

## Silver Diamine Fluoride in Pediatric Dentistry

Hiba Ahmed<sup>1\*</sup>

<sup>1</sup>Pediatric Dentistry Specialist, Hera General Hospital, Makkah, Saudi Arabia

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\*Corresponding author: Hiba Ahmed

Pediatric Dentistry Specialist, Hera General Hospital, Makkah, Saudi Arabia

### Abstract

The use of Silver Diamine Fluoride (SDF) in pediatric dentistry has lately been gaining recognition and acceptance among dentists and parents. SDF has shown effectiveness in arresting dental caries in primary teeth in children. This review article states a brief history of the use of SDF in dentistry, advantages, disadvantages, indications, contra indications and clinical application of SDF.

**Keywords:** Silver Diamine Fluoride (SDF), bacterial cellular components, pediatric dentistry, infection.

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### What is SDF?

Silver diamine fluoride (SDF) (38% w/v Ag (NH<sub>3</sub>)<sub>2</sub>F, 30% w/w) is a colorless liquid that at pH 10 is 24.4% to 28.8% (weight/volume) silver and 5.0% to 5.9% fluoride. (Horst JA, Ellenikotis 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.). SDF was approved and has been used in Japan since 1970, in Australia and Brazil since 1980 and was approved for clinical use in Canada in 2017.

### Mechanism of Action

Silver diamine fluoride contains silver and fluoride with the ability of both components to inhibit cariogenic biofilms formation. According to a review done by Zhao *et al.*, "it was found that SDF possessed antimicrobial action against cariogenic monospecies strains of *S. mutans* or *A. naeslundii*, dual-species cariogenic biofilms of *S. mutans* and *L. acidophilus* and multispecies cariogenic biofilms formed on dentine surfaces. In the caries process, bacterial invasion initially involves *Streptococci*, *Actinomycetes* and *Lactobacilli*. *Streptococcus mutans* is one of the most important pathogens associated with the initiation and progression of caries" (Irene Shuping Zhao, 2018). High concentrations of fluoride in SDF inhibit the formation of biofilm because of the binding of fluoride to the bacterial cellular components and influencing enzymes that are related to carbohydrate metabolism and sugar uptake (Irene Shuping Zhao, 2018).

On the other hand, depending on the concentration of ionized silver in SDF, it either kills the cariogenic microorganisms or interferes with their metabolic processes (Knight GM, 2009).

Additionally, fluoride has the ability to promote the remineralization of hydroxyapatite in enamel and dentin. Hydroxyapatite crystallization is of great importance in the process of remineralization. Mei *et al.*, (2017) designed an in vitro study to experiment different SDF concentrations to investigate the effect on the growth of apatite crystals. They stated that "SDF reacted with calcium and phosphate ions and produced fluorohydroxyapatite. This preferential precipitation of fluorohydroxyapatite with reduced solubility could be one of the main factors for arrest of caries lesions treated with SDF" (Mei, 2017).

### Indications and Contraindications (Nuvvula S, 2019)

According to (Nuvvula S, 2019) SDF is indicated in the following:

- Individuals with high caries risk with active cavitated lesions on any surface of the anterior or posterior primary teeth and permanent first molars.
- Individuals with behavioral or medical management problems having cavitated dental caries lesions, when local or general anesthesia is not preferred or to be delayed to a later date as a holding measure until definitive treatment is possible, as in cases of preoperative children.

- Individuals with several cavitated dental caries lesions, needing multiple visits to manage (cannot be managed in a single visit).
- Cavitated dental caries lesions that is difficult to treat.
- Individuals or communities lacking access to or with difficulty in accessing dental care.
- Active cavitated dental caries lesions without any clinical signs of pulp involvement.
- As part of the silver modified atraumatic restorative technique (SMART).
- Treatment of dentinal hypersensitivity.
- Treatment of molar incisor hypomineralization (MIH).
- Treatment of recurrent caries (secondary caries) at the restoration margins.
- Treatment of incipient interproximal lesions.
- Disinfection of the root canal system.
- Indirect pulp treatment (IPT).
- Arresting caries to maintain the teeth nearing exfoliation.
- As a substitute to sealants in children who cannot endure a scrupulous sealant procedure.

