

COMPARING THE EFFECTIVENESS OF SILVER DIAMINE FLUORIDE IN ARRESTING DENTAL CARIES IN CLASS I AND CLASS II CAVITIES: A PILOT STUDY

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ABSTRACT

Silver diamine fluoride (SDF) is widely used to arrest dentinal caries in primary teeth. However, its effectiveness may vary depending on lesion characteristics. Evidence for the comparison of caries arrest rates of SDF between International Caries Detection and Assessment System (ICDAS) Class I and Class II cavities in primary teeth? is still limited. This pilot study aimed to compare the caries arrest rates of ICDAS Class I and Class II lesions following the application of 38% SDF in primary teeth. Twenty-three children, aged 3 to 6 years, from Wat Plubplachai School, Bangkok, Thailand, with at least two active dentinal carious lesions in posterior teeth were recruited to the study. SDF was applied to all eligible cavities following the Thailand Dental Association's Guidelines. Caries status was assessed at baseline using ICDAS, and caries activity was evaluated using Nyvad criteria. At baseline, 23 children with a total of 90 cavities (45 cavities in Class I and 45 cavities in Class II) were examined. After applying SDF for 3 months, SDF was effective overall and more in Class I cavities (84.4%) than in Class II cavities (57.8%), with a statistically significant difference between the two groups ($p = 0.05$). In conclusion, SDF was effective in arresting dentinal caries in primary teeth, with greater effectiveness observed in ICDAS Class I than in Class II cavities. The lower effectiveness in Class II lesions may be due to their hard-to-access, more plaque and food retention, which can make treatment less effective.

Keywords: Silver Diamine Fluoride, Arrested Caries, ICDAS

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INTRODUCTION

Early childhood caries (ECC) has been extensively studied as a major oral health problem among young children. Data from the 2023 9th National Oral Health Survey in Thailand indicate that dental caries remains the most prevalent oral disease among preschool children and is a major cause of early primary tooth loss if left untreated. Compared with the 8th survey, the proportion of caries-free children improved to 53.0% at age 3 and 27.9% at age 5. However, the prevalence of initial caries increased to 38.0% and 45.5%, and untreated caries remained high at 46.1% and 70.4% (Bureau of Dental Health, 2023), indicating a continued need for strengthened preventive care.

The current management of caries has shifted from traditional restorative approaches to minimally invasive techniques that focus on caries arrest procedures more than surgical procedures (Tinanoff et al., 2024; Walsh & Brostek, 2013). These approaches focus on early detection of carious lesions, caries risk assessment, and remineralization of affected tooth structures, such as using fluoride varnish for arresting enamel carious lesions and Silver diamine fluoride for arresting dentine carious lesions, minimally invasive surgical interventions, and repair rather than replacement of restorations (American Academy of Pediatric Dentistry, 2025). These strategies are especially crucial in pediatric dentistry, where the primary objective is to achieve long-term oral health outcomes, and patient cooperation may be limited.

Silver diamine fluoride (SDF) has become a key material in modern caries management, particularly for young children. It contains silver ions with strong antimicrobial properties and fluoride ions that promote remineralization of dental hard tissues (Nishino et al., 1969). When applied to carious lesions, SDF inhibits cariogenic bacteria by damaging their cell walls and disrupting their metabolic processes through the action of silver ions. This leads to a reduction in biofilm formation and microbial activity in the affected areas (Mei et al., 2020). Simultaneously, the fluoride in SDF strengthens the tooth structure, increasing its resistance to further demineralization (Seifo et al., 2020). This mechanism has been shown to effectively arrest dentinal caries, with reported success rates of approximately 65-91% in primary teeth (Seifo et al., 2019).

Similarly, previous studies have compared the caries-arrest effectiveness of SDF with other preventive agents and have consistently reported clear clinical outcomes, showing that SDF is highly effective in slowing or stopping caries progression. For instance, Comparing of 38% SDF with 5% sodium fluoride varnish, found significantly higher caries arrest rates in the SDF group, reporting 20.5% vs 12.3% at 6 months and 35.7% vs 20.9% at 12 months (Mabangkhu et al., 2020). Likewise, comparing SDF with nano silver fluoride (NSF) and observed arrest rates of 65.0% for SDF and 78.4% for NSF at 6 months, and 56.3% for SDF and 71.3% for NSF at 12 months (Quritum et al., 2024). Collectively, these findings reinforce the role of SDF as an effective minimally invasive approach for caries control, particularly among pediatric and high-risk populations.

