This draft does not constitute an official AAPD health oral policy or clinical guideline until approval by the General Assembly. Circulation is limited to AAPD members.

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

Originating Council

Council on Clinical Affairs

Adopted

2017

Purpose

The American Academy of Pediatric Dentistry **(AAPD)** recognizes that dental caries continues to be a prevalent and severe disease in children; especially those of low socioeconomic status. This policy intends to educate professionals, parents and patients about the use of silver diamine fluoride **(SDF)** or silver nitrate **(SN).**The dental profession has historically viewed dental caries as an acute disease condition requiring surgical debridement, cavity preparation, and mechanical restoration of the tooth. Increasingly, especially for the infant and child population, practitioners are utilizing individually tailored strategies to prevent, arrest, or ameliorate the disease process based on caries risk assessment. One of these strategies employs the application of silver diamine fluoride (SDF) or silver nitrate (SN) as an antimicrobial and remineralization agent to arrest active carious dental lesions.

Methods

This policy is a review of current dental and medical literature and sources of recognized professional expertise and stature, including both the academic and practicing health communities, related to SDF and SN. In addition, systematic literature searches of PubMed® and Google Scholar electronic databases were conducted with the following parameters: Terms: “diamine silver fluoride and caries”, “Howe’s solution”, “silver nitrate and caries”, and “silver diamine fluoride”; Fields: all; Limits: within the last 15 years, humans, English, birth through age 99. One hundred eight articles matched these criteria. Papers for review were chosen from this list and from the references within selected articles. When data did not appear sufficient or were inconclusive, recommendations were based upon expert and/or consensus opinion by experienced researchers and clinicians.

Background

Treatment of incipient caries usually involves early therapeutic intervention using topical fluoride,

and non-surgical restorative techniques like sealants and resin infiltration. The use and outcomes of these techniques have been well documented and there are current policies and guidelines with recommendations for their use in the practice of dentistry. [1-3] In contrast, treatment of cavitated lesions traditionally requires surgical intervention to remove the diseased tooth structure followed by placement of a restorative material to restore form and function to the tooth. Barriers to traditional restorative treatment like behavioral issues due to age and/or limited cooperation, access to care and/or financial constraints, call for other alternative caries management modalities.

Silver topical products, such as silver nitrate and silver diamine fluoride (SDF) have been used in Japan for over 40 years to arrest caries and reduce tooth hypersensitivity in primary and permanent teeth. During the past decade many other countries such as Australia and China have begun been using this compound with similar success.[4, 5] As marketed in the United States, SDF is a 38% silver diamine fluoride which is equivalent to 5% fluoride in a colorless liquid, with a pH of 10. The exact mechanism of SDF is not understood. It is theorized that fluoride ions act mainly on the tooth structure, while silver ions, like other heavy metals, are antimicrobial. It also is theorized that SDF reacts with hydroxyapatite in an alkaline environment to form calcium fluoride (CaF_2) and silver phosphate as major reaction products. CaF_2 provides sufficient fluoride to form fluorapatite which is less soluble than hydroxyapatite in an acidic environment. [6, 7] A side effect is the discoloration of demineralized or cavitated surfaces. Patients and parents should be advised regarding the black staining of the lesions associated with the application of SDF. Ideally prior to the use of SDF, parents should be shown before and after images of teeth treated with SDF. Recently, the Food and Drug Administration approved SDF as a device for reducing tooth sensitivity and off label use for arresting caries is now permissible and appropriate for use in patients.[8-12]

Many clinical trials have evaluated the efficacy of SDF on caries arrest and/or prevention, [6, 9-11, 13-33] although clinical trials many have risk of bias because of the staining and because there is no methods to accurately determine caries arrest. However, studies consistently conclude that SDF is indeed more effective for arresting caries [6, 9-11, 15, 16, 18, 20-33] than fluoride varnish. SDF reportedly also has approximately 2-3 times more fluoride retained than delivered by sodium fluoride, stannous fluoride or acidulated APF fluoride commonly found in foams, gels and varnish. [28] Additionally the use of SDF has not shown to reduce adhesion of resin or glass ionomer restorative materials. [6, 28, 29, 34-37] The use of SDF poses little toxicity and fluorosis risk when used in adults and children. [38-40] Placement of SDF should follow manufacturer's recommendations. The

AAPD has developed the "Silver Diamine Fluoride Management of Dental Caries Chairside Guide" to assist health care professionals in the application of SDF. [41]

Policy statement

The AAPD

- Supports the use of silver diamine fluoride as a caries arresting medicament for patients for whom traditional restorative treatment is not possible or immediately available.
- Supports third party reimbursement for fees associated with SDF.
- Encourages more research to be conducted on SDF.
- Supports the use of informed consent for prior to application of SDF, including the use of images of teeth treated with SDF.

