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# Incorporating silver diamine fluoride into your clinical practice: How SDF can help your patients during the COVID-19 pandemic and beyond

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| PUBLICATION DATE: | SEPTEMBER 2021 |
| EXPIRATION DATE: | AUGUST 2024 |

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# Incorporating silver diamine fluoride into your clinical practice: How SDF can help your patients during the COVID-19 pandemic and beyond

## Educational objectives

1. Review the scientific evidence for silver diamine fluoride (SDF)
2. Review the benefits of SDF to patients and the dental practice
3. Discuss case selection for the application of SDF
4. Describe the clinical protocol for SDF application

## Abstract

Silver diamine fluoride (SDF) is a revolutionary approach to managing caries in a noninvasive manner. This course will explore the scientific evidence as well as the unique benefits SDF offers to today's dental practitioners and patients. Whether stabilizing caries in a phobic or medically frail patient or managing sensitivity in a patient with stress-induced wear, SDF can help improve oral health and increase access to care.

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## Introduction

Dental caries remains a tremendous public health burden with challenges including access to care, the cost of care, and the sheer amount of untreated oral disease. Many dental offices closed their doors to routine care during the COVID-19 pandemic, creating a backlog of patients with pending treatment as well as delayed routine care. As offices reopened, providers found themselves managing not only the delayed care patients, but also the ramifications of patients' poor diets and hygiene practices and stress-induced wear on their dentition. Concern has also been raised regarding dental aerosols and their potential infectivity to patients and staff, leading some providers to seek treatments that reduce or eliminate aerosols. Certain jurisdictions have temporarily prohibited nonemergent aerosolizing procedures. SDF is a groundbreaking approach to managing caries in a noninvasive manner, which offers many advantages when dealing with COVID-19 and beyond. This course will explore the scientific evidence as well as the unique clinical benefits SDF offers to today's dental practitioners and their patients.

## Background: What is SDF?

SDF is a topical antimicrobial and remineralizing agent capable of arresting an average of 80% of carious lesions when applied biannually.[1] There is an abundance of scientific evidence demonstrating the efficacy of SDF, including at least 12 randomized clinical trials.[2-13] A systematic review and meta-analysis found that the use of SDF is 89% more effective in controlling/arresting caries than other treatments or placebos, and the quality of evidence was graded as high.[14] The American Dental Association (ADA) and American Academy of Pediatric Dentistry (AAPD) recently released their first evidence-based clinical practice guidelines, which include recommendations for SDF.[1,15] A 2020 survey of program directors found that US pediatric residency programs have now universally adopted SDF for caries arrest in primary dentition, compared to only 25% in 2015.[16]

Though it has been used to treat decay in other countries for decades, SDF was first cleared in the US by the FDA in 2014 as a dentin desensitizer. Shortly after, the ADA released a CDT code, D1354: Interim caries arresting medicament application per tooth, appropriate for secondary prevention and arrest. There is a new CDT prevention code in 2021, D1355: Caries preventive medicament application per tooth, for high-risk sites, such as exposed root surfaces.

**FIGURE 1:** Severe early childhood caries in a 19-month-old child.

**FIGURE 2.** SDF is applied to arrest caries and avoid general anesthesia.

In 2015, Advantage Arrest 38% SDF (Elevate Oral Care) became the first commercially available product in the US. It is composed of 25% silver, 8% ammonia, and 5% fluoride. One drop (0.05 ml) of Advantage Arrest contains 2.24 mg of fluoride and 4.74 mg of silver with a pH of 10.17 A study on the short-term serum pharmacokinetics of SDF found fluoride exposure was below the US Environmental Protection Agency (EPA) oral reference dose, and while the silver exposure exceeded the dose for cumulative daily exposure over a lifetime, its occasional use (typically biannual application) was well below the concentrations associated with toxicity.[18] One drop per 10 kg of body weight is considered a safe dose and, depending on the size of the lesion(s), may treat as many as five to six teeth.[19] There are no reports of adverse outcomes or known side effects, other than the trademark black stain of active caries, transient metallic taste, and potential gingival irritation, similar to a bleach burn, which resolves on its own in a few days (figures 1, 2). SDF occludes dentinal tubules, producing preferential fluorohydroxyapatite and increasing mineral density and hardness.[20]

