

Silver Diamine Fluoride: A Narrative Review

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Abstract:

Dental caries is the most frequently seen oral lesion, and if left untreated, it can have a negative impact on children's oral health and quality of life by causing pain, severe lesions, malnutrition, and psychological repercussions. Although there are many treatment and prevention strategies, socioeconomic level, behavioural problems, and other factors can make it challenging to obtain the desired results. For patients who cannot receive typical restorative treatment, silver diamine fluoride combines the remineralizing and antibacterial properties of silver with fluoride to offer an alternative care pathway. The use of 38% SDF for both caries prevention and caries arrest has been advocated by many nations. SDF has been shown to be more effective as a caries-prevention strategy than fluoride varnishes and APF Gel. Present review of literature aim to discuss silver diamine fluoride in detail.

Keywords: Dental Caries, SDF, Caries Prevention.

Introduction: Dental hard tissues undergo phasic demineralization and remineralization as a result of dental caries, a biofilm-mediated, sugar-driven, multifactorial, dynamic illness. Over the past 25 years, the burden of caries has increased for children, affecting 50% of Indian youngsters. The severity of caries is frequently linked to socioeconomic level, which is worse. Another difficult part of treating caries in children is getting the patient's cooperation. Therefore, a different approach that is affordable, effective in treating people with high-risk dental caries, and accessible to dental caries is needed in order to lessen the burden of caries and prevent any sequelae connected with it.

Mechanical cavity preparation and restorations are the traditional approaches to treating caries. The main necessity for this sort of management is the patient's compliance, especially in children. It is also quite expensive and technique-sensitive.²

Modern dentistry is undergoing a paradigm change from surgical to medicinal care of caries, with the primary goal of conserving the sound tooth structure by non-invasive techniques, particularly the no-drill procedure.²

The goal of the no-drill Silver Diamine Fluoride (SDF) treatment is to stop caries and prevent the development of new lesions. It is almost two times as effective as fluoride varnish, according to studies. In both clinical and in-vitro tests over the past four decades, it has demonstrated an impressive success rate.³

Silver Diamine Fluoride: The first mention of silver's use in dentistry dates back to the early 17th century. SDF has been used extensively in Japan since the 1960s to cosmetically darken teeth, but it has only lately become accessible in the US. Ammoniacal silver fluoride was first introduced by Drs. Nishino and Yamaga in Japan to stop the development of caries. The first SDF product, Saforide, was approved in 1970 as a result of its creation. The US Food and Drug Administration approved SDF as a therapy for dentinal sensitivity in 2014.⁴ As part of a comprehensive caries care programme, the SDF Panel of the American Association of Paediatric Dentistry (AAPD) published a recommendation in 2017 endorsing the use of 38% SDF for the arrest of cavitated

lesions in primary teeth. The American Dental Association (ADA) approved it (code D1354) as a temporary medication to stop caries in 2017.⁵

SDF ($\text{Ag} [\text{NH}_3] \text{F}_2$) is an ionic topical fluoride solution that contains ions of fluoride (44,860 ppm) and silver (254709 ppm). It can be colourless or blue.⁶ SDF is more stable than silver fluoride and may be kept conveniently at a constant pH of 10.4 for a long time.⁷ Deionized water serves as a liquid basis, and ammonia aids in lowering the oxidative potential of SDF, enhancing its stability.⁸ The liquid has a 1.25 specific gravity and a strong ammonia smell.

Since it is a light-sensitive liquid, it is frequently kept in an opaque bottle. Advantage Arrest (38% SDF), Bioride (30% SDF), Cariestop (12% and 38% SDF), Cariostatic (10% SDF), Dengen Caries Arrest (38%), FAgamin (38%), FluoroplatV (38%), Riva Star (38% SDF), and Saforide (38% SDF) are a few examples of commercially available SDF.^{9,10}

Composition of SDF¹

Silver: 24-27%

Ammonia: 7.5-11%

Fluoride: 5-6% (approx 44,800)

Blue coloring: <1%

Deionized water: <62.5%

Mechanism of Action of SDF: The combination of silver nitrate and fluoride gives the SDF its efficacy. There are three key mechanisms that can stop or prevent dental caries: the antimicrobial action on cariogenic bacteria, encouragement of enamel and dentine remineralization and prevention of dentine demineralization, and decrease of dentine collagen matrix by collagenase inhibition. Silver phosphate and calcium fluoride are the products of the SDF's reaction with hydroxyapatite, and they operate as a reservoir for fluoride and phosphate ions that encourage remineralization. (25–30 microns into the enamel, 200–300 microns into the dentin, and up to 2 mm into a severe carious lesion) The silver ions enter the lesions and stay there to exercise their influence. The carious lesions turn black due to the presence of silver compounds like silver oxide and silver phosphate.¹¹⁻¹³

Indication and contraindication of SDF (Table 1)

