidence of dental caries on sealed surfaces was higher in this study than in those international studies, which reported a caries rate of only 3.1-8.0%[28,29].

When sealant retention was analyzed by occlusal and buccal surfaces, it was found that occlusal surfaces showed higher full retention rates compared to buccal surfaces. This finding is consistent with previous studies and may be explained by the positioning of the SS-suction device. One arm of the device obstructs access to the buccal area, making it more difficult to perform procedures on that surface compared to the occlusal surface. Additionally, the buccal surface is located closer to the gingiva, increasing the likelihood of saliva contamination, which is a common cause of sealant failure[24].

Regarding left versus right sides, the left side demonstrated higher full retention rates than the right. This aligns with findings from a previous study showing that dental nurses reported lower satisfaction scores on the right side in all aspects of SS-suction use. This difference may be due to greater tension from the suction tubing on the right side, which can hinder performance. Therefore, it is recommended that practitioners follow the device's usage guidelines to maximize the effectiveness of SS-suction[9].

This study found that teeth with total loss of pit and fissure sealants were 5.9 times more likely to develop caries compared to those with remaining sealant, a statistically significant difference. This finding is consistent with the study by Walaiporn, which reported a statistically significant association between sealant retention and the occurrence of dental caries in first permanent molars at a 60-month follow-up[19]. Among children with a plaque index score of ≥2, the likelihood of developing dental caries was 4.8 times higher than in those with a plaque index score of <2, a statistically significant difference. This finding is consistent with previous studies reporting that sealant failure frequently

occurs in areas with poor oral hygiene[24], typically indicated by plaque covering more than two-thirds of the tooth surface. Once pit and fissure sealants are lost, they can no longer provide effective caries prevention. In contrast, when sealants remain fully retained, they are known to offer up to 100% protection against dental caries[5].

A strength of this study is its long-term follow-up over a 5-year period, which is relatively rare in studies on pit and fissure sealants conducted in Thailand. This extended duration offers valuable insights into the durability and effectiveness of sealants over time.

In this study, both recall bias and social desirability bias are considered to be minimal. This is supported by the fact that 61% of the children reported improper brushing habits, which suggests they answered truthfully rather than providing socially desirable responses. Furthermore, the questionnaire focused on behaviors that are part of the children's current daily routine, which helps reduce the potential for recall bias. However, a notable limitation of the study is the relatively small number of participants who were successfully followed up, which may influence the robustness of conclusions drawn regarding sealant retention and caries prevention, including the absence of a control group for comparison and potential selection bias due to loss of follow-up. Furthermore, there is limited generalizability given the specific population and setting.

Given the public health implications, especially the shortage of dental assistants, SS-suction should be used to improve the effectiveness of dental services.

Conclusion

This study successfully achieved its objective of determining the long-term retention of sealants applied using the SS-suction method for moisture control. The findings demonstrated a retention rate superior to those reported in other 5-year studies in the country. This suggests that the SS-suction technique can effectively assist dental nurses in maintaining moisture control and ensuring the quality of sealants for long-term caries prevention. This approach could be particularly beneficial for providing dental care in settings where chairside assistance is limited. Future studies should include a follow-up of an even longer duration to further assess the sealant retention of the SS-suction device.

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Conflict of interest

The authors declare no conflict of interest.

References

1. Puangsri P. Diverse Oral Health: Anamai Poll Survey Results May 2024 [homepage on the Internet]. Nonthaburi: Department of Health; 2024 [cited 2025 Jul 14]. Available from: https://hfd.anamai.moph.go.th/th/news-anamai-2/226057
2. Bureau of Dental Health, Department of Health, Ministry of Public Health. Report on the Results of the 9th National Oral Health Survey, Thailand, B.E. 2566. Nonthaburi: Bureau of Dental Health; 2023.
3. Eid SA, Khattab NMA, Elheeny AAH. Untreated dental caries prevalence and impact on the quality of life among 11 to 14-year-old Egyptian schoolchildren: a cross-sectional study. BMC Oral Health 2020;20:83.
4. Pakkhesal M, Riyahi E, Naghavi Alhosseini A, Amdjadi P, Behnampour N. Impact of dental caries on oral health related quality of life among preschool children: perceptions of parents. BMC Oral Health 2021;21:68.