## Indications for SDF treatment

- High caries risk
- Inability of patient to tolerate surgical restorations due to age (e.g., pediatric or geriatric patients), behavior, special needs, medical condition, dental phobia, anxiety, or psychological condition
- Need to delay or avoid the use of sedation or anesthesia
- More lesions than can be treated in one appointment
- Financial barriers
- Poor access to care
- Xerostomia (due to salivary dysfunction or medications)
- Difficult-to-treat lesions (e.g., root caries, furcations, hypomineralization)
- Recurrent caries at restoration margins
- Carious primary teeth that will soon exfoliate
- Carious lesions that are either asymptomatic or have reversible pulpitis
- Hypersensitivity

## Contraindications for SDF treatment

- Irreversible pulpitis
- Carious lesions extending to the pulp
- Silver allergy (rare)
- Mouth sores, ulcerative gingivitis (or coat soft tissue lesion(s) with petroleum jelly)

## Basic application of SDF

1. Place protective eyewear and a plastic-lined bib on the patient.
2. Apply petroleum jelly to the patient's lips and perioral area to prevent inadvertently staining the lips or face with the SDF (stain can be removed with hydrogen peroxide).
3. No caries removal is necessary, although the tooth should be clean and free from food or plaque.
4. Isolate with Dri-Aids and/or cotton rolls.

5. Thoroughly dry the tooth (patients with hypersensitivity may not be able to tolerate drying with compressed air, so dry with cotton instead).
6. Place one drop of SDF into a plastic dappen dish or open the unit-dose ampule.
7. Dip a microbrush into the SDF and apply to the tooth for one to three minutes.
8. Do not rinse, light cure, or blow compressed air on the SDF; simply allow it to absorb into the tubules by capillary action.
9. After allowing the SDF to absorb for at least one minute, it is optional to blot any excess SDF with gauze and then coat the tooth with fluoride varnish to help mask the taste and prevent unintended stain elsewhere in the mouth.
10. SDF will only permanently stain active carious lesions. Healthy enamel and soft tissue will not stain permanently.
11. Reassess and reapply SDF to unrestored carious lesions at a minimum of every six months (biannually).

## Benefits for patients of all ages

While SDF first gained attention in the US as a way to avoid invasive treatment in young children, it's not just for kids. SDF's unique antimicrobial properties are beneficial to patients of all ages. Thirty-eight percent SDF inhibits multispecies cariogenic biofilm formation on dentin carious lesions and reduces the demineralization process.[21] In particular, SDF is effective against cariogenic Streptococcus mutans biofilm, likely due to the synergistic effect of fluoride and silver ions.[22] SDF inhibits biofilm adhesion, denatures proteins, breaks down cell walls, and inhibits DNA replication, which helps to prevent new lesions and improve gingival health.

A systematic review of seven studies indicated that SDF, at concentrations of 30% and 38%, is more effective than other preventive management strategies for arresting dentinal caries in the primary dentition. In 2016, the FDA released a safety announcement warning that repeated or lengthy use of general anesthetic and sedation drugs during surgeries or procedures in children younger than three years or in pregnant women during their third trimester may affect pediatric neurological development. SDF is a welcome alternative to conventional surgical treatment in young, precooperative patients as a means to delay or even avoid sedation or general anesthesia altogether. A widely held misconception is that parents may reject it due to the black stain; yet, while parents tend to prefer SDF treatment in posterior teeth, 70-76% prefer SDF even for anterior teeth when it presents an alternative to sedation and general anesthesia.[23]

With a growing population of older patients, a low-cost, effective, and minimally invasive treatment alternative such as SDF is advantageous for preserving hard tissues and helping retain teeth long term while improving quality of life. A systematic review with meta-analysis in the August 2018 issue of the Journal of the American Dental Association (JADA) concluded that yearly 38% SDF applications to exposed root surfaces of older adults are a simple, inexpensive, and effective way of preventing caries initiation and progression.[24] When managing frail or medically complex elderly patients and those residing in long-term care facilities, the nonsurgical therapy of SDF is easy for patients to receive and helps avoid progression of lesions to an acute condition.[25] SDF is especially useful for the very young and the very old, but it can help patients of any age and, when clinically appropriate, should be offered as a treatment option.

## Stabilize and improve oral health

The COVID-19 pandemic has taken a toll on all aspects of life, including oral health. The ADA Health Policy Institute reported that dentists are seeing an increase in decay, periodontal disease, temporomandibular joint disorder (TMD) symptoms, and fractured teeth. The latter even led to a featured article in the New York Times on September 8, 2020: A Dentist Sees More Cracked Teeth. What's Going On?[26] Patients may have more treatment needs, but many are finding themselves with new responsibilities and challenges that impact their time and ability to come in for treatment, such as overseeing their children's virtual learning or adjusting to closed daycares and preschools.

