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Caries Arrest With Silver DIAMINE FLUORIDE

THE USE OF THIS AGENT OFFERS MANY BENEFITS IN MANAGING LESIONS, ESPECIALLY AMONG UNDERSERVED AND LOW-INCOME POPULATIONS

By Bernadette Alvear Fa, DDS; Jeremy A. Horst, DDS, MS, PhD; Jason P. Hirsch, DMD, MPH; Steve Duffin, DDS; Allen Wong, DDS, EdD; and Douglas A. Young, DDS, EdD, MBA, MS

EDUCATIONAL OBJECTIVES
After reading this course, the participant should be able to:
1. Describe silver diamine fluoride's (SDF) mechanism of action.
2. Identify possible uses for SDF in clinical practice.
3. List the contraindications for SDF.
4. Discuss the technique for using SDF.

In light of the fact that dental caries remains a significant problem across all age groups, researchers have long sought additional approaches to caries management. Among these, caries management by risk assessment (CAMBRA) is based on the unique risks faced by each patient. The CAMBRA protocol is an evidence-based approach to preventive and reparative treatment of early caries lesions that can be integrated into any dental setting. Sample CAMBRA protocols have been published and updated for children and adults. These guidelines focus on modifying individuals' risk factors via a combination of chemotherapeutic interventions, coupled with behavioral modifications targeted at altering microbiota while supporting tooth remineralization.

Although silver diamine fluoride (SDF) has long been used in Japan, Australia and Argentina for caries prevention, and the value of silver ions to treat dental caries has been known for more than a century, SDF only recently became available in the United States. In 2014, the U.S. Food and Drug Administration cleared SDF for marketing as a Class II medical device for treating dentinal hypersensitivity in adults. Consequently, choosing this chemotherapeutic option for caries management in the U.S. is considered off-label use, similar to fluoride varnish. As with other forms of off-label use, clinicians should use professional judgment when applying SDF for caries management.

A 2009 systematic review reported that SDF is a safe and effective caries-preventive agent that appears to meet both the World Health Organization’s Millennium Goals and the U.S. Institute of Medicine’s criteria. The use of SDF to chemically arrest active caries eliminates the need for local anesthesia and electric or air-turbine handpieces, which can improve children’s experience in the dental office. This paper will review the scientific properties of SDF and its clinical applications for caries arrest.
MECHANISM OF ACTION

An inexpensive and colorless topical agent, SDF offers clinicians another option for preventing and treating cavities. Silver is a substantive antimicrobial that limits the reinfection of cariogenic bacteria after application. The fluoride ions promote remineralization. Upon application of SDF to a decayed surface, a silver-protein conjugate layer forms, which increases resistance to acid dissolution and enzymatic digestion. Treated lesions will increase in mineral density and hardness as lesion depth decreases.

Recently, Horst et al. recommended the widespread off-label use of SDF for preventing and treating cavities in the U.S. In January 2016, the Current Dental Terminology (CDT) billing code 1354 for interim cavities arresting medicament application became active. It states: “Conservative treatment of an active, nonsymptomatic caries lesion by topical application of a caries-arresting or inhibiting medicament without mechanical removal of sound tooth structure.” With the introduction of CDT 1354, Medicaid began reimbursing for the application of SDF.

Several randomized clinical trials evaluated the efficacy of SDF in treating dental caries. Two studies in children demonstrated 91% to 93% caries arrest after two years to three years of biannual application.13,14 And with annual application, two studies showed 65% to 79% arrest after two years to two-and-a-half years.15,16 A dose-response relationship was seen, with better outcomes associated with more frequent application.14 Reapplication appears to provide additional benefits; after 12 months, the caries arrest rate plummeted without reapplication,13 but it increased with reapplication.14 Thus, oral health professionals may wish to observe the effects of SDF before prematurely prescribing conventional restorative dentistry. Studies have reported better caries prevention with annual application of SDF, compared with other topical medicament treatments, such as four-times-per-year applications of fluoride varnish15,17 or chlorhexidine varnish.17

Two reports using silver compounds (SDF or silver nitrate plus fluoride varnish) have shown the potential to dramatically reduce the need to treat children with behavior issues for early childhood caries in hospital settings. The first report was from a private practice setting in which Medicaid-eligible children represented a large percentage of the population.18 The second was from a large Medicaid-managed care organization in Oregon with hundreds of thousands of enrollees.19

As a dental agent, SDF has an impressive safety profile. Based on a large, 500-fold LD50 (lethal-dose for 50%) test, no one who imbibes a particular dose safety margin and a postulated 100% absorption, a single drop (25 μl) results in a reasonable dose limit of 1 drop/10 kg (~22 lbs) child per visit.9 Predictable side effects include blackening of the treated lesion, a short-lived bitter metallic taste, and temporary staining of soft tissues. This agent also has been shown to stain clinical surfaces and leave residual stains on treatment trays. As a result, reasonable caution is advised to avoid touching patients’ soft tissues, as well as clinical surfaces. In addition, patients should be told to expect the lesion to darken substantially over a week’s time.