Table 1: Indication and contraindication of SDF^{2,3,13}

Indication	Contraindication
High-caries-risk individuals who have active cavitated lesions on the permanent first molars and the anterior or posterior surfaces of their primary teeth. Dental caries in medically compromised children. Caries management in uncooperative children. To arrest root caries. To prevent pit and fissure caries. To prevent recurrent caries. Treatment of incipient interproximal lesions. Disinfection of the root canal system. Indirect pulp treatment (IPT). Arresting caries to maintain the teeth nearing exfoliation Treatment of molar incisor xypomineralization	Known silver allergy. Presence of oral soft tissue ulcerations or stomatitis, especially if the ulcer can come in contact during application of SDF. Active cavitated caries lesions with pulp involvement as per the clinical judgment. Refusal of consent by parents/guardians due to concerns with the color change.

Clinical Steps in SDF application¹⁴⁻¹⁶

Patient and Practitioner preparation

- After the clinical evaluation is complete, go over the procedure with the parents and legal guardians and mention the discolouration that would happen after the SDF application.
- Collect signatures for the informed consent form (illustration)
- Plaque and other debris should be removed from the cavitated lesion.
- Before applying SDF, removal of soft caries from the lesion may not be necessary or may be considered for aesthetic reasons, which may lower the percentage of arrested caries that result in tooth discolouration.
- To prevent temporary henna tattoos from developing on the lips, mucosa, and surrounding soft tissues after contact with SDF, a protective coating of petroleum jelly can be put over those areas.
- Use cotton rolls or other means to isolate the teeth.
- Use of plastic dishes is advised because SDF can corrode glass and metal.

Application of SDF

- The exposure of the intraoral and extraoral soft tissues can be avoided with careful application using a microbrush. There shouldn't be more than one drop of SDF utilised for a single full appointment. Five to six teeth can be treated with one drop.
- Use a gentle stream of compressed air to dry the lesion.
- Dip the brush into SDF and pat it against the side of the plastic dish to absorb any remaining liquid before applying it to the teeth.
- Only coat the damaged tooth surface with SDF.
- Excess SDF is collected with gauze, cotton rolls, or pellets to reduce systemic absorption.
- Application time: If at all feasible, use a mild flow of compressed air for at least one minute to ensure that the SDF is completely dry. The treatment region must be isolated for three minutes.
- Application frequency: According to numerous research, biannual application is advised for better outcomes or to maintain the arrest. Studies with three applications per year revealed greater arrest rate.

Discussion: Children all across the world are impacted by dental caries, which is a serious illness. The average number of missing and decaying teeth worldwide is 2.4. International studies demonstrate that childhood dental caries is still a major condition that is youngsters from both developed and developing countries have been observed.¹⁷

The WHO millennium goals are met by the safe, efficient, patient-centered, and widespread use of SDF. The use of silver diamine fluoride may improve oral health, expand access to care for rural areas, and eventually lessen the need for urgent care and treatment.¹⁸

In the study by Zhi et al.¹⁹, a comparison was made to assess the efficiency of an annual application of SDF solution, a semiannual application of SDF solution, and an annual application of a flowable high fluoride-releasing glass ionomer in primary teeth for stopping active dentin caries. The study's findings suggested that using SDF 38% semi-annually was preferable to applying it annually or using glass ionomer. In a systematic analysis, Chibinski et al.²⁰ found that

SDF is 89% more effective at stopping dental caries in the primary dentition than other alternative therapies or a placebo.

There are 44,800 ppm of fluoride in the 38% SDF. The standard SDF dosage when using a micro-applicator is 0.22 mg (8.8 g F). Since the amount of SDF administered to many carious teeth is far below the acute lethal levels, dental fluorosis can be regarded as a theoretical concern.²¹ It is best to seek medical attention if a significant dose of SDF is accidentally consumed. The formation of insoluble calcium fluoride (CaF₂), which is not absorbed in the digestive tract, makes 10% calcium gluconate (10 mL) solution effective for inducing emesis to prevent absorption in the body.²²

The dark staining effect on carious tissue is the primary disadvantage of silver compounds. The oxidation of ionised silver into metallic silver results in this discolouration, which may make it harder for patients who value aesthetics to accept the treatment. When SDF is used in larger concentrations or is applied repeatedly, silver phosphate is created, which results in black staining of carious enamel and dentin but not sound dental tissue. Potassium iodide can be supplied to create a creamy, white material of silver iodide to help with the staining issue.¹⁸

Conclusion: For high-risk children and adolescents across all age groups, silver diamine fluoride may be a viable, cost-efficient, and long-term solution for preventing dental caries. The best alternative treatment for primary dentition caries, particularly in cases of early childhood caries, is SDF. The black staining is a potential drawback, but because SDF is painless and safe, the parents prefer it to intrusive techniques.

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