

## Original Contributions

## Systematic Review

## Controlling caries in exposed root surfaces with silver diamine fluoride

A systematic review with meta-analysis

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Supplemental material is available online.

## ABSTRACT

**Background.** In this systematic review, the authors aim to assess the effect of silver diamine fluoride (SDF) in preventing and arresting caries in exposed root surfaces of adults.

**Types of Studies Reviewed.** Two reviewers independently searched for controlled clinical trials with at least 12 months of follow-up, without language or date of publication restraints, in 8 electronic databases, 5 registries of ongoing trials, and reference lists of narrative reviews.

**Results.** The authors found 2,356 unique records and included 3 trials in which the investigators randomly assigned 895 older adults. Investigators in all studies compared SDF with placebo; investigators in 1 also compared 38% SDF with chlorhexidine and sodium fluoride varnishes. The primary effect measures were the weighted mean differences (WMDs) in decayed or filled root surfaces (DFRS) and the mean differences in arrested carious lesions between SDF and control groups. The studies had low risk of bias in most domains. SDF applications had a significantly better preventive effect in comparison with placebo (WMD DFRS: 24 months,  $-0.56$ ; 95% confidence interval,  $-0.77$  to  $-0.36$ ; 30 months or more,  $-0.80$ ; 95% confidence interval,  $-1.19$  to  $-0.42$ ), and they were as effective as either chlorhexidine or sodium fluoride varnish in preventing new root carious lesions. SDF also provided a significantly higher caries arrest effect than did placebo (pooled results not calculated). Complaints about black staining of the carious lesions by SDF were rare among older adults.

**Conclusions and Practical Implications.** Yearly 38% SDF applications to exposed root surfaces of older adults are a simple, inexpensive, and effective way of preventing caries initiation and progression.

**Key Words.** Root caries; preventive dentistry; cariostatic agents; fluoride; dental health care for aged; systematic review.

**PROSPERO registration:** CRD42016036963.

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The cumulative incidence of root caries in people 60 years or older ranges from 12% to 77%; relevant risk factors are age, poor oral health, and periodontal disease.<sup>1</sup> The widespread occurrence of root caries in older adults translates into a peak of untreated caries in the world adult population at approximately 70 years of age.<sup>2</sup> Besides placing a huge financial burden on society,<sup>2</sup> untreated caries negatively affects the quality of life for older adults, especially because of pain, which can lead to psychological and physical discomfort, social disability, and even handicap.<sup>3</sup>

The development of root caries is a result of repeated cycles of demineralization and remineralization coupled with the degradation of the organic matrix of dentin and cementum. Demineralization initiates the caries process, but protein degradation plays a key role in its progression. Thus, topical applications of substances containing protease inhibitors could be an effective means of controlling root caries.<sup>4</sup>

Silver diamine fluoride (SDF) is an alkaline topical solution containing fluoride and silver that clinicians mainly have used for caries treatment in young children.<sup>5</sup> Besides reducing the growth of cariogenic bacteria and promoting the remineralization of the inorganic content of enamel and

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dentin, SDF prevents collagen degradation in dentin by inhibiting the activity of collagenases and cysteine cathepsins.<sup>6</sup> SDF is also known for its ability to desensitize hypersensitive teeth.<sup>5</sup>

Clinicians have used SDF for decades in some countries such as Australia, Brazil, China, and Japan.<sup>5</sup> The Food and Drug Administration of the United States approved it in 2016 as a dentin desensitizing agent, but clinicians also use it off-label for caries treatment.<sup>7</sup> The application of SDF is simple, painless, noninvasive, and inexpensive.<sup>8,9</sup> Therefore, it may be an attractive approach for the prevention and treatment of caries in older adults, especially in those with limited locomotion and impaired self-care ability.