However, SDF is not uniformly effective in all clinical situations. Several factors may influence treatment outcomes, including lesion size and severity, tooth location, plaque accumulation, and patient-related factors such as dietary habits and oral hygiene practices (Fung et al., 2016). Posterior teeth, in particular, may be more susceptible to treatment failure due to their anatomical complexity and greater tendency to retain food (Mei et al., 2020). In addition, microbial variations and differences in application frequency or follow-up protocols may also affect the success of caries arrest (Paul et al., 2021; Zaffarano et al., 2022).

Although many studies have compared the effectiveness of SDF with other caries-preventive agents, most have focused primarily on overall caries arrest rates without considering the influence of specific cavity characteristics. However, limited research has examined how variations in cavity type may affect the effectiveness of SDF treatment. In particular, evidence

comparing caries arrest rates between ICDAS Class I and Class II cavities remains scarce. Differences in cavity morphology, location, and accessibility may potentially influence the penetration and retention of SDF, thereby affecting treatment outcomes. Therefore, this clinical study aimed to compare the effectiveness of SDF in arresting caries between Class I and Class II cavities and to determine whether cavity type influences treatment outcomes in primary teeth.

Objective

To compare the caries arrest rate between ICDAS Class I and Class II lesions after application of silver diamine fluoride in primary teeth.

RESEARCH METHODOLOGY

This pilot study was a prospective cohort study conducted on carious lesions among children aged 3 to 6 years enrolled in kindergarten levels II and III at schools in Bangkok, Thailand. Ethical approval was obtained from the Human Research Ethics Committee, Faculty of Dentistry, Chulalongkorn University (HREC-DCU2025-036). Eligible participants were healthy children classified as ASA I or II who presented with at least two active dentinal carious lesions classified as ICDAS II scores 5 and 6 on posterior teeth and had not previously received SDF treatment, without the following conditions: systemic diseases, use of oral or systemic antibiotics within the past two months, non-cooperative parents, known allergy to silver, or presence of active oral ulcerations. Teeth exhibiting signs of non-vitality, such as mobility, discoloration, pulpal exposure, or dental abscess, were also excluded. The primary outcome measured in this study was the number of cavities, which were assessed and recorded for each participant, with the number of cavities varying among individuals.

Before subject recruitment, a written informed consent will be obtained from parents or legal guardians, and assent will be obtained from the participating children. All participating children will receive oral hygiene instructions before SDF treatment.

Regarding sample size determination, the calculation was based on previously reported caries arrest over 6 months between SDF and sodium fluoride varnish form (Mabangkhu et al., 2020). The SDF group showed a higher caries arrest rate (228/1,111 cavities; 20.5%) than the sodium fluoride varnish group (140/1,138 cavities; 12.3%) ($p = 0.001$). Using a 5% alpha level and 80% power, G*Power version 3.1 estimated a required sample size of 319 cavities per group, given the comparable outcome measures. For this pilot study, with the limitation of eligible participants, approximately 90 cavities overall (45 cavities per group) were recruited.