With unemployment on the rise, patients are finding themselves strapped for cash, and some have lost dental benefits. Offering minimal interventions such as SDF is an excellent way to build good faith with patients, giving them an affordable way to stabilize their dentition until they are financially able to complete their restorative care, as opposed to not initiating treatment of any kind and having their condition worsen. Patients will appreciate it and remain loyal to the practice.

A recently published study found that SDF helped reduce emergency visits for children with early childhood caries while on treatment waiting lists and confirmed the effectiveness of SDF for caries arrest in primary teeth, with the cumulative incidence of dental emergencies approximately 80% lower in the SDF-treated group than in the comparison group, and 81% of SDF-treated surfaces were arrested at a follow-up visit.[27] SDF has also been shown to help prevent new carious lesions in both primary and permanent teeth, improving overall oral health.[6]

## Expand restorative treatment options

SDF does not restore form or function; it can remineralize, but it does not regenerate missing tooth structure. In order to improve the function, esthetics, and cleansability of the tooth, as well as to prevent further deterioration, fracture, or abscess, it is advantageous to restore SDF-treated lesions as time, behavior, and finances allow. That being said, not every SDF-treated tooth will need a restoration, such as primary teeth that will soon exfoliate.

SDF penetrates about 25 microns into enamel and 300 microns into dentin, occluding dentinal tubules, which prevents further mineral loss and arrests carious lesions.[19] Lesions also increase in microdensity and hardness, so if and when a restoration is placed, tooth preparation can be more conservative. The application of SDF is relatively quick, simple, and painless, offering the opportunity to build trust in even the most fearful patients, helping them tolerate restorative treatment in the future, if needed. SDF-arrested lesions can be restored using the principles of minimal intervention dentistry, often

without the need for local anesthetic or sedation, known as silver modified atraumatic restorative technique (SMART).[28,29] Hydrophilic biomimetic materials, such as glass ionomer cement, resin-modified glass ionomer, and glass hybrid restoratives, can restore and further remineralize lesions by releasing fluoride and chemically sealing the margins. SDF will not decrease bond strength to resin or glass ionomer cements or restoratives.[30-32] These materials can be used on SDF-treated lesions without concern for reduced retention. In fact, a recent study demonstrated increased retention of resin sealants placed on surfaces that had previously been treated with SDF.[33]

Another popular clinical option is to use SDF to extend the lifespan of an existing restoration. This can be achieved by applying SDF to filling and crown margins to prevent or arrest recurrent decay (figure 3). Further, for incipient proximal lesions, rather than simply "watching" them potentially get larger, a new option is to offer SDF to arrest and remineralize the enamel.

This technique was first described by G. V. Black in his classic textbook, Operative Dentistry, where he described applying silver nitrate to proximal lesions with silk floss. Two clinical studies in children have demonstrated the benefit of proximally applied SDF in mitigating carious lesions. This can be achieved by placing woven floss into the contact and applying SDF to the lingual, buccal, and occlusal aspects of the contact, saturating the floss, using caution to avoid the floss coming in contact with the patient's lips, and allowing it to absorb for at least one minute[34,35] (figure 4).

## Increase access to care and improve outcomes

The prevalence of early childhood caries (ECC) in the US remains overwhelmingly high, particularly among low-income children. The Healthy People initiative reports that, from 1990 to 2010, the percentage of children with untreated decay remained virtually unchanged at almost 30%, while in underserved, rural, and minority populations, the percentage was significantly higher at almost 50%. Even more concerning, traditional restorative dentistry to treat ECC performed under general anesthesia has relapse rates of between 20-80%.[36,37] A

**FIGURE 3:** Silver diamine fluoride applied to the margin of a crown in a medically frail, elderly woman.

2015 systematic review found a lack of substantial evidence to suggest that restorative treatment leads to acceptable long-term clinical outcomes, and there is certainly a need to go beyond drill-and-fill dentistry and integrate other concepts of disease management to ensure long-term success.[38]

In 2013, Indian Health Service pediatric dentist Dr. Frank Mendoza implemented a three-year pilot study of a nonsurgical caries treatment model for the Warm Springs tribal region in Oregon, where greater than 90% of Head Start children historically had decay, and three decades of caries intervention and prevention programs resulted in no discernable change in the rate or severity of the disease. His protocol involved three applications of silver nitrate (the SDF substitute prior to its FDA clearance and US commercial availability) covered by fluoride varnish. The results of this pilot demonstrated 85% arrest of lesions, 75% with no new lesions, and greater than 50% reduction of cases requiring treatment under general anesthesia. SDF is now recommended by Indian Health Service programs across the US.