USE IN CLINICAL PRACTICE

Before placing SDF, oral health professionals should consider whether a patient is appropriate for this treatment. As previously mentioned, SDF is used off label for arresting caries, especially among select populations. It will likely benefit patients diagnosed with sallyvary dysfunction, individuals with special health care needs, the underserved, medically compromised individuals, and patients with severe early childhood caries. It may also be useful for treating lesions that would otherwise be difficult or impossible to treat with traditional methods. Furthermore, SDF is likely useful when applied to enamel pit and fissure surfaces of patients at high caries risk who may not be able to tolerate conventional sealants. In addition, SDF can be used in conjunction with sealants when a lesion is suspected, but has not been visualized. Once it is determined that a patient is a candidate for SDF treatment, oral health professionals must receive informed consent from the patient or guardian.

BERNADETTE ALVEAR FA, DDS, is an assistant professor in the Department of Integrative Restorative Dental Sciences and a general dentist in the Faculty Service Dental Group at the University of the Pacific, Arthur A. Dugoni School of Dentistry in San Francisco. She can be reached at balvear@pacific.edu.

JEREMY A. HORST, DDS, MS, PhD, is a pediatric dentist and fellow at the University of California San Francisco (UCSF). He focuses on discovery of drug leads for dental caries using genome-wide analyses and led the assembly of the UCSF Guidelines on Silver Diamine Fluoride.

JASON P. HIRSCH, DMD, MPH, is a pediatric dentist in private practice in Royal Palm Beach, Florida. He focuses on childhood caries management.

STEVE DUFFIN, DDS, is a general dentist focused on public health programs and treating patients with special needs in Keizer, Oregon. Over the past 10 years, he has examined the history and practice of using silver compounds in controlling caries among high-risk populations.

ALLEN WONG, DDS, EdD, is a professor, director of the advanced education in general dentistry program, and director of the hospital dentistry program at the University of the Pacific School of Dentistry.

DOUGLAS A. YOUNG, DDS, EdD, MBA, MS, is a professor in the Department of Dental Practice at the University of the Pacific School of Dentistry.

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TABLE 1. Patient Populations That May Not Return for Follow-Up Care

- Underserved populations with limited access to care
- Patients with special healthcare needs
- Individuals who need to receive dental care in hospital settings
- Patients unable/unwilling to return for care

Table 1: Patient Populations That May Not Return for Follow-Up Care

Patients or parents/caregivers regarding the risks, benefits and alternatives to SDF therapy.
Clinicians should also consider if repeated SDF application is appropriate. For example, when treating a patient who is not likely to return for follow-up evaluation and treatment (Table 1), clinicians should consider the following options:
- Not placing SDF
- Placing SDF only once, with the understanding the patient may not return for subsequent applications
- Placing SDF and a glass ionomer cement (GIC) sealant/restoration at the same appointment

CONTRAINdicATIONS

While SDF is safe, clinicians should exercise caution in some situations. For a tooth that is symptomatic, partially necrotic or otherwise pulpally involved, SDF may not be beneficial, and immediate traditional treatment may be a better approach. With careful application, SDF will not go beyond treated sites, but patients and providers should be aware that SDF will cause stinging if it contacts soft tissue ulcerations or lacerations.

Patients who refuse the use of fluoride may require extended discussions to obtain informed consent. Clinicians may wish to mention that SDF is twice as concentrated as fluoride varnish, but less than half the volume is used, lowering the total fluoride dose.

A meta-analysis of long-term clinical trials reported that heavy body (i.e., low viscosity) GICs are at least as effective as resin sealants in preventing caries in permanent molars. With conventional GICs, maximal remineralization occurs at the tooth interface.

It is worth noting that light curing is not needed when using conventional GIC restorative materials, which is clinically relevant because light curing after SDF placement can increase the darkening of the lesion. In situations in which patient behavior necessitates short treatment times, a resin modified glass ionomer may be more appropriate than other light-cured restoratives, due to their shorter curing times. Light curing oxidizes SDF, which precipitates the silver out of the solution and turns plastic-based fillings dark immediately. This occurs for light cured resin-modified glass ionomers just as with composite. The silver on healthy enamel can be polished off.

REGULATORY CONSIDERATIONS

Providers are encouraged to examine their states’ dental board regulations to determine who can lawfully place SDF, sealants and nonsurgical restorations. Clinicians who are permitted to place fluoride varnish will most likely be able to place SDF. In some states, however, it is unclear who, other than dentists, are credentialed to perform caries arrest by medicament (CDT 1354). Where nondentists are permitted to perform caries arrest procedures, these should be performed in collaboration with the dentist of record and/or as dictated by state laws.

