DISCUSSION

The results of these studies are mixed and suffer from many differences in methods, prevention modes, and the reporting of their findings. As a consequence of this, it's difficult to predict how long the various treatment strategies will arrest caries progression. Overall, the most effective treatment appears to be the combination of silver fluoride and stannous fluoride, although more evidence is needed before this can be recommended.

Pakdaman A, Montazeri A, Evans RW: Deciduous dentition approximal caries lesion progression and regression following preventive treatment: Literature review. *Austral Dent J* 63:422-428, 2018

Clinical Significance

The focus of future research in this area should rest on the effectiveness of the different forms of topical fluoride in terms of their ability to arrest lesion progression in deciduous teeth. Approximal surface sealants should also be studied to determine how well these agents prevent caries.

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SILVER DIAMINE FLUORIDE

Silver diamine fluoride for caries prevention and arrest

BACKGROUND

Caries experience is not the same for all socioeconomic groups, with lower income groups experiencing a higher rate of dental decay. Lower income groups are especially vulnerable to having a high dietary sugar intake, which is a primary cause of caries, along with a higher proportion of untreated dental decay. The factors of cost and availability or access to services are primary contributors to this situation. In addition, even when dental services are accessible, traditional restorative treatment can be difficult to deliver to young children who have severe dental disease or those with special management needs. Older adults have a similar situation, in that they have a higher percentage of untreated decay, which affects their quality of life, often as a result of challenges with mobility and comorbid conditions. Silver diamine fluoride (SDF) is a clear liquid that combines the antibacterial effects of silver and the remineralizing abilities of fluoride. The fluoride component strengthens the tooth structure being attacked by the acid components of the bacterial metabolism. In addition, SDF may interfere with the biofilm and kill bacteria that cause the imbalance leading to caries development and progression. SDF has been found in numerous studies to be safe, effective, efficient, easy to apply, minimally invasive and painless, and affordable, which is important for the populations most in need of it. The most apparent drawback is that the precipitation of silver byproducts in the dental tissues stains the caries lesions black as they become arrested (Figure 1). The findings of current systematic reviews and meta-analyses concerning SDF as a treatment to arrest caries were outlined.

METHODS

Various databases were searched for systematic reviews reported in English and published or accepted for publication through March 2018. Six systematic reviews complied with most of the guidelines set forth in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

RESULTS

The clinical trials and systematic reviews indicate that SDF arrests caries in primary teeth as well as root caries in elderly patients. In addition, it may prevent the formation of new caries. It should be noted that some lesions don't become arrested, but anterior teeth have considerably higher rates of arrest than posterior teeth (Box 2). A guideline for its use has been published by the American Academy of Pediatric Dentistry, and the World Health Organization has concluded that SDF should be used as an alternative procedure for the tertiary prevention of caries. This is based on its ability to reduce the negative impact of established disease by restoring function and reducing disease-related complications, thus improving the quality of life for children.

Adverse Effects

There are no acute side effects of SDF, although minor side effects have been reported. These include transient gingival irritation and a metallic taste in a few patients. The gingival irritations tend to heal within a couple of days. SDF should not be used on lesions suspected to involve the pulp because it will not prevent further progression of the infection into surrounding tissues.

The primary side effect of SDF use is its dark staining of carious tooth tissue. Parents consider staining unacceptable in some

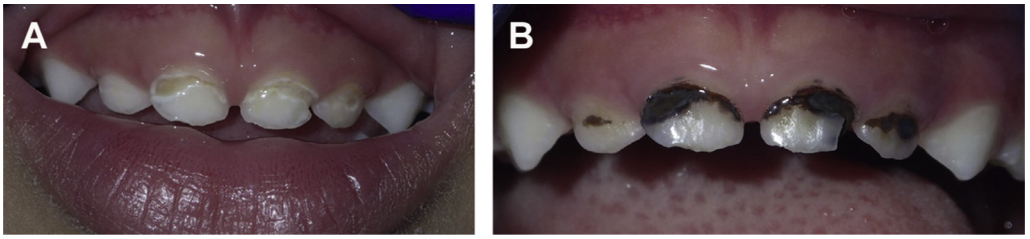

Figure 1. A, Enamel and dentin caries lesions in primary anterior teeth. **B,** Same lesions showing staining after SDF treatment. (Courtesy of Crystal YO, Niederman R: Evidence-based dentistry update on silver diamine fluoride. *Dent Clin N Am* 63:45-68, 2019.).