References

1. American Academy of Pediatric Dentistry. Guideline on Fluoride Therapy. Pediatr Dent, 2016; 38(6): 181-4.
2. American Academy of Pediatric Dentistry. Guideline on Pediatric Restorative Dentistry. Pediatr Dent, 2016; 38(6): 250-62.
3. American Academy of Pediatric Dentistry. Policy on Use of Fluoride. Pediatr Dent, 2016; 38(6):45-6.
4. Mei ML, Zhao IS, Ito L, Lo EC, Chu CH. Prevention of secondary caries by silver diamine fluoride. Int Dent J, 2016; 66(2):71-7.
5. Bianchi VC. [Ammonium silver nitrate in infantile odontology; penetration and precipitation in dentine]. An Esp Odontoestomatol, 1950; 9(5):431-50.
6. Fung M. WM, Lo E, Chu CH. Arresting Early childhood Caries with Silver Diamine Fluoride-A Literature Review. Oral Hygiene & Health, 2013; 1(3):1-5.
7. Yamaga R, Nishino M, Yoshida S, Yokomizo I. Diamine silver fluoride and its clinical application. J Osaka Univ Dent Sch, 1972; 12:1-20.
8. Mei ML, Lo EC, Chu CH. Clinical Use of Silver Diamine Fluoride in Dental Treatment. Compend Contin Educ Dent, 2016; 37(2):93-8; quiz100.
9. 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.

10. 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.
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. Sharma G, Puranik MP, K RS. Approaches to Arresting Dental Caries: An Update. J Clin Diagn Res, 2015; 9(5):ZE08-11.
13. Li R, Lo EC, Liu BY, Wong MC, Chu CH. Randomized clinical trial on arresting dental root caries through silver diammine fluoride applications in community-dwelling elders. J Dent, 2016; 51:15-20.
14. 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.
15. Mattos-Silveira J, Floriano I, Ferreira FR, Vigano 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.
16. 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.
17. Chu CH, Gao SS, Li SK, Wong MC, Lo EC. 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.
18. 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.
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. Shah S, Bhaskar V, Venkataraghavan K, Choudhary P, Ganesh M, Trivedi K. Efficacy of silver diamine fluoride as an antibacterial as well as antiplaque agent compared to fluoride varnish and acidulated phosphate fluoride gel: an in vivo study. Indian J Dent Res, 2013; 24(5):575-81.
21. 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.
22. 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.

23. Monse B, Heinrich-Weltzien R, Mulder J, Holmgren C, van Palenstein Helderman WH. 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.
24. 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.
25. 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.
26. 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.
27. Beltran-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.
28. Rosenblatt A, Stamford TC, Niederman R. Silver diamine fluoride: a caries "silver-fluoride bullet". J Dent Res, 2009; 88(2):116-25.
29. Braga MM, Mendes FM, De Benedetto MS, Imparato JC. Effect of silver diammine fluoride on incipient caries lesions in erupting permanent first molars: a pilot study. J Dent Child (Chic), 2009; 76(1):28-33.
30. Chu CH, Lo EC. Promoting caries arrest in children with silver diamine fluoride: a review. Oral Health Prev Dent, 2008; 6(4):315-21.
31. Llodra JC, Rodriguez A, Ferrer B, Menardia V, Ramos T, Morato M. 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.
32. 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.
33. 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.
34. 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.
35. Wu DI, Velamakanni S, Denisson J, Yaman P, Boynton JR, Papagerakis P. Effect of Silver Diamine Fluoride (SDF) Application on Microtensile Bonding Strength of Dentin in Primary

Teeth. Pediatr Dent, 2016; 38(2):148-53.

36. 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.

37. Han LOkiji T, Dentin tubule occluding ability of dentin desensitizers. Am J Dent, 2015; 28(2):90-4.

38. 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.

39. Chu CH, Mei L, Seneviratne CJ, Lo EC. Effects of silver diamine fluoride on dentine carious lesions induced by Streptococcus mutans and Actinomyces naeslundii biofilms. Int J Paediatr Dent, 2012; 22(1):2-10.

40. de Almeida Lde F, Cavalcanti YW, Valenca AM. In vitro antibacterial activity of silver diamine fluoride in different concentrations. Acta Odontol Latinoam, 2011; 24(2):127-31.

41. American Academy of Pediatric Dentistry. Silver Diamine Fluoride Management of Dental Caries Chairside Guide. Pediatric Dentistry, 2017; 39(6) special issue.