#### Contraindications Include

- Individuals with known silver allergy.
- Individuals with oral soft tissue ulcerations especially that can come in contact during application of SDF.
- Active cavitated caries lesions with pulp involvement as per the clinical judgment.
- If parents/guardians do not consent.

#### Advantages and Disadvantages (Bedi, 1999) (Doaa Makki Alharbi, 2020)

The major advantages as mentioned by Bedi and Infirri are as follows:

- Management of discomfort and infection. SDF is effective in arresting decays progression that if left without treatment will trigger discomfort and infection.
- Affordable expense. The expense of SDF treatment is low and need to be affordable in the majority of communities.
- Simplicity of treatment. The procedures are basic. This allows non-dental specialists consisting of primary healthcare employees to be easily educated to use SDF to children.
- Minimal support required. The treatment does not need pricey equipment or assistance infrastructure such as piped water and electrical energy. Consequently, the program is simple and affordable to establish.

#### Disadvantages

- Black stained lesions.
- Metallic taste of SDF.
- Gingival and mucosal irritation.

- SDF is sensitive to light.
- Suggested toxicity of high fluoride concentrations in SDF.
- SDF can stain skin, clothes and dental instruments if not handled with caution.

Teeth Selection for SDF Application (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.) (Doaa Makki Alharbi, 2020) (Robin Graham, 2011):

- Absence of clinical signs related to inflamed pulp or history of spontaneous pain.
- Carious lesions that are not infringing on to the pulp. When possible, prescribe radiographs to assess the proximity of pulp to caries lesions.
- Carious lesions on any surface that is accessible with a brush during SDF application.
- Before placement of restoration and as a cariostatic means.

Clinical Application (Nuvvula S, 2019) (Robin Graham, 2011) (Yasmi O. Crystal, 2017).

#### Preparation of Patients and Practitioners

Informed consent, particularly highlighting expected staining of treated lesions, potential staining of skin and clothes, and need for reapplication for disease control, is recommended. The following practices are presented to support patient safety and effectively use SDF:

- Universal precautions.
- No operative intervention (e.g., affected or infected dentin removal) is necessary to achieve caries arrest.
- Protect patient with plastic-lined bib and glasses.
- Cotton roll or other isolation as appropriate.
- Use a plastic dappen dish as SDF corrodes glass and metal.
- Carefully dispose of gloves, cotton rolls, and micro brush into plastic waste bag.

#### Application

- Remove gross debris from the dental cavity to allow better SDF contact with denatured dentin.
- Minimize contact with gingiva and mucous membranes to avoid potential pigmentation or irritation; consider using cotton rolls to protect surrounding gingival tissues.
- Dry the affected tooth surface with a gentle flow of compressed air.
- Bend micro sponge brush, dip and dab on the side of the dappen dish to remove excess liquid before application [1]; apply SDF directly to only the affected tooth surface. • Dry with a

gentle flow of compressed air for at least one minute.

- Remove excess SDF with gauze, cotton roll, or cotton pellet to minimize systemic absorption [13] Continue to isolate site for up to three minutes when possible.

### Application Time

An application time of one minute, drying with a gentle flow of compressed air, is recommended. Clinical studies that report application times range from 10 seconds to three minutes. A current review states that application time in clinical studies does not correlate to outcome. More studies are needed to confirm an ideal protocol.

### Post-Operative Instructions

- Restrict food and drink consumption for 30 minutes to 1 hour after SDF application.
- Follow up at 2-4 weeks after application.
- Reapplication of the SDF is needed according to the progression or the hardness of the lesion.
- Restore the carious lesions after SDF application with resin modified glass ionomer or composite.
- In case of the lesions are not restored, biannual application of SDF is recommended.

### Parental Acceptance

According to (Marwah Almarwan, 2021) "Parental acceptance of SDF was higher for primary compared to permanent teeth and posterior compared to anterior teeth in both dentitions, as well as for those with a positive history of dental pain and/or inflammation." (Marwah Almarwan, 2021).

## CONCLUSION

Silver diamine fluoride is child friendly, requiring no anesthesia nor drilling, hence reducing chair side time and anxiety (Slayton RL, 2018). Additionally, SDF is affective, inexpensive and sustainable for high risk patients across all age groups. The literature recommends for further research to determine the status of the arrested lesions if treatment is withdrawn after 2-3 years and to assess the efficacy of SDF related to the prevention of dental caries in permanent molars.

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