cases, although a significant number of parents would accept SDF treatment to avoid having to use advanced behavioral techniques on their children, such as sedation or general anesthesia. Parents should be appropriately informed before treatment begins so that they understand the benefits and compromises that are involved with this therapy. SDF can also temporarily stain skin and gingiva, so contact with these tissues should be avoided.

Concern has arisen over the high concentration of fluoride in SDF, especially when very young children receive multiple applications. The high concentrations of silver have also prompted concern. Precautions should be taken so that multiple and frequent applications in young children are avoided.

RECOMMENDED USE

Clinical Applications

The clinical application of SDF should follow the current evidence provided. The recommended solution is 38% SDF, and no caries removal is required with its use. Applications twice a year are more effective than yearly doses. Annual applications of SDF over longer periods are more effective than giving 3 weekly applications at baseline. It can take from 10 seconds to 3 minutes to apply SDF. Larger lesions, occlusal lesions, and those with visible plaque are less likely to respond to the use of SDF. For older adults who can accomplish self-care, annual application of SDF appears to be effective in arresting and preventing root caries. For more dependent and at-risk older populations, multiple applications may be required. Dental professionals should exercise their clinical judgment about the frequency of application based on individual caries risk factors, exposure to fluoride, patient needs, and individual social determinants of health.

Box 2. Caries Arrest by Type of Primary Tooth Using SDF 38% Semiannually

Overall arrest at 30 mo all teeth	75.0%
Lower anterior teeth	91.7%
Upper anterior teeth	85.6%
Lower posterior teeth	62.4%
Upper posterior teeth	57.0%

Data from Fung MHT, Duangthip D, Wong MCM, et al: Randomized clinical trial of 12% and 38% silver diamine fluoride treatment. *J Dent Res* 2018;97(2):171-8. (Courtesy of Crystal YO, Niederman R: Evidence-based dentistry update on silver diamine fluoride. *Dent Clin N Am* 63:45-68, 2019.)

Indications and Patient Selection and Care

SDF therapy is used to arrest caries in patients who have cavitated lesions on coronal or root surfaces that are not suspected to involve the pulp, that have no symptoms, and that can be cleansed. Radiographs should be obtained to verify these indications are present.

The candidates for SDF treatment should not have immediate access to traditional restorative care and nor have a silver allergy. Close monitoring is advised to verify that the patient's lesions are arrested, especially when the SDF is applied to permanent teeth. Ideally the patient should be followed with both a clinical and a radiographic evaluation. In addition, the patient should be counseled regarding plaque control techniques, dietary choices, and the use of various other fluoride delivery modes to prevent caries, including sealants. This follow-up will depend on the patient's age and risk assessment. Glass ionomer restorations or traditional restorative treatment may be required for large lesions or those in difficult-to-access areas, as appropriate.

Clinical Significance

SDF has the potential to benefit many patients. Currently the effectiveness of SDF for caries arrest and prevention in children is widely accepted, along with its ability to prevent caries and manage dentin desensitization in adults. Future research should establish the frequency and intensity of SDF used in conjunction with adjunctive preventive agents, the timing of application, and restorative care that should follow its use. It should also be established how long lesions can be arrested and/or prevented.

Crystal YO, Niederman R: Evidence-based dentistry update on silver diamine fluoride. *Dent Clin N Am* 63:45-68, 2019

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