

# International Journal of Dental Science and Innovative Research (IJDSIR)

# IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 6, Issue – 6, December - 2023, Page No. : 53 - 59

Evaluating the effectiveness of Silver Diamine Fluoride in arresting caries in primary molars with different application times and light-curing.

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**Citation of this Article:** Vaishnavi Agarwal, Vasudha Sodani, Parth Chhabria, Sowjanya Rajesh, "Evaluating the effectiveness of Silver Diamine Fluoride in arresting caries in primary molars with different application times and light-curing", IJDSIR- December - 2023, Volume – 6, Issue - 6, P. No. 53 - 59.

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Type of Publication: Original research article

**Conflicts of Interest:** Nil

# Abstract

**Introduction:** Silver diamine fluoride (SDF) has been identified as a potentially cost-effective, simple, safe and topical cariostatic agent. The duration of SDF application may vary and may be shorter than recommended if the patient's cooperation is limited because isolation is difficult to maintain.

**Methods:** 28 patients with carious lesions in 40 primary molars were categorized according to ICDAS criteria. Randomization was performed and 10 teeth were assigned per group. SDF was applied with the tip of the applicator for different durations. Group 1 - 30 seconds, Group 2 - 60 seconds, Group 3 - 120 seconds, Group 4 - 5 seconds and light curing. Follow-up was performed after 2 weeks to evaluate the arrest of the carious lesion. **Results**: Caries arrest was observed in 52.5% of the total number of samples. There was no statistically significant difference when comparing the caries arrest between the groups (p value=0.43).

**Conclusion:** SDF can be effectively used in minimally cooperative children, as caries arrest does not differ significantly with different durations of application and light curing. Reduced application time shortens clinical procedure time. It therefore helps to significantly reduce the time spent at the chair for both the doctor and the patient.

Keywords: SDF, dental caries, light-curing

## Introduction

Dental caries is the localized destruction of susceptible hard dental tissues by acidic by-products from bacterial fermentation of dietary carbohydrates.<sup>1</sup> Traditional treatment of dental caries has focused primarily on treatment through the removal of diseased tissues and subsequent restoration of the defect. It is a mechanical preparation of the teeth, which is a destructive and irreversible procedure in which the natural tooth tissues are removed.<sup>2</sup>

The biggest challenge pediatric dentists face is managing fear and anxiety in children. It is difficult to treat children who are minimally cooperative or who have multiple carious primary teeth with rapid progression of carious lesions. The current philosophy of dental caries treatment has changed from a traditional extensive approach to an adjunctive conservative model, which often includes the use of fluoride, mouthwashes and sealants.<sup>3</sup> Among these, Silver Diamine Fluoride (SDF) has been identified as a potentially cost-effective, simple, safe, local cariostatic and preventive medicine. It provides conservative treatment of asymptomatic active caries lesions.<sup>4</sup>

According to the AAPD, SDF is indicated in cases of difficult-to-treat lesions and patients at high risk for dental caries, including patients with medical or behavioral complications, those requiring multiple treatments or patients without access to dental care. One of the indications is also teeth with active cavitated carious lesions without clinical signs of pulp involvement.<sup>5</sup>

Although studies have shown that SDF is effective in arresting tooth decay, the mechanism of action is unclear. It limits the growth of cariogenic bacteria. It inhibits demineralization and promotes remineralization of demineralized enamel and dentin along with inhibition of dentinal collagen degradation.<sup>6</sup>

SDF is emerging as a promising, non-invasive treatment option for carious lesions and has demonstrated its efficacy in halting caries progression. The main disadvantage of SDF is its unaesthetic result, it permanently blackens the enamel lesion and dentin caries and creates a henna-like temporary tattoo when in contact with the skin.<sup>5</sup>

Previous research has demonstrated the effectiveness of SDF in arresting caries progression in primary molars, with studies highlighting its ability to penetrate and strengthen demineralized enamel and dentin. However, there is limited evidence regarding the effect of varying application time and potential improvement through light curing. The role of light curing in conjunction with SDF application requires investigation due to its potential to improve solution penetration and retention in carious lesions. Studies suggest that light curing can improve the bond strength of SDF to the tooth structure and subsequently affect its overall effectiveness in arresting dental caries.<sup>5,7</sup>

This study aims to evaluate the caries-arresting ability of SDF based on different application time and light curing in the treatment of cavitated primary molar carious lesions.

