

Policy on the Use of Silver Diamine Fluoride for Pediatric Dental Patients

Latest Revision

2023

How to Cite: American Academy of Pediatric Dentistry. Policy on the use of silver diamine fluoride for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:103-5.

Purpose

The American Academy of Pediatric Dentistry (AAPD) recognizes that dental caries continues to be a prevalent and severe disease in children. This policy addresses the use of silver diamine fluoride (SDF) as part of an ongoing caries management plan with the aim of optimizing individualized patient care consistent with the goals of a dental home.

Methods

This document was developed by the Council on Clinical Affairs, adopted in 2017¹, and last revised in 2018². This policy is based on a review of current dental and medical literature and sources with recognized professional expertise and stature, including both the academic and practicing health communities, related to SDF and silver nitrate. In addition, literature searches of PubMed[®]/MEDLINE and Google Scholar databases were conducted using the terms: diamine silver fluoride AND caries, Howe's solution, silver nitrate AND caries, silver diamine fluoride; fields: all; limits: within the last 15 years, humans, English, birth through age 99. Two hundred five articles matched these criteria. Papers for review were chosen from this list and from the references within selected articles. Expert and/or consensus opinion by experienced researchers and clinicians also was considered.

Background

Treatment of incipient caries usually involves early therapeutic intervention using topical fluoride and nonsurgical restorative techniques such as dental sealants and resin infiltration.³ The use and outcomes of these techniques have been well-documented, and recommendations for their use in pediatric dentistry have been developed.^{4,5} In contrast, treatment of cavitated caries lesions traditionally requires surgical intervention to remove diseased tooth structure followed by placement of a restorative material to restore form and function. Barriers to traditional restorative treatment (e.g., behavioral considerations due to age and/or limited cooperation, financial constraints) call for alternative caries management modalities.

Topical silver products, such as silver nitrate and SDF, have been used in Japan for over 40 years to arrest caries and reduce tooth hypersensitivity in primary and permanent teeth.⁶ Many other countries (e.g., Australia, China) have been using this compound with similar success.^{7,8} The United States (U.S.) Food and Drug Administration has approved SDF as a Class II

medical device for reducing tooth sensitivity, and off-label use for arresting caries is now permissible and appropriate for patients.⁹⁻¹³ As marketed in the U.S., SDF is a 38 percent silver diamine fluoride, which is equivalent to five percent fluoride, in a colorless liquid with a pH of 10. Current studies indicate fluoride ions act by remineralizing enamel and dentin, while silver ions have an antimicrobial effect mainly in the treated carious dentin.¹⁴ Silver and fluoride in an alkaline solution may have a synergistic effect that creates an unfavorable environment for collagen enzyme activation thereby reducing dentin degradation.¹⁵ A side effect is the permanent black discoloration of demineralized or cavitated surfaces. Before-and-after images of teeth treated with SDF can be helpful in the consent process.¹⁶

Many clinical trials have evaluated and confirmed the efficacy of SDF on caries arrest and/or prevention.^{10-12,17-35} Although clinical trials have inherent bias because of the staining (i.e., the difference between control and treated teeth is obvious to the researcher), studies consistently conclude that SDF is indeed more effective for arresting dentinal caries than fluoride varnish.^{10-12,22-35} SDF reportedly also has approximately two to three times more fluoride retained than delivered by sodium fluoride, stannous fluoride, or acidulated phosphate fluoride (APF) commonly found in varnishes, gels, and foams.²¹ Additionally, SDF has not been shown to reduce adhesion of resin or glass ionomer restorative materials.³⁴⁻³⁹ SDF is safe when used in adults and children in accordance with dosing and application criteria⁴⁰⁻⁴² and does not appear to negatively impact oral health-related quality of life in young children.^{43,44} Follow-up for evaluation of caries arrest is advisable⁴⁰, and reapplication of SDF may be necessary to achieve or sustain arrest.^{21,33,36,40,45}