The procedure to apply SDF is relatively quick, simple, painless, and inexpensive. It can even be done without a compressor or electricity. This low-tech approach can be done in virtually any setting and has become a staple of many dental mission trips, charitable dental organizations, and public health entities. With the increased popularity of teledentistry during the COVID-19 pandemic, SDF expands our ability to provide low-cost dental care to patients residing in nursing homes and assisted living facilities. In several states, SDF application can be delegated

**FIGURE 4:** Silver diamine fluoride applied with woven floss to arrest proximal caries.

to dental hygienists and dental assistants, though you should always check with your individual state dental board to ensure compliance.

## Conclusion

Whether you're stabilizing caries in a fearful or medically frail patient or managing sensitivity in a patient with stress-induced wear, SDF can help improve oral health and increase access to care. SDF is now an essential component of the modern dental provider's toolkit.

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## QUESTIONS

1. According to the literature, SDF arrests approximately what percentage of carious lesions?
   A. 100%
   B. 80%
   C. 50%
   D. 25%

2. Which of the following is a contraindication for SDF treatment?
   A. Irreversible pulpitis
   B. Cavitated lesions
   C. Incipient lesions
   D. Root caries

3. What is the pH of Advantage Arrest 38% SDF?
   A. 13
   B. 7
   C. 10
   D. 5

4. Ideally, SDF should be applied to a lesion for at least:
   A. 10 seconds
   B. 10 minutes
   C. 1 minute
   D. 5 minutes

5. Which of the following are disadvantages of SDF treatment?
   A. Does not restore the form and function of teeth
   B. Radiolucent
   C. Permanently stains active caries black
   D. All of the above

6. How much fluoride is in one drop of 38% SDF?
   A. 2.24 mg
   B. 38 mg
   C. 3.8 mg
   D. 0.38 mg

7. What is the CDT code for interim caries arresting medicament, otherwise known as the SDF code for arrest and secondary prevention?
   A. 1204
   B. 1205
   C. 1354
   D. 1355

8. What is the CDT code for caries preventive medicament application per tooth, for primary prevention?
   A. 1204
   B. 1205
   C. 1354
   D. 1355

9. What is the minimum frequency that SDF should be reapplied to unrestored carious lesions?
   A. It only needs to be applied once.
   B. Annually
   C. Biannually
   D. Monthly

10. Which of the following is a benefit of SDF during the COVID-19 pandemic?
    A. Reduces or eliminates aerosols
    B. Stabilizes oral health
    C. Buys time on existing restorations with recurrent caries at margins
    D. All of the above

11. Which of the following is an advantage of SDF treatment?
    A. Procedure is quick, simple, and painless
    B. Low cost
    C. Well tolerated by all ages
    D. All of the above

12. Which of the following is an indication for SDF treatment?
    A. High caries risk
    B. Lack of access to dental care
    C. Reversible pulpitis
    D. All of the above

13. When was silver diamine fluoride first cleared by the US FDA?
    A. 2014
    B. 2015
    C. 2019
    D. 2005

14. What was the initial indication for SDF given by the US FDA?
    A. Caries arrest
    B. Dentin desensitization
    C. Pulp capping medicament
    D. Cavity liner

15. Which concentration(s) of SDF was/were found to be more effective than other preventive management strategies for arresting dentinal caries in the primary dentition?
    A. 38%
    B. 28%
    C. 30%
    D. Both A and C

16. Which actions describe SDF's impact on biofilm?
    A. Inhibits biofilm adhesion, denatures proteins, breaks down cell walls, and inhibits DNA replication
    B. Increases biofilm and promotes cell replication
    C. Reduces antimicrobial activity
    D. Enhances biofilm adhesion

17. What depth can SDF penetrate into enamel?
    A. 25 microns
    B. 25 centimeters
    C. 300 microns
    D. 10 millimeters

18. What depth can SDF penetrate into dentin?
    A. 25 microns
    B. 25 centimeters
    C. 300 microns
    D. 10 millimeters

## ONLINE COMPLETION

QUICK ACCESS code 21011

Use this page to review questions and answers. Visit **dentalacademyofce.com** and sign in. If you have not previously purchased the course, select it from the Online Courses listing and complete your online purchase. Once purchased, the exam will be added to your Archives page, where a Take Exam link will be provided. Click on the Take Exam link, complete all the program questions, and submit your answers. An immediate grade report will be provided. Upon receiving a grade of 70% or higher, your verification form will be provided immediately for viewing and printing. Verification forms can be viewed and printed at any time in the future by visiting the site and returning to your Archives page.