## Methodology

28 patients were selected from patients reporting to the Department of Pedodontics and Preventive Dentistry at Ahmedabad Dental College & Hospital for dental checkups. Ethical clearance was obtained from institutional ethical committee. From them, 40 carious primary molars were included in the study.

#### **Inclusion criteria**

- Deciduous molar with carious lesion as defined by the ICDAS criteria subgroup 5 & 6 (cavitated lesion).
- Tooth not near to its exfoliation age.
- Free from pathologic mobility.
- No history of silver allergy.

## **Exclusion criteria**

- Deciduous molar with carious lesions which are non cavitated.
- Deciduous molar with carious lesion as defined by the ICDAS criteria other than subgroups 5 & 6.
- Tooth near to exfoliation age.
- Tooth with pathologic mobility.
- Patient having any other systemic disease.
- Patient allergic to silver.

The procedure and its possible discomforts and benefits were explained to the parents of the children and consent was obtained prior to the treatment. The patients enrolled for the present study were randomly allotted to one of the 4 groups. Included patients and teeth were designated numbers to allow future comparisons. Moreover, all individuals were provided orientation about dietary and oral hygiene habits.

The teeth were randomly allocated into 4 groups based on the time duration of the SDF application:

- In group 1, applied silver diamine fluoride was allowed to absorb for 30 seconds.
- In group 2, applied silver diamine fluoride was allowed to absorb for 60 seconds.
- In group 3, applied silver diamine fluoride was allowed to absorb for 120 seconds.
- In group 4, applied silver diamine fluoride was allowed to absorb for 5 seconds followed by light curing.

#### Clinical Procedure of SDF Application

Gross debris was removed from the cavity to allow better contact of SDF with denatured dentin. The affected tooth surface was dried with a gentle flow of compressed air. One drop of 38% SDF (e-SDF) the solution was placed in a small plastic dappen dish. The applicator tip was dipped and moistened on the side of the dappen dish to remove excess liquid. Isolation of the tooth was performed using cotton rolls. The carious lesion was gently swabbed with an applicator tip dipped SDF. AAPD guidelines and manufacturer's in instructions were followed for SDF application. The material was allowed to absorb according to the predetermined time interval (according to the assigned study group). Excess material was removed with a cotton pellet to minimize systemic absorption.

The tooth was evaluated after 2 weeks for:

- Dentin color
- Texture of the lesion

The presence or absence of pain and infection was recorded at baseline and at the follow-up visit by examination and interview with the parents. The ability to stop tooth decay was determined as follows:3

• Positive result: Dark, hard and black lesions without pain or infection (inactive or arrested).

(Figure 1-a, b)



Figure 1-a: Preoperative of primary molar before SDF application

# Vaishnavi Agarwal, et al. International Journal of Dental Science and Innovative Research (IJDSIR)



Figure 1-b: Postoperative of primary molar with positive outcome showing inactive/ arrested carious lesion

• Treatment Failure: Progression of the lesion, a yellow, brown, soft lesion with or without pain or infection (active lesion). (Figure 2-a, b)



Figure 2-a: Preoperative of primary molar before SDF application



Figure 2-b: Postoperative of primary molar with treatment failure showing active carious lesion

All the recorded data was tabulated and subjected to statistical evaluation and SPSS 20.0, IBM, Chicago software was used for analyzing the data.

## Results

The study consisted of 40 teeth, of which positive outcome was seen in 21 teeth (52.5%) while negative outcome was seen in 19 teeth (47.5%). In Group 1, Group 2, Group 3, and Group 4, at the end of 2 weeks, the percentage of caries arrest were 40% (n = 4), 40% (n = 4), 60% (n = 6), and 70% (n = 7) respectively. (Table 1 and Figure 3). Although caries arrest was seen more in Group 4 compared to other groups, this difference was not statistically significant (p value=0.439) (p value <0.05 is significant).

