

## Silver Diamine Fluoride: What Does the Current Evidence Say?

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### Introduction

Silver Diamine Fluoride (SDF) is a colorless alkaline liquid containing silver particles and 38% (44,800 ppm) fluoride ion. SDF consists of 25% silver, 8% ammonia, 5% fluoride, and 62% water at pH 10. This is ultimately referred to as 38% SDF. Silver Diamine Fluoride is a clinically applied treatment that helps in controlling active dental caries and aids in preventing further progression of the disease [1].

### Mechanism of Action

Silver Diamine Fluoride has a dual mechanism of action resulting from the combination of its ingredients including silver and fluoride component respectively. The silver component acts as an anti-microbial agent killing bacteria and preventing the formation of new biofilm whereas Fluoride acts to prevent further demineralization of tooth structure [2,3].

The illustration has briefly described the Mechanism of action of SDF.



<https://cen.acs.org/articles/94/i31/New-materials-take-bite-tooth.html>  
Credit: Yang H. Ku/C&EN/Shutterstock

### Overview

#### Strength of Evidence

Based on the available evidence in the literature, Analysis of nine clinical trials in children shows that SDF prevented 61% of new

lesions compared to controls. The preventive effect apparently appeared to be immediate and maintained at the same fraction over time. However, enamel lesions might be even more responsive as compared to cavitated dentin lesions. Moreover, direct comparisons of SDF applied once per year with alternative treatments show that SDF is more effective than other topical fluorides placed two to four times per year and more cost-effective than dental sealants.

An annual application of SDF to high-risk surfaces (e.g., mesial surfaces of permanent first molars where the distal surface of the second primary molar) in patients with a risk of new caries lesions appears to be the most cost-effective treatment approach available to prevent dental caries lesion. Authors concluded that SDF is an underutilized evidence-based preventive agent for dental caries [4].

### Comparisons

Products	Preventive effect	Cost-effective
SDF	Similar effect	Yes
Topical Fluorides	Yes	To some extent
Sealants	Yes	Less compared to SDF

### ADA (American Dental Association) Recommendations

The expert panel recommends clinicians prioritize the use of 38% SDF solution biannually to arrest advanced cavitated carious lesions on coronal surfaces of primary teeth. The expert panel extrapolated these results to suggest that clinicians could use 38% SDF solution biannually to arrest advanced cavitated lesions on coronal surfaces of permanent teeth as well [5]. The preventive effect of SDF for root caries is similar to that of 5% Fluoride varnish (FV) and 1% Chlorohexidine (CHX) varnish [6].

### Indications

SDF arrests active carious lesions painlessly and without the administration of local anesthetic. This intervention can be applied to teeth as soon as caries is detected. For advanced cavitated lesions may be relevant if access to care is limited. For patients when a general anesthetic is not considered safe. Nevertheless, very young "pre cooperative" children, persons with intellectual/developmental

disabilities, or older adults [5,6]. Yearly 38% SDF applications to exposed root surfaces of older adults are effective against caries initiation and progression [7-10].

### Contraindications

No adverse events using silver compounds have been reported in more than 80 years of use in dentistry. Silver allergy is the only known contraindication so far. However, teeth with evidence of pulpitis or pulpal necrosis are not appropriate for SDF treatment approach and require surgical intervention. Likewise, teeth with deep lesions where the carious dentin has been excavated are not candidates for SDF treatment approach, due to the ammonia content and high pH, which might create a pulpal reaction.

### Clinical Protocol

UCSF suggests initially dryness of the lesion during SDF application. Then isolation should be performed with gauze and/or cotton rolls. Consequently air-drying before an application might improve effectiveness. Lately, allowing 1-3 minutes for the silver diamine fluoride to soak into and react with a lesion is thought to affect success. However, allowing only a few seconds to soak in due to the cooperation limits of very young patients commonly results in an arrest.

Moreover, application time in clinical studies does not correlate to an outcome. However, UCSF committee decided to be cautious for initial use. Longer absorption time also decreases concerns about removing silver diamine fluoride with a post-treatment rinse. Removing any excess material with the same cotton used to isolate is routine to minimize systemic absorption of SDF. Many clinicians place silver diamine fluoride at the diagnostic visit, then at 1 and/or 3 months follow-ups, then at semi-annual recall visits (6, 12, 18, 24 months) [3].

### Drawbacks

SDF applied to dental decay or other tissues of the oral cavity, lips, and skin causes significant, irreversible black staining due to the formation of silver oxide. Superficial black staining of the skin and oral mucosa tends to resolve within days as epithelial cells slough off. In contrast, unrestored caries lesions treated with SDF remain black permanently a significant aesthetic problem, especially in anterior teeth. Therefore, SDF is most appropriately applied carefully to caries lesions only by trained, skilled providers in a controlled clinical environment [10,11].

### Legal Considerations

Silver diamine fluoride is cleared by the FDA to treat tooth sensitivity. It is used off label by dentists to prevent caries. A special consent form must be used as a way to inform patients, parents, and caregivers, about the standardized procedures [3].

### Additional Efficacy

There is insufficient evidence in the literature to support additional efficacy of SDF use, some practitioners prefer to apply fluoride varnish or fluoride in addition to SDF treatment, but not to the teeth already treated with SDF. UCSF's protocol includes replacement of fluoride varnish with the application of silver diamine fluoride to active lesions only for any patient with active caries. However, dental sealants are more effective than SDF for caries prevention in non-cavitated teeth. Compared to SDF, the use of dental sealants is firmly supported for long term caries prevention by the quantity and quality of evidence available [1].

In non-compliant patients, the application of 38% SDF could be used as an adjunct to fluoride toothpaste, to remineralize incipient caries lesions of permanent teeth where esthetics is not a main concern [12].

### Conclusion

Silver diamine fluoride is considered to be a safe, effective treatment for dental caries among the all age spectrum. Clinical evidence supports continued application 1-2 times per year. It is unclear what will happen if treatment is stopped after 2-3 years and further prospective research is required to be addressed in the field of expertise. Another concern is to determine the best frequency and interval of SDF applications. Future studies in elderly populations should consider the impact of SDF on satisfaction with dental care, quality of life and the cost-benefit of using SDF in place of more complex treatments at this stage of life.

**Conflict of Interest:** The authors declare no conflict of interest for the products mentioned in the manuscript.

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