The AAPD's *Chairside Guide: Silver Diamine Fluoride in the Management of Dental Caries Lesions* provides guidance on the placement of SDF.⁴⁰ Professional fluoride products are prescribed by, and intended for application by or under the direction of, a licensed dental or medical care provider who is familiar with the child's oral health status and can determine the need and frequency for application based upon a completed

ABBREVIATIONS

AAPD: American Academy of Pediatric Dentistry. **SDF:** Silver diamine fluoride. **U.S.:** United States.

a caries risk assessment.⁴⁶ SDF is optimally utilized in the context of a chronic disease management protocol, one that allows for the monitoring of the clinical effectiveness of SDF treatment, disease control, and risk assessment.⁴⁵ The ultimate decision regarding disease management and application of SDF is to be made by the practitioner and the patient/parent, acknowledging individuals' differences in disease propensity, lifestyle, and environment.⁴⁵ Delegation of the application of SDF to allied dental personnel, as permitted by state law, is by prescription or order of the dentist after completion of a comprehensive oral examination and caries risk assessment.

Policy statement

The AAPD:

- supports the use of SDF as part of an ongoing caries management plan with the aim of optimizing individualized patient care consistent with the goals of a dental home.
- recognizes the application of SDF as a minimally-invasive approach that may prevent or delay the need for more extensive and expensive procedures.
- supports delegation of application of SDF to qualified allied dental personnel with training and supervision according to a state's dental practice act by prescription or order of a dentist after a comprehensive oral examination and caries risk assessment.
- supports the education of dental students, residents, other oral health professionals and their staffs to ensure understanding of the appropriate clinical use of SDF.
- encourages more practice-based research to be conducted on SDF to evaluate its efficacy and impact on oral health-related quality of life for infants, children, adolescents, and individuals with special health care needs.

References

1. American Academy of Pediatric Dentistry. Policy on use of silver diamine fluoride for pediatric dental patients. *Pediatr Dent* 2017;39(6):51-3.
2. American Academy of Pediatric Dentistry. Policy on use of silver diamine fluoride for pediatric dental patients. *Pediatr Dent* 2018;40(6):51-4.
3. Urquhart O, Tampi MP, Pilcher L, et al. Nonrestorative treatments for caries: Systematic review and network meta-analysis. *J Dent Res* 2019;98(1):14-26. Available at: "<https://journals.sagepub.com/doi/pdf/10.1177/0022034518800014>". Accessed January 3, 2023.
4. American Academy of Pediatric Dentistry. Fluoride therapy. *The Reference Manual of Pediatric Dentistry*. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:352-8.
5. American Academy of Pediatric Dentistry. Pediatric restorative dentistry. *The Reference Manual of Pediatric Dentistry*. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:443-56.
6. Gao SS, Zhao IS, Duffin S, Duangthip D, Lo ECM, Chu CH. Revitalising silver nitrate for caries management. *Int J Environ Res Public Health* 2018;15(1):80. Available at: "<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5800179/>". Accessed January 1, 2023.
7. Zhao IS, Gao SS, Hiraishi N, et al. Mechanisms of silver diamine fluoride on arresting caries: A literature review. *Int Dent J* 2018;68(2):67-76.
8. Mei ML, Zhao IS, Ito L, et al. Prevention of secondary caries by silver diamine fluoride. *Int Dent J* 2016;66(2):71-7.
9. Mei ML, Lo EC, Chu CH. Clinical use of silver diamine fluoride in dental treatment. *Compend Contin Educ Dent* 2016;37(2):93-8; quiz 100.
10. Gao SS, Zhang S, Mei ML, Lo EC, Chu CH. Caries remineralisation and arresting effect in children by professionally applied fluoride treatment – A systematic review. *BMC Oral Health* 2016;16:12.
11. Duangthip D, Chu CH, Lo EC. A randomized clinical trial on arresting dentine caries in preschool children by topical fluorides—18 month results. *J Dent* 2016;44:57-63.
12. Duangthip D, Jiang M, Chu CH, Lo EC. Restorative approaches to treat dentin caries in preschool children: Systematic review. *Eur J Paediatr Dent* 2016;17(2):113-21.
13. Sharma G, Puranik MP, K RS. Approaches to arresting dental caries: An update. *J Clin Diagn Res* 2015;9(5):ZE08-11. Available at: "<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4484184/>". Accessed May 23, 2023.
14. Sulyanto RM, Beall CJ, Berger MB, et al. Silver diamine fluoride alters microbial communities in subsurface dentin. *JADA FS* 2022;1:100004. Available at: "[https://jadafs.ada.org/article/S2772-414X\(21\)00004-9/pdf](https://jadafs.ada.org/article/S2772-414X(21)00004-9/pdf)". Accessed March 5, 2023.
15. Mei ML, Lo ECM, Chu CH. Arresting dentine caries with silver diamine fluoride: What's behind it? *J Dent Res* 2018;97(7):751-8.
16. Crystal YO, Janal MN, Hamilton DS, Niederman R. Parental perceptions and acceptance of silver diamine fluoride staining. *J Am Dent Assoc* 2017;148(7):510-8.e4.
17. Deutsch A. An alternate technique of care using silver fluoride followed by stannous fluoride in the management of root caries in aged care. *Spec Care Dentist* 2016;36(2):85-92.
18. Li R, Lo EC, Liu BY, et al. Randomized clinical trial on arresting dental root caries through silver diamine fluoride applications in community-dwelling elders. *J Dent* 2016;51:15-20.
19. Zhang W, McGrath C, Lo EC, Li JY. Silver diamine fluoride and education to prevent and arrest root caries among community-dwelling elders. *Caries Res* 2013;47(4):284-90.

