



SDF IN PEDIATRIC DENTISTRY: A REVIEW

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ABSTRACT

Children who have dental caries have serious oral health problems that result in discomfort, lost function, and a low quality of life. Preschoolers still have a significant incidence of untreated caries lesions despite the use of fluoridated toothpaste. The usefulness of silver diamine fluoride (SDF) in stopping carious lesions and reducing decay has drawn attention. Direct application of SDF to carious lesions allows for a more cautious approach to tooth preparation and prevents darkening of the tooth's colour. It is a good treatment option for paediatric dental caries because to its noninvasiveness and comfort. Based on the known literature, the current review provides information about the clinical importance of SDF in paediatric dentistry.

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INTRODUCTION

The term "tooth decay," sometimes known as "cavities" or "caries," refers to the bacterially-induced destruction of teeth. From yellow to black, the cavities might be any colour. 1. Only a few of the symptoms include pain and difficulty eating. 2,3 The tooth may get infected or develop an abscess, and the surrounding tissue may become irritated. 2

Cavities are brought on by bacterial acid that dissolves the enamel, dentin, and cementum, the hard tissues of the teeth. The bacteria that live on the surface of the teeth create acid when they digest food particles or sugar. Because the main source of energy for these bacteria is simple sugars in food, a diet heavy in simple sugars poses a risk. Dental caries is a disease that is biofilm-mediated, complex, non-communicable, and dynamic.⁴ Dental caries is a disease that is biofilm-mediated, complex, non-communicable, and dynamic.⁵

3.6 billion individuals worldwide suffer from dental caries, which is 9% more common in infant teeth. The illness is the main reason why youngsters lose their teeth, and it is particularly prevalent in South Asia, the Middle East, and Latin American nations. Dental caries are the most prevalent chronic paediatric illness in the United States and account for 5–10% of healthcare spending. In lower-income nations, treatment expenses may surpass budgets. Even while tooth decay cases have decreased in several wealthy nations, the illness is still not distributed equally.⁷

By consuming fewer fermentable carbohydrates and dispersing the dental biofilm, dental caries can be avoided. If treatment is ineffective, carious lesions could develop and call for minimally invasive dentistry. Dietary control, sealing, mineralization, restorative, and non-restorative techniques are all used in management. SDF (silver diamine fluoride) is a cariostatic agent that may curtail carious lesions and manage dental caries in children all over the world that is non-invasive, affordable, and effective. Since the 1970s, it has been widely utilised in China, Australia, Brazil, Argentina, China, and Japan.⁸

The American Academy of Paediatric Dentistry recommends it. SDF was approved by the FDA in 2014 for the treatment of dental hypersensitivity and caries arrestment. Its value in paediatric dentistry, with a focus on preventing and controlling dental cavities in primary and primary molars, is supported by aggregate of RCTs.^{9,10}

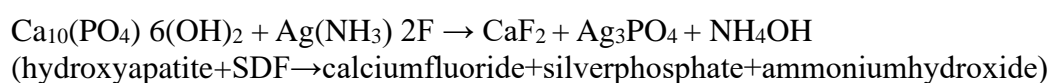
COMPOSITION

SDF is an alkaline solution with a pH between 8 and 10. Ammonia, fluoride, and silver make up its key ingredients. Basically, the ammonia stabilises the solution, the fluoride promotes remineralization, and the silver acts as an antibacterial agent.¹¹ The most typical concentration is 38%, or 4.48% of fluoride and 2.55% of silver.¹²

It reacts with hydroxyapatite in the tooth to produce silver phosphate and oxide. . By rupturing membranes, denaturing proteins, and obstructing DNA replication, ionic silver functions as an antibacterial. SDF prevents the collagenolytic enzymes from degrading the organic matrix of dentin. Organometallic compounds develop inside bacterial cells, deactivating enzymes and promoting cell death.^{13,14,15}