			Group				Total
			Group 1- 30 seconds of applicatio n	Group 2- 60 seconds of applicatio n	Group 3- 120 seconds of applicatio n	Group 4- 5 seconds of applicatio n and light curing	
caries arrest after 2 weeks of application	Positive Outcome	Count	4	4	6	7	21
		% within Group	40.0%	40.0%	60.0%	70.0%	52.5 %
	Negative Outcome	Count	6	6	4	3	19
		% within Group	60.0%	60.0%	40.0%	30.0%	47.5 %
Total Con % v Grou		Count	10	10	10	10	40
		% within Group	100.0%	100.0%	100.0%	100.0%	100.0 %

Table 1: Caries arrest after 2 weeks of application



Figure 3: Caries arrest after 2 weeks of application An intergroup comparison was done. All the possible pairs of groups were made and Pearson chi-square test was applied to obtain p value. However, all the combinations yielded p value >0.05 which is not statistically significant.

# Discussion

SDF is a valuable carious lesion-arresting tool that can be used in the context of caries management in pediatric patients. No serious pulp damage or response to SDF was reported.<sup>8</sup> This clinical study compared the efficacy of different durations of SDF application and light curing in arresting active carious lesions in a primary tooth.

AAPD recommends applying SDF for 1 minute using a gentle stream of compressed air until the liquid dries. The literature reports studies with durations ranging from 10 seconds to 3 minutes.<sup>5</sup> In the literature review, we found very few studies regarding caries arrest rates in SDF assessed according to ICDAS criteria. There are also limited studies evaluating the role of light curing after a short application of SDF, which this study investigates.

A characteristic feature of SDF is a visible dark stain, which is a sign of caries arrest in treated carious lesion. This dark discoloration is permanent if not restored When it comes in contact with the skin or mucous membrane, it creates a temporary henna-like tattoo. A study that assessed parents' perception and acceptance of SDF based on staining found that staining on posterior teeth was more acceptable than on anterior teeth.<sup>9</sup> Thus, from the perspective of the literature, molars were selected in the current study.

This study showed that the duration of the application did not affect the ability of SDF to arrest caries. Although caries arrest was higher in the 120-second and light cure group, it was not statistically significant (p > 0.05). This is in accordance with a study conducted by Thakur S *et al*<sup>3</sup> in 2022, the caries arrest rate was higher with the 120-second duration of SDF application

compared to 30 seconds and 90 seconds; this difference was not statistically significant (p > 0.05).

This result is consistent with the study conducted by Clemens *et al.*<sup>10</sup> They reported 100% caries arrest with 30 and 90-second application durations and 97.3% with 120 seconds. However, the effectiveness of the arrest of dental caries does not differ significantly in different application durations.

The level of cooperation in young children varies significantly, which further determines the length of time a carious tooth can be isolated for SDF absorption without saliva contamination. Our results suggest that a minimally cooperative or uncooperative patient should not be a contraindication to the use of SDF, especially if isolation of the tooth for at least 30 seconds is possible. However, Horst recommends the longest absorption time possible, as this has the added benefit of reducing concerns about systemic absorption and the need to rinse off the SDF after treatment.<sup>4</sup>

There are limited studies in the literature comparing light curing with regular SDF application. The literature supports that light curing increases material penetration in vitro. Crystal YO *et al* performed an ex-vivo study investigating the effect of light-emitting diode (LED) curing light on the depth of penetration of silver fluoride (SDF) into carious lesions. They concluded that the use of LED light for 20 seconds after 10 seconds of SDF application appeared to facilitate silver penetration, similar to the application of SDF for 1 minute.<sup>11</sup>

This study supports the above research article with the clinical finding that light curing after 5 seconds of application also produces similar results to the AAPD recommendation of 1 minute of application.<sup>5</sup>

Binhezaim A *et al* in  $2023^{12}$  conducted a systematic review including six studies (five in vitro and one ex vivo). This investigation concluded that light curing was

# Vaishnavi Agarwal, et al. International Journal of Dental Science and Innovative Research (IJDSIR)

found to be an effective approach to improve the properties of SDF.<sup>12</sup> They also suggested that further clinical studies be conducted to correlate this laboratory finding. Our study is one of the clinical studies correlating the findings.