20. Chu CH, Gao SS, Li SK, et al. The effectiveness of the biannual application of silver nitrate solution followed by sodium fluoride varnish in arresting early childhood caries in preschool children: Study protocol for a randomised controlled trial. *Trials* 2015;16:426.
21. Chu CH, Lo EC, Lin HC. Effectiveness of silver diamine fluoride and sodium fluoride varnish in arresting dentin caries in Chinese pre-school children. *J Dent Res* 2002;81(11):767-70.
22. Beltrán-Aguilar ED. Silver diamine fluoride (SDF) may be better than fluoride varnish and no treatment in arresting and preventing cavitated carious lesions. *J Evid Based Dent Pract* 2010;10(2):122-4.
23. Castillo JL, Rivera S, Aparicio T, et al. The short-term effects of diammine silver fluoride on tooth sensitivity: A randomized controlled trial. *J Dent Res* 2011;90(2):203-8.
24. Duangthip D, Jiang M, Chu CH, Lo EC. Non-surgical treatment of dentin caries in preschool children – Systematic review. *BMC Oral Health* 2015;15:44.
25. Gluzman R, Katz RV, Frey BJ, McGowan R. Prevention of root caries: A literature review of primary and secondary preventive agents. *Spec Care Dentist* 2013;33(3):133-40.
26. Liu BY, Lo EC, Chu CH, Lin HC. Randomized trial on fluorides and sealants for fissure caries prevention. *J Dent Res* 2012;91(8):753-8.
27. Llodra JC, Rodriguez A, Ferrer B, et al. Efficacy of silver diamine fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. *J Dent Res* 2005;84(8):721-4.
28. Mattos-Silveira J, Floriano I, Ferreira FR, Viganó ME, Mendes FM, Braga MM. Children's discomfort may vary among different treatments for initial approximal caries lesions: Preliminary findings of a randomized controlled clinical trial. *Int J Paediatr Dent* 2015;25(4):300-4.
29. Mattos-Silveira J, Floriano I, Ferreira FR, et al. New proposal of silver diamine fluoride use in arresting approximal caries: Study protocol for a randomized controlled trial. *Trials* 2014;15:448. Available at: "<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4255679/>". Accessed May 23, 2023.
30. Monse B, Heinrich-Weltzien R, Mulder J, et al. Caries preventive efficacy of silver diammine fluoride (SDF) and ART sealants in a school-based daily fluoride toothbrushing program in the Philippines. *BMC Oral Health* 2012;12:52.
31. Shah S, Bhaskar V, Venkataraghavan K, et al. Efficacy of silver diamine fluoride as an antibacterial as well as anti-plaque agent compared to fluoride varnish and acidulated phosphate fluoride gel: An in vivo study. *Indian J Dent Res* 2013;24(5):575-81.
32. Tan HP, Lo EC, Dyson JE, Luo Y, Corbet EF. A randomized trial on root caries prevention in elders. *J Dent Res* 2010;89(10):1086-90.
33. Zhi QH, Lo EC, Lin HC. Randomized clinical trial on effectiveness of silver diamine fluoride and glass ionomer in arresting dentine caries in preschool children. *J Dent* 2012;40(11):962-7.