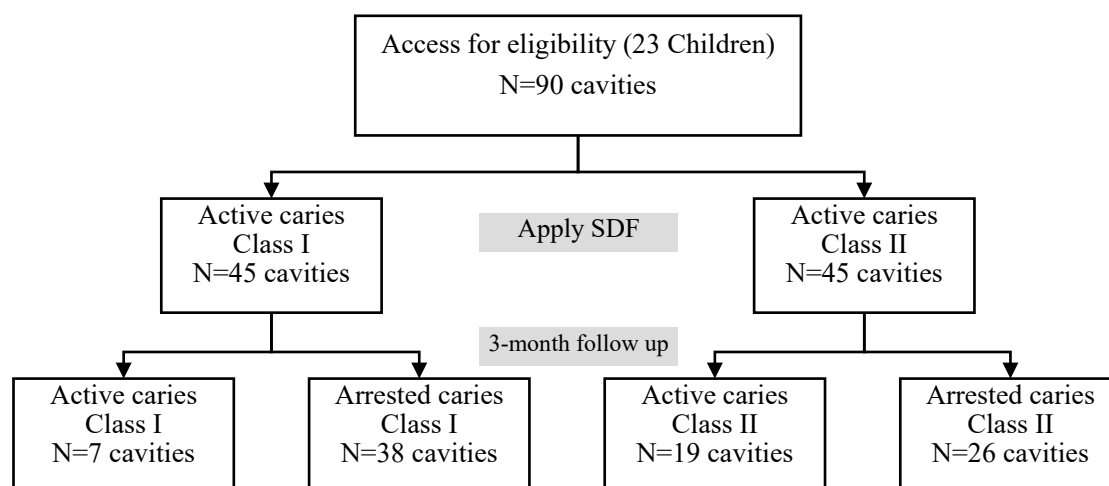


Figure 1 CONSORT diagram

For the SDF application, a freshly opened bottle of 38% silver diamine fluoride will be used for each procedure. The affected tooth will be isolated with cotton rolls, and the surrounding gingival tissue will be protected with a thin layer of petroleum jelly. The tooth surface will then be cleaned and thoroughly dried. A single drop of SDF solution will be dispensed into a disposable dish and applied directly to the carious lesion using a micro-applicator. After approximately 1 minute, any excess solution will be removed with gauze, and rinsing will be avoided after application. Following the Thailand Dental Association's Guidelines on Use of Fluoride in Dentistry (Dental Association of Thailand, 2023).

The oral examination will be performed and recorded using a dental examination form, which is used in Pediatric Dental Clinics at the Faculty of Dentistry, Chulalongkorn University. The presence and severity of coronal caries will be assessed using the International Caries Detection and Assessment System (ICDAS) codes ranging from 0 to 6. Caries activity will then be evaluated according to the Nyvad criteria (scores 0-9) to determine lesion status. Active caries (active group) will be identified as lesions presenting with a matte surface that feels soft or leathery upon gentle probing. In contrast, inactive or arrested caries (arrested group) will be characterized by lesions with a shiny appearance and a hard, smooth surface when gently examined with a probe.

Before initiating the study, the researcher and an additional dentist will undergo training to perform oral examinations on patients with a history of receiving 38% silver diamine fluoride treatment and ongoing care at the Pediatric Dentistry Clinic, Faculty of Dentistry, Chulalongkorn University. Inter-rater reliability, accuracy, and consistency of the assessment process will be controlled by examining 10 patients and comparing the findings with the standards established by pediatric dentistry specialists. The evaluation of inter-rater reliability will involve intraoral examinations and caries detection conducted using the ICDAS and Nyvad criteria. To assess intra-rater reliability, the researcher and the dentist will independently perform repeated assessments after a minimum interval of 30 minutes. Cohen's Kappa statistics will be utilized for analysis, with a threshold value set at greater than 0.8 to indicate an acceptable level of agreement.

The Chi-Square test statistics were used to analyze the caries arrest rate at different ICDAS classifications at a significant level of 0.05 by using SPSS Statistics 30.0.

RESEARCH RESULTS

A total of 23 healthy children aged 3 to 6 years were included in the study, with a mean age of 4.52 years (SD = 0.947). Of these, 11 were boys (47.8%), and 12 were girls (52.2%). At baseline, a total of 90 cavities that met the inclusion criteria were identified and recorded for the study. These comprised 45 cavities classified as ICDAS Class I and 45 cavities classified as ICDAS Class II, allowing for direct comparison of treatment outcomes between occlusal and proximal carious lesions.

Table 1 Baseline Characteristics of Cavities Lesions by ICDAS classification

Characteristics	Class I	Class II	<i>p-value</i>
Tooth location	n (%)	n (%)	
Maxillary	18/90 (20)	26/90 (28.9)	
Mandibular	27/90 (30)	19/90 (21.1)	0.09
ICDAS Score	n (%)	n (%)	
Code 5	43/90 (47.8)	39/90 (43.3)	
Code 6	2/90 (2.2)	6/90 (6.7)	0.14

Following the application of SDF to all cavities, a follow-up examination was conducted after 3 months. Overall, 64 cavities (71.1%) showed signs of arrest, while 26 cavities (28.9%)

remained active. Among the ICDAS Class I cavities, 38 cavities demonstrated caries arrest (84.4%), while 7 cavities remained active (15.6%). In the case of ICDAS Class II, 26 cavities exhibited caries arrest (57.8%), with 19 cavities remaining active (42.2%). The difference in outcomes between the two cavity classes was statistically significant ($p = 0.05$), as shown in Table 2.