The development of silver compounds causes a dramatic alteration in the colour of the tooth structure. The primary side effect of SDF therapy is this. Over patients' worries over fluoride, the amount of SDF used to treat a tooth with caries contains less fluoride than fluoride varnish.¹⁴ When administered in accordance with manufacturer recommendations, SDF has not been associated with any significant or systemic side effects, according to the American Academy of Paediatric Dentistry (AAPD).¹⁶

The following response takes place when SDF is applied to the tooth:



The remineralization of tooth hard tissues depends on fluoride. Silver phosphate treatment of carious lesions results in the formation of calcium fluoride and

fluorhydroxyapatite. The effects of fluoride on sugar consumption and carbohydrate metabolism include increased tooth resistance to demineralization. Silver ions have antibacterial capabilities that can cause germs to die or impede their metabolic processes.^{17,18}

USING SDF: WHY

SDF is a reliable and efficient solution that gives medical professionals the chance to forego invasive procedures and the anxiety-inducing effects of dental local anaesthesia. For young children with behavioural issues that cannot be addressed in typical therapeutic settings, it is very helpful. For underprivileged people without frequent access to oral healthcare experts or public health dentistry, SDF is an appealing choice due to its low cost and ease of use.

Since it may be done in a variety of places, such as dentistry offices, childcare centres, hospitals, and nursing homes, it is also seen as inclusive. SDF is a non-invasive, non-restorative therapy that can stop active carious processes in both permanent and baby teeth, enhance dental health without exacerbating disease symptoms, and encourage patients to change their eating habits and oral hygiene routines.

In paediatric dentistry, the additional time made possible using SDF may also be crucial for enhancing patient conduct. In addition, the following list of primary indications¹⁹ covers individuals who have

- Number of active cavitated lesions that require prompt attention to prevent the advancement of decay;
- Particular requirements, such as profound cognitive or physical impairments;
- Early childhood tooth decay;
- Behavioural issues (SDF is a therapy option instead of sedation or total anaesthesia);
- Dental phobia or those who, for medical or psychological reasons, cannot bear routine dental care, especially youngsters who are not yet agreeable.
- Large lesions that are too extensive to repair and are not accompanied by infection or discomfort that arise spontaneously.

The administration of SDF to a tooth will only be possible if there are no clinical indications of inflammation of pulp, toothaches, or exposure of pulp. SDF is contraindicated with a history of silver allergy since it may result in mucositis or gingivitis.

The primary drawback of using SDF is tooth discoloration. Carious tissue in the enamel and dentin is anticipated to change to dark brown or black as it serves as an indicator to arrest the decay from progressing. Sound enamel won't become discoloured.¹⁹

SPECIFICS ON THE FREQUENCY AND CONCENTRATION OF APPLICATION

The current body of research advises using 38% SDF solution,^{9,22} applying it twice annually (every six months),^{20,21,22} and leaving carious tissue alone.¹⁹

The recommendation is supported by randomised clinical trials that examined how well SDF prevented or neutralised carious lesions in the dentin of deciduous teeth. There are data available from various studies^{21,23} that followed individuals for 24 to 30 months²¹. It has been demonstrated that 38% SDF consistently inactivated carious lesions in preschoolers more successfully than 12% SDF did by comparing the concentrations of 12 and 38% SDF.

Dentin carious lesions can be stopped by using SDF 38% annually. However, more applications must be made often.

EVIDENCE-BASED STUDIES VALIDATE THE CLINICAL SDF'S EFFICACY.

The quality of the available evidence is evaluated by rigorous and scientific processes such as meta-analysis and systematic reviews. These strategies combine the available data, steer clear

of individual randomised clinical trials, and offer a careful study selection procedure to assist stakeholders and physicians in making informed judgements. Additionally, they guarantee that statistical analysis of data adheres to the authors' quality standards.