Damrongsri S *et al* in 2022<sup>13</sup> suggested in their in-vitro study that shortening the application time with light curing increased SDF remineralization similar to the conventional method. This could be valuable for caries management in young or uncooperative children and patients with special needs by reducing SDF application time by 50% over American Academy of Pediatric Dentistry recommendations while maintaining adequate SDF remineralization efficacy.

Moreover, AAPD (2017)<sup>5</sup> advocates the need for more studies to confirm the ideal protocol regarding the duration of SDF application, and our study is one of them.

### Conclusion

SDF can be effectively used in minimally cooperative children because caries arrest does not differ significantly with different application durations and light curing. Reduced application time shortens clinical procedure time. In addition, the incorporation of light curing alongside the application of SDF has shown promise as a means of increasing its effectiveness. Although our pilot study provides valuable insights, it is critical to acknowledge its limitations, including the small sample size and the need for further research to validate and generalize our findings. Future research should investigate the long-term effects and potential adverse outcomes associated with prolonged SDF exposure and light curing.

From a practical point of view, the results of this study offer clinicians a basis for improving treatment strategies in the treatment of carious lesions in primary molars. As we move forward, larger and longer-term studies are essential to strengthen the evidence base and facilitate the translation of these findings into clinical practice. This research contributes to the ongoing dialogue on optimizing SDF application protocols and represents a step toward more effective and patient-centered approaches in pediatric dental care.

### References

- 1. Selwitz RH, Ismail AI, Pitts NB. Dental caries. The Lancet. 2007 Jan 6;369(9555):51-9.
- Mei ML, Lo EC, Chu CH. Arresting dentine caries with silver diamine fluoride: what's behind it? Journal of dental research. 2018 Jul;97(7):751-8.
- Thakur S, Sojan M, Singhal P, et al. A Comparative Study to Evaluate the Effectiveness of Silver Diamine Fluoride at Different Time Durations of Application in Treating Carious Primary Teeth: A Randomized Trial. Int J Clin Pediatr Dent 2022;15(S-2): S147–S150.
- Horst JA, Ellenikiotis H, Milgrom PL. UCSF protocol for caries arrest using silver diamine fluoride: rationale, indications, and consent. J Calif Dent Assoc 2016;44(1):16–28.
- Crystal YO, Marghalani AA, Ureles SD, et al. Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special health care needs. Pediatr Dent 2017;39(5): E135-E145.
- Zhao IS, Gao SS, Hiraishi N et al. Mechanisms of silver diamine fluoride on arresting caries: a literature review. Int Dent J 2018;68(2):67–76.
- Rosenblatt A, Stamford TC, Niederman R. Silver diamine fluoride: a caries "silver-fluoride bullet". Journal of dental research. 2009 Feb;88(2):116-25.
- Llodra JC, Rodriguez A, Ferrer B, Menardia V, Ramos T, Morato M. Efficacy of silver diamine

Page **D** 

Vaishnavi Agarwal, et al. International Journal of Dental Science and Innovative Research (IJDSIR)

fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. J Dent Res 2005; 84(8):721-4.

- Crystal YO, Janal MN, Hamilton DS, Niederman R. Parental perceptions and acceptance of silver diamine fluoride staining. J Am Dent Assoc 2017; 148(7):510-8.
- Clemens J, Gold J, Chaffin J. Effect and acceptance of silver diamine fluoride treatment on dental caries in primary teeth. J Public Health Dent 2018;78(1):63–68.
- Crystal YO, Rabieh S, Janal MN, Cerezal G, Hu B, Bromage TG. Effects of LED curing light on silver diamine fluoride penetration into dentin. J Clin Pediatr Dent. 2023 Nov 3; 1:7.
- 12. Binhezaim A, Almutairi T, Alsaleem A, Albegamy A, Alsaadon S, Shaikh MS. Effect of light curing on the efficacy of silver diamine fluoride in dental applications: A systematic review. Journal of Taibah University Medical Sciences. 2023 Sep 22.
- Pornprasertsuk-Damrongsri S, Karnowakul J, Punyanirun K, Jirakran K, Thanyasrisung P, Techatharatip O, Trairatvorakul C. Enhanced effectiveness of silver diamine fluoride application with light curing on natural dentin carious lesions: an in-vitro study.