Table 2 Caries arrest rate

	Active	Arrested	Caries arrested rate (%)	<i>p-value</i>
Class I	7/45	38/45	84.4	0.05
Class II	19/45	26/45	57.8	
Total	26/90	64/90	71.7	

** The “Active” and “Arrested” categories present the number of cavities.*

DISCUSSION

This pilot study demonstrated that 38% SDF is effective in arresting dentinal caries in primary teeth, with an overall arrest rate of 71.1% at 3 months. This finding supports the role of SDF as a practical and minimally invasive treatment option for managing dental caries in young children, particularly in situations where conventional restorative treatment may be difficult to perform. The observed arrest rate is consistent with previous studies reporting success rates of approximately 65-91% in primary teeth (Seifo et al., 2019), indicating that SDF provides reliable clinical outcomes across different settings and populations.

When comparing lesion types, caries arrest was higher in ICDAS Class I cavities (84.4%) than in Class II cavities (57.8%), with a statistically significant difference. This suggests that the anatomical location and accessibility of the lesion are important factors influencing treatment success. Class I cavities, typically located on occlusal surfaces, are easier to access during SDF application, allowing better penetration and contact with the carious dentin. In contrast, Class II cavities involve proximal surfaces, which are more difficult to visualize and reach, potentially limiting the effectiveness of SDF. The lower arrest rate observed in Class II lesions may also be associated with the frequent occurrence of food impaction and plaque accumulation in proximal areas (Mei et al., 2020), creating an environment that promotes continued bacterial activity and reduces the caries-arresting effect of SDF.

Previous studies have shown that patient behaviour significantly influences treatment outcomes. Children who consume cariogenic diets or maintain inconsistent oral hygiene are more likely to experience continued caries progression despite SDF treatment (Fung et al., 2016). Due to the limitations of this study, data on these aspects were not collected. Therefore, future studies should include the collection of additional information on children's demographic characteristics, dietary habits, toothbrushing behaviours, frequency of dental visits, and family background through structured questionnaires to better identify factors associated with caries arrest.

Regarding sample size determination, the calculation was based on previously reported caries arrest over 6 months (Mabangkhru et al., 2020). In that study, the SDF group showed a higher caries arrest rate (228/1,111 cavities; 20.5%) than the sodium fluoride varnish group (140/1,138 cavities; 12.3%) ($p = 0.001$). Using a 5% alpha level and 80% power, G*Power version 3.1 estimated a required sample size of 319 cavities per group. After adjusting for an anticipated 20% dropout rate, the required sample size increased to 383 cavities per group. Nevertheless, recruitment was constrained by several practical limitations. This study was designed as a pilot investigation and was conducted in a single school, including only children from kindergarten levels II and III. Although all eligible children whose parents provided informed consent were

examined, only 23 participants met the inclusion criteria and were available for analysis, resulting in approximately 45 cavities per group in this pilot study.

Although SDF is an effective and minimally invasive option for arresting dentinal caries in primary teeth, its effectiveness may vary depending on cavity type and individual patient factors. These findings emphasize the importance of tailoring treatment strategies to specific clinical conditions and patient needs. Further studies with larger sample sizes and extended follow-up periods are recommended to confirm these results and to better understand the long-term effectiveness of SDF in different types of carious lesions.

LIMITATIONS

This pilot study, conducted in a single school, was limited by a small sample size, a short follow-up period, and the absence of data on parental behaviours. These constraints may have limited the reliability of the statistical analyses and reduced both the statistical power and the generalizability of the findings to the broader pediatric population.