## QUESTIONS

19. What percent reduction of emergency visits was seen in children treated with SDF?
    A. 100%
    B. 80%
    C. 20%
    D. 50%

20. Which of the following should be avoided when applying SDF?
    A. Good isolation
    B. Remove food and plaque from lesion
    C. Light curing
    D. Dry lesion prior to application

21. What can be applied to skin to help remove accidental SDF stains?
    A. Hydrogen peroxide
    B. Water
    C. Windex
    D. Vaseline

22. Which of the following is not necessary for SDF treatment?
    A. Informed consent
    B. Follow up
    C. Reapplication to unrestored lesions
    D. Caries removal

23. What percentage of parents consented to SDF treatment in anterior teeth as an alternative to sedation and general anesthesia?
    A. 0%
    B. 70-76%
    C. 50%
    D. 100%

24. Which of the following is true regarding placement of restorative materials after SDF treatment?
    A. SDF does not reduce bond strength to resin.
    B. SDF does not reduce bond strength to glass ionomer cement.
    C. SDF treatment improved retention of resin sealant.
    D. All of the above

25. What is a SMART filling?
    A. SDF material above restorative technique
    B. Silver modified atraumatic resin treatment
    C. Silver modified atraumatic restorative technique
    D. SDF masked restoration technique

26. According to a 2015 survey of pediatric residency program directors, what percentage of US training programs were utilizing SDF?
    A. 25%
    B. 50%
    C. 75%
    D. 100%

27. According to a 2020 survey of pediatric residency program directors, what percentage of US training programs were utilizing SDF?
    A. 25%
    B. 50%
    C. 75%
    D. 100%

28. Which component of the biofilm is SDF particularly effective against?
    A. Streptococcus mutans
    B. Plaque
    C. pH
    D. Lactobacillus

29. Why is SDF more effective than other topical fluorides?
    A. The high silver concentration
    B. The synergistic effects of fluoride and silver ions
    C. The high fluoride concentration
    D. The ammonia component

30. Which of the following are benefits of SDF treatment in elderly patients?
    A. Effective at controlling and arresting root caries
    B. Low cost
    C. Nonsurgical treatment that is well tolerated by frail patients
    D. All of the above

### Notes

| | |
|---|---|
| PUBLICATION DATE: | SEPTEMBER 2021 |
| EXPIRATION DATE: | AUGUST 2024 |

ANSWER SHEET

# Incorporating silver diamine fluoride into your clinical practice: How SDF can help your patients during the COVID-19 pandemic and beyond

NAME: TITLE: SPECIALTY:

ADDRESS: EMAIL: AGD MEMBER ID (IF APPLIES):

CITY: STATE: ZIP: COUNTRY:

TELEPHONE (PRIMARY): TELEPHONE (OFFICE):

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**COURSE CAN ALSO BE COMPLETED ONLINE AT A LOWER COST.** Scan the QR code or go to dentalacademyofce.com to take advantage of the lower rate.

## Educational Objectives

1. Review the scientific evidence for silver diamine fluoride (SDF)
2. Review the benefits of SDF to patients and the dental practice
3. Discuss case selection for the application of SDF
4. Describe the clinical protocol for SDF application

## Course Evaluation

1. Were the individual course objectives met?

   Objective #1: Yes No Objective #3: Yes No

   Objective #2: Yes No Objective #4: Yes No

*Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 2. To what extent were the course objectives accomplished overall? | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Please rate your personal mastery of the course objectives. | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. How would you rate the objectives and educational methods? | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. How do you rate the author's grasp of the topic? | 5 | 4 | 3 | 2 | 1 | 0 |
| 6. Please rate the author's effectiveness. | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Was the overall administration of the course effective? | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Please rate the usefulness and clinical applicability of this course. | 5 | 4 | 3 | 2 | 1 | 0 |
| 9. Please rate the usefulness of the references. | 5 | 4 | 3 | 2 | 1 | 0 |
| 10. Do you feel that the references were adequate? | Yes | | No | | | |
| 11. Would you take a similar course on a different topic? | Yes | | No | | | |

12. If any of the continuing education questions were unclear or ambiguous, please list them.

    _____

13. Was there any subject matter you found confusing? Please describe.

    _____

14. How long did it take you to complete this course?

    _____

15. What additional dental continuing education topics would you like to see?

    _____

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| 5. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 20. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
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| 7. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 22. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 8. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 23. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 9. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 24. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 10. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 25. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 11. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 26. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 12. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 27. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 13. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 28. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 14. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 29. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 15. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 30. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |

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