ENSURING PATIENT COMMUNICATION

After completing a thorough exam, charting, and caries risk assessment, treatment plan options should be discussed with the patient. With guidance from an appropriate oral health professional, patients should ultimately choose the best SDF option, as determined by their wants, needs, financial status, and abilities to cooperate with proposed treatment. Appropriate discussions with a patient or parent/caregiver can motivate and encourage treatment aimed at preventing or halting disease progression, thereby eliminating or limiting the need for more invasive procedures in the future. Table 2 provides a checklist for use when discussing SDF therapy with patients.

TABLE 2. Checklist for Discussing Silver Diamine Fluoride Therapy With Patients

- Disclose and document potential adverse side effects of silver diamine fluoride (SDF), including the likelihood that:
  - Decayed dentin will darken (to dark brown or black) as the caries lesion arrests
  - Although the lesion will darken, healthy tooth structure should not
  - Restorations placed at the same appointment with SDF application may darken
  - Direct contact of SDF with gingiva and skin can temporarily stain and irritate soft tissue; it can also stain external surfaces (e.g., countertops or fabric)
- Stains will disappear in one to three days on oral soft tissues, and two to three weeks on the skin without treatment
- Minimize movement as much as possible during SDF placement to avoid inadvertent contact to unintended areas. The "tell-show-do" approach may be useful for patients with anxiety or behavioral management problems
- Reassure the patient that a more esthetic approach may be available once the caries lesion is arrested with SDF

In such cases, reapplication has been recommended at least biannually until a tooth exfoliates, is extracted, or the tooth is restored. In situations in which restorations are not an option, repeated applications of SDF may be the best option (Figure 1, page 49).

The mechanics of how practitioners are coding and billing for SDF application with restoration are still evolving. Clinical applications in which SDF is combined with GIC sealant/restoration include:

1. Multiple applications of SDF, followed by GIC sealant/restoration after lesion arrest (Figure 2, page 49)
   - Ideally, the preferred approach relies on multiple applications of SDF, followed by placement of a restoration (if needed); however, there may be situations in which a practitioner will only be able to see the patient once (Table 1).

2. Single application of SDF, with immediate GIC sealant/restoration (Figure 3, page 49)
   - If there is concern that a patient may not return for multiple SDF applications, or if a patient has large numbers of active lesions or particularly large lesions (making it impractical to restore all teeth at one
appointment), less time-consuming techniques — such as SDF in combination with immediate GIC sealant/restoration placement — may be considered.22

3. Arrest and repair secondary caries with SDF

At an existing restorative margin, SDF can be applied to arrest secondary caries, followed by repair of the restoration (if appropriate and consistent with tooth preservation strategies).23 Placement of SDF and GIC sealant/restoration is considered a restorative CDT code. It is not appropriate to bill CDT 1354 along with immediate placement of GIC sealant/restoration.

CONCLUSION

The science and versatility of SDF make a strong case for its widespread adoption for caries management. Applying SDF does not preclude the option of subsequent placement of traditional restorations for the purposes of esthetics, comfort and function. This agent offers disinfection and remineralization properties that can reduce the need for traditional invasive procedures. Combining the synergistic compatibilities of SDF and conventional GIC offers new ways to empower and motivate dental professionals and patients to transform disease to health.24

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CE QUESTIONS
The answer sheet and further instructions are located on the tear-out card that appears on page 37, or take the test online at DecisionsinDentistry.com.

1. Which country has a long history of using silver diamine fluoride (SDF) to prevent caries?
   A. Japan
   B. Australia
   C. Argentina
   D. All of the above

2. The U.S. Food and Drug Administration has cleared SDF as a treatment for dental hypersensitivity in adults.
   True
   False

3. Upon application of SDF to a decayed surface, a silver-protein conjugate layer forms that increases resistance to acid dissolution and enzymatic digestion.
   True
   False

4. Which is the correct current Dental Terminology billing code for the use of SDF in caries prevention?
   A. 1354
   B. 3154
   C. 4135
   D. 5413

5. Two studies conducted on children found what percentage of caries arrest after two years to three years of biannual applications?
   A. 86% to 90%
   B. 89% to 91%
   C. 91% to 93%
   D. 100%

6. Which of the following is a side effect of SDF application for caries prevention?
   A. Blackening of the treated lesion
   B. Bitter metallic taste
   C. Temporary staining of the soft tissues
   D. All of the above

7. Which population will most likely benefit from SDF application to prevent caries?
   A. Patients with salivary dysfunctions
   B. Patients with special health care needs
   C. Children with severe early childhood caries
   D. All of the above

8. Which patient population is the most unlikely to return for follow-up dental care?
   A. Patients who need to receive dental care in hospital settings
   B. Children with no history of caries
   C. Patients undergoing orthodontic treatment
   D. None of the above

9. In which scenario is SDF possibly contraindicated?
   A. Tooth that is symptomatic
   B. Tooth that is partially necrotic
   C. Tooth with pulpal involvement
   D. All of the above

10. Replication of SDF is recommended how often?
    A. Annually
    B. Biannually
    C. Three times per year
    D. Monthly

REFERENCEs