Further studies should include data collection from multiple schools to obtain larger sample sizes, incorporate longer follow-up periods (e.g., 3 and 6 months), and involve more comprehensive data collection, particularly regarding parental and behavioural factors. Such improvements would help validate the present findings and provide a clearer understanding of the long-term effectiveness of SDF across different types of carious lesions.

CONCLUSION

This pilot study indicated that SDF effectively arrests dentinal caries in primary teeth, with a higher arrest rate in ICDAS Class I than Class II cavities, indicating that cavity type influences treatment outcomes. The reduced effectiveness observed in Class II lesions may be attributed to challenges such as limited access, plaque retention, and food impaction.

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REFERENCES

- American Academy of Pediatric Dentistry. (2025). Policy on minimally invasive dentistry. In *The Reference Manual of Pediatric Dentistry* (pp. 107-109). Chicago, IL: American Academy of Pediatric Dentistry.
- Bureau of Dental Health, D. o. H., Ministry of Public Health. (2023). *The Ninth National Oral Health Survey in Thailand 2022-2023*.
- Dental Association of Thailand. (2023). Guideline on Use of Fluoride in Dentistry. *The Journal of the Dental Association of Thailand*, 73(2), 92-103.
- Fung, M. H. T., Duangthip, D., Wong, M. C. M., Lo, E. C. M., & Chu, C. H. (2016). Arresting Dentine Caries with Different Concentration and Periodicity of Silver Diamine Fluoride. *JDR Clin Trans Res*, 1(2), 143-152.
- Mabangkhu, S., Duangthip, D., Chu, C. H., Phonghanyudh, A., & Jirarattanasopha, V. (2020). A randomized clinical trial to arrest dentin caries in young children using silver diamine fluoride. *J Dent*, 99, 103375.
- Mei, M. L., Yan, Z., Duangthip, D., Niu, J. Y., Yu, O. Y., You, M., Lo, E. C. M., & Chu, C. H. (2020). Effect of silver diamine fluoride on plaque microbiome in children. *J Dent*, 102, 103479.

- Nishino, M., Yoshida, S., Sobue, S., Kato, J., & Nishida, M. (1969). Effect of topically applied ammoniacal silver fluoride on dental caries in children. *J Osaka Univ Dent Sch*, 9, 149-155.
- Paul, B., Sierra, M. A., Xu, F., Crystal, Y. O., Li, X., Saxena, D., & Ruff, R. R. (2021). Microbial population shift and metabolic characterization of silver diamine fluoride treatment failure on dental caries. *PLOS ONE*, 16(3), e0242396.
- Quritum, M., Abdella, A., Amer, H., El Desouky, L. M., & El Tantawi, M. (2024). Effectiveness of nanosilver fluoride and silver diamine fluoride in arresting early childhood caries: a randomized controlled clinical trial. *BMC Oral health*, 24(1), 701.
- Seifo, N., Cassie, H., Radford, J. R., & Innes, N. P. T. (2019). Silver diamine fluoride for managing carious lesions: an umbrella review. *BMC Oral health*, 19(1), 145.
- Seifo, N., Robertson, M., MacLean, J., Blain, K., Grosse, S., Milne, R., Seeballuck, C., & Innes, N. (2020). The use of silver diamine fluoride (SDF) in dental practice. *Br Dent J*, 228(2), 75-81.
- Tinanoff, N., Banerjee, A., Buzalaf, M. A. R., Chen, J. W., Dhar, V., Ekstrand, K. R., Fontana, M., Innes, N., Koo, H., Listl, S., Lo, E. C. M., Potgieter, N., Schwendicke, F., Sharkov, N., Twetman, S., & Vargas, K. (2024). Principles and care pathways for caries management in children: IAPD Rome forum. *Int J Paediatr Dent*, 34(5), 692-699.
- Walsh, L. J., & Brostek, A. M. (2013). Minimum intervention dentistry principles and objectives. *Aust Dent J*, 58(Suppl 1), 3-16.
- Zaffarano, L., Salerno, C., Campus, G., Cirio, S., Balian, A., Karanxha, L., & Cagetti, M. G. (2022). Silver Diamine Fluoride (SDF) Efficacy in Arresting Cavitated Caries Lesions in Primary Molars: A Systematic Review and Metanalysis. *Int J Environ Res Public Health*, 19(19).

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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