5. Jayanth V, Kumar MDS. A contemporary perspective on dental sealants. J Calif Dent Assoc 1998;26:78–85.
6. Tianviwat S, Hintao J, Chongsuvivatwong V, Thitasomakul S, Sirisakulveroj B. Factors related to short-term retention of sealant in permanent molar teeth provided in the school mobile dental clinic, Songkhla province, southern Thailand. J Public Health 2011;41:50-8.
7. Bureau of Dental Health. Dental health personnel report 2015. Nonthaburi: Bureau of Dental Health; 2015.
8. Tianviwat S, Pokawattana K, Thitasomakul S. Safety and effectiveness of an innovative SS-suction device to control moisture in dental procedures. Heliyon 2023;9:e18129.
9. Pokawattana K, Tianviwat S, Thitasomakul S. The effectiveness and satisfaction of moisture control innovation (tongue and cheek retractor and saliva contamination: SS-Suction) for dental sealant in 6-8 years old children by dental nurses without assistant. J Dent Assoc Thai 2022;72:588–96.
10. Pornsoongsong K, Santiwong B. The clinical comparison of sealant retention between resin-based fissure sealant with adhesive and glass ionomer sealant on partially erupted second permanent molars. M Dent J 2011;31:37–45.
11. Thangwongthawornkit M, Pitiphat W, Angwaravong O. Six-month retention rate of two resin sealants in hypomineralized permanent first molars: a randomized controlled trial. Khon Kaen Dent J 2013;16:23–35.
12. Choomphupan V. Comparison of pit and fissure sealant retention rate between mobile dental unit in school and dental unit in health center at 6, 12, and 36 months in Minburi district, Bangkok. Th Dent PH 2011;16:34–41.
13. Tianviwat S, Hintao J, Chongsuvivatwong V, Thitasomakul S. A randomized controlled trial of cluster audit and feedback on the quality of dental sealant for rural schoolchildren. Community Dent Health 2016;33:27–32.
14. Obsuwan K. The effectiveness of the pit and fissure sealant in the "Save our six" project Chiang Rai, Thailand. Th Dent PH 2008;13:52–62.
15. Ismail AI, Gagnon P. A longitudinal evaluation of fissure sealants applied in dental practices. J Dent Res 1995;74:1583–90.
16. Simonsen RJ. Retention and effectiveness of dental sealant after 15 years. J Am Dent Assoc 1991;122:34–42.
17. Petersen PE, Baez RJ. Oral health surveys: basic methods. 5th ed. Geneva: World Health Organization; 2013.
18. Green JC, Vermillion JR. The simplified oral hygiene index. J Am Dent Assoc 1964;68:7–13.
19. Arunroch W. Effectiveness of dental sealant's retention and occurrence of tooth decay after a 60-month period among students in primary schools. SCNJ 2016;3:95–109.
20. Tianviwat S, Sirisakulveroj B, Jaralpong C, Duksukkaew T, Patinotham N, Arsae F, et al. Effectiveness of 5-year school-based dental sealant program in Songkhla province and opinions toward causes related to most common sealant failures. Songklanakarin Dent J 2017;5:26–37.
21. Mahasaranont W. The effectiveness of dental sealant after 1 and 5 years and sealant utilization in first grade primary school children of Hatyai, Songkhla province [thesis]. Songkhla: Prince of Songkla University; 2019.
22. Sakolwasan C. Caries status of sealed first permanent molars in primary school students. Th Dent PH J 2015;20:10–5.
23. Chestnutt IG, Schafer F, Jacobson PM, Stephen KW. The prevalence and effectiveness of fissure sealants in Scottish adolescents. Br Dent J 1994;20:125–9.
24. Tianviwat S, Hintao J, Thitasomakul S, Sirisakulveroj B, Chongsuvivatwong V. The effectiveness of a school-based sealant program and common failures in southern Thailand. J Dent Assoc Thai 2015;62:107–15.
25. Tianviwat S. Comparative school dental sealant program to alleviate dental caries problem—Thai versus international perspective. In: Virdi MS, editor. Emerging trends in oral health sciences and dentistry. Rijeka: InTech; 2015.
26. Naaman R, El-Housseiny A, Alamoudi N. The use of pit and fissure sealants—a literature review. Dent J (Basel) 2017;5:34.
27. Hicks MJ, Silverstone LM. The effect of sealant application and sealant loss on caries-like lesion formation in vitro. Pediatr Dent 1982;4:111–4.
28. Holst A, Braune K, Sullivan A. A five-year evaluation of fissure sealants applied by dental assistants. Swed Dent J 1998;22:195–201.
29. Francis R, Ariga J, Al Mutawa S, Soparkar P, Mascarenhas AK. Five-year Sealant Retention and Efficacy in a Multi-operated School-based Oral Health Programme in Kuwait. Oral Health Prev Dent 2016;14:349–54.