Investigators in previous reviews on the effects of SDF in preventing and arresting root caries in adults conducted systematic searches of the evidence, but they lacked methodological sophistication.<sup>10,11</sup> They did not follow the guidelines for conducting and reporting systematic reviews,<sup>12,13</sup> and only the investigators in the 2017 review<sup>11</sup> provided some critical appraisal of the design and reporting of the included studies. Most investigators did not conduct meta-analyses—that is, they did not combine the results of individual studies statistically to provide a more precise estimate of the degree to which SDF prevents new root carious lesions from occurring or arrests the progression of existing lesions. Moreover, to our knowledge, investigators have not published reviews of head-to-head comparisons between SDF and other interventions (for example, sodium fluoride varnish [FV] or chlorhexidine [CHX] varnish). Our objective in this systematic review was to perform a qualitative and quantitative synthesis of the scientific evidence on the effect of SDF for preventing and arresting caries on exposed root surfaces of adults.

## METHODS

This is a systematic review of randomized controlled clinical trials. We registered it at PROSPERO (CRD42016036963) and reported it according to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.<sup>13</sup> To be eligible for inclusion in our review, studies had to meet the following criteria:

- *participants*: adults of any age with exposed root surfaces at the beginning of the study;
- *intervention*: topical SDF solution (any concentration or frequency) applied by any health care worker in any setting;
- *comparisons*: no intervention, placebo, or any cariostatic agent or dental restorative material;
- *outcomes*: primary outcomes were the development of new carious lesions and the arrest of existing carious lesions in exposed root surfaces of permanent teeth within at least 12 months after product application (for example, 12, 24, or 30 months or more of follow-up). The secondary outcome measures were any self-reported, caregiver-reported, or professionally diagnosed adverse events.

We developed a highly sensitive search strategy for MEDLINE and later adapted it for other databases and online repositories of trials with the help of a librarian ([Appendix](#), available online at the end of this article). We searched the databases—Cochrane Central Register of Controlled Trials, Embase, MEDLINE via PubMed, Scopus, Web of Science, Latin American and Caribbean Health Sciences Literature, Biblioteca Brasileira de Odontologia, SciELO—in April 2016 without language or date of publication restrictions. We also searched 5 registries of ongoing trials—[ClinicalTrials.gov](#), Brazilian Clinical Trials Registry, European Union Clinical Trials Register, International Standard Randomised Controlled Trial Number Registry and Current Controlled Trials, and Australian New Zealand Clinical Trials Registry—and the Brazilian database of theses and dissertations. We updated all searches in July 2017. We used cross-referencing from narrative reviews on the subject of SDF for caries prevention or arrest to identify additional articles.

We organized the records downloaded from each database into 1 core database (EndNote X7, Thomson Reuters). After training, 2 authors (B.O., A.R.) independently examined the titles and abstracts of all records that remained after removal of duplicates and decided which articles should be read in full. When a study apparently met the inclusion criteria but no abstract was available or there was not enough information in the title or abstract, we obtained and read the article. We examined studies in Japanese and Chinese regarding inclusion with the help of people knowledgeable in those languages.

We prepared and pilot tested an extraction data form. Two review authors (B.O., A.R.) independently read all the studies selected for inclusion and extracted the data. They also independently assessed the risk of bias for all included trials by using the Cochrane Risk of Bias Tool.<sup>12</sup> We

## ABBREVIATION KEY

<b>CHX:</b>	Chlorhexidine.
<b>DFRS:</b>	Decayed or filled root surfaces.
<b>FV:</b>	Sodium fluoride varnish.
<b>KI:</b>	Potassium iodide.
<b>N<sub>p</sub>:</b>	No. of participants in analysis of caries incidence or arrest.
<b>N<sub>r</sub>:</b>	No. of participants randomly assigned.
<b>OHE:</b>	Oral health education.
<b>OHI:</b>	Oral hygiene instruction.
<b>PF:</b>	Prevented fraction.
<b>SDF:</b>	Silver diamine fluoride.

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