The six systematic reviews and meta-analyses of SDF that are currently available are shown in Table,

Year	Authors	Design of study	Study period(months)	
2016	Duangthip et al. ¹⁰	rct	18	The progression of active dentin caries in toddlers' primary teeth appears to be stopped or reduced with DF applications once or twice a year and daily brushing with fluoride toothpaste, while there is little evidence to support this conclusion.
2016	Goa et al. ²⁴	Systematic review with 19 rct	6-30	SDF is useful for halting caries in children and was frequently used at a high dose. On the quantity and frequency of its use to prevent caries, there is disagreement.
2017	Ana Cláudia Chibinski et al. ²⁵	Systematic review with 11 rct	12 to 36	SDF is more effective than other active treatments or a placebo for preventing caries in primary teeth. The body of evidence was fairly strong for primary teeth. There is inadequate information available to make a judgement on the cessation of caries in the first permanent molars.
2017	Violeta Contreras et al. ²⁶	Systematic review with 7 studies	6 to 12	A thorough analysis of 7 studies revealed that SDF, at concentrations of 30% and 38%, is superior to conventional preventative therapy methods for stopping dentinal caries in the primary dentition. SDF concentrations of 30% and 38%, respectively, in primary teeth and permanent first molars show promise as a treatment to prevent caries.
2019	Branca Heloisa Oliveira et al. ²⁷	Systematic review with 4 studies	12 to 36	When applied to caries lesions in primary teeth, SDF appears to effectively prevent dental caries across the whole dentition when compared to no treatment, a placebo, or fluoride varnish.

2019	Alice Trieu et al ²⁸	Systematic review with 6 studies	18 to 30	Compared to NaF, SDF is a more potent dentine caries arresting agent. Further clinical study is required to confirm these findings, thus they should be treated with care.
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Despite variations in SR and MA techniques, the articles indicated that SDF is superior to other caries arrestment treatments. SDF was discovered to be more efficient than placebo, fluoride varnish, and atraumatic restorative therapy.

The SDF for treating carious lesions in children and adults was the subject of an umbrella review in 2019 that evaluated the data from previous systematic studies. The study discovered solid evidence and reliable coronal caries prevention in deciduous teeth. Due to SDF's extensive scientific support, paediatric dentists feel secure utilising it in their everyday practise.²⁹

The first step is to choose the materials for applying SDF, which include a toothbrush, petroleum jelly, glass Dappen dish, disposable applicators, cotton rolls, and SDF solution. The toothbrush is not necessary if the application is carried out at a dental clinic since dental prophylaxis can be carried out with a Robinson brush. The SDF application process is a straightforward process. The subsequent stages are given.³⁰

- The removal of the biofilm from the tooth surface (dentin or enamel) is necessary for dental prophylaxis. If a dental office is nearby, the expert may do a dental prophylaxis using a Robinson brush and a pumice-and-water paste.
- Petroleum jelly must be applied on soft tissues to prevent them from coming into touch with the SDF solution directly.
- To contain the work area, cotton rollers are required;
- Before putting a drop to a glass Dappen dish, the SDF solution must be thoroughly mixed to ensure homogeneity;
- The tooth surface or cavity that will get the SDF treatment must be dried with dry cotton pellets or a little stream of compressed air;
- Active application of SDF solution using disposable tips, with a 1-minute application duration;
- the operatory field must be isolated throughout this procedure with the help of a compressed air.
- If feasible, the isolation can be removed after around 3 minutes.

When treating very young or particularly challenging patients, the treatment periods can be decreased without sacrificing the cariostatic effect.

The SDF application uses the following protocol:³⁰

- keeping the relative isolation in place after applying SDF, and wiping away any excess SDF solution using a cotton roll or gauze;
- With a fresh, disposable applicator, apply the KI solution to the tooth;
- At this stage, tripotassium phosphate will have formed, turning the solution creamy white;
- With gauze or cotton rolls, remove any excess KI solution;
- The relative isolation can be erased by washing the teeth with water.

CONCLUSION

For high-risk children and adolescents, silver diamine fluoride (SDF) is an economical, long-term solution to stop dentin caries. It works wonders as an antibacterial agent and inhibits the growth of biofilm. SDF is appropriate for patients with particular medical conditions, limited access to dental care, and those without traditional restorative therapy. To ascertain the condition of arrested lesions and the long-term security of repeated usage, more study is required.

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