34. Lo EC, Chu CH, Lin HC. A community-based caries control program for pre-school children using topical fluorides: 18-month results. *J Dent Res* 2001;80(12):2071-4.
35. Rosenblatt A, Stamford TC, Niederman R. Silver diamine fluoride: A caries "silver-fluoride bullet". *J Dent Res* 2009;88(2):116-25.
36. dos Santos VE Jr., de Vasconcelos FM, Ribeiro AG, Rosenblatt A. Paradigm shift in the effective treatment of caries in schoolchildren at risk. *Int Dent J* 2012;62(1):47-51. Available at: "<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9374964/>". Accessed August 7, 2023.
37. Han L, Okiji T. Dentin tubule occluding ability of dentin desensitizers. *Am J Dent* 2015;28(2):90-4.
38. Savas S, Kucukyilmaz E, Celik EU, Ates M. Effects of different antibacterial agents on enamel in a biofilm caries model. *J Oral Sci* 2015;57(4):367-72.
39. Wu DI, Velamakanni S, Denisson J, et al. Effect of silver diamine fluoride (SDF) application on microtensile bonding strength of dentin in primary teeth. *Pediatr Dent* 2016;38(2):148-53.
40. American Academy of Pediatric Dentistry. Chairside guide: Silver diamine fluoride in the management of dental caries lesions. *The Reference Manual of Pediatric Dentistry*. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023:638-9.
41. de Almeida Lde FD, Cavalcanti YW, Valença AMG. In vitro antibacterial activity of silver diamine fluoride in different concentrations. *Acta Odontol Latinoam* 2011;24(2):127-31.
42. Vasquez E, Zegarra G, Chirinos E, et al. Short term serum pharmacokinetics of diammine silver fluoride after oral application. *BMC Oral Health* 2012;12:60. Available at: "<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3538059/>". Accessed May 29, 2023.
43. Duangthip D, Gao SS, Chen KJ, Lo ECM, Chu CH. Oral health-related quality of life of preschool children receiving silver diamine fluoride therapy: A prospective 6-month study. *J Dent* 2019;81:27-32.
44. Sihra R, Schroth RJ, Bertone M, et al. The effectiveness of silver diamine fluoride and fluoride varnish in arresting caries in young children and associated oral health-related quality of life. *J Can Dent Assoc* 2020;86:k9.
45. Crystal YO, Marghalani AA, Ureles SD, et al. Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special health care needs. *Pediatr Dent* 2017;39(5):E135-E145.
46. Weyant RJ, Tracy SL, Anselmo T, Beltrán-Aguilar EJ, Donly KJ, Frese WA. Topical fluoride for caries prevention: Executive summary of the updated clinical recommendations and supporting systematic review. *J Am Dent Assoc* 2013;144(11):1279-91. Erratum in *J Am Dent Assoc* 2013;144(12):1335. Dosage error in article text. Available at: "[https://jada.ada.org/article/S0002-8177\(14\)60659-0/fulltext](https://jada.ada.org/article/S0002-8177(14)60659-0/fulltext)". Accessed April 29, 2023.