

What is SDF?

Silver diamine fluoride (SDF) is a colorless liquid that is composed of 24.4% to 28.8% Silver ions and 5.0% to 5.9% Fluoride ions, which are dissolve in 8% amine. SDF is FDA approved topical used to control active dental caries and prevent further caries lesion progression.

History

1840- Silver was first used in dentistry in 1840s in the form of "nitrate of silver" (known today as silver nitrate, AgNO₃) for arresting caries lesions.

1917- Ammonia water was added to make solution alkaline. "Howe's solution" (AgNH₃NO₃) was used to sterilize root canals and applied to the enamel to prevent caries. Could not promote demineralization.

1969- Silver fluoride (AgF) was added, in Japan by Mizuho Nishino. (Ag(NH₃)₂F) or Silver Diamine Fluoride was a combination of antimicrobial silver properties and high dosage of fluoride. It was approved by Ministry of Health and Welfare of Japan as a cariostatic agent and marketed under the name Saforide.

2014- SDF was approved by U.S. Food and Drug Administration as a medical device for treating dentinal hypersensitivity.

2016- FDA granted the designation of breakthrough therapy to Advantage Arrest 38% SDF as a treatment for arresting dental caries in children and adults.

Study	N (age)	Duration/Intervention	38% SDF	Main results
Chiu et al. 2002 China	375 children at baseline - 308 completed (3-5 yrs) Max ant teeth Mean dmfs 4.66 Low F	Duration 30 mo 1. Remove caries then annual SDF 2. Annual SDF 3. Remove caries then NaF every 3 mo 4. NaF every 3 mo 5. Water (cnt)		Mean # of arrested carious surfaces 1. 2.5 2. 2.8 3. 1.3 4. 1.5 5. 1.3 p<0.001
Llorens et al. 2005 Cuba	452 children at baseline 373 completed (=6 yrs) Primary canines, molars Permanent 1 st molars/ Low F	Duration 36 mo 1. Biannual SDF 2. Cnt		Mean # of arrested carious surfaces 1. 2.8 2. 1.8 p< 0.05
Zhi et al. 2012 China	212 children at baseline 181 completed (3-4 yrs) Dmfs 5.1±4.0/ Low F	Duration 24 mo 1. Annual SDF 2. Biannual SDF		% of caries arrested 1. 79% 2. 91% p=0.007
Yee et al. 2009 Nepal	976 children at baseline 624 completed (3-9 yrs) Low F	Duration 24 mo 1. SDF once 2. SDF once +transic acid 3. 12% SDF once 4. Cnt		Mean # of arrested carious surfaces at 6mo/1224mo 1. 4.53/42.1 2. 4.54/12.2 3. 2.31/71.5 4. 1.61/31.09<0.001(p<0.001)(p<0.01
Zhang et al. 2013 Hong Kong	277 elderly 227 (60-89 yrs)	Duration 24 mo 1. Annual SDF +OHI+OHE 2. Annual SDF+ OHI 3. OHI		Mean # of arrested carious surfaces 0.33 0.28 0.04 p=0.006

Liu et al. 2012 Southern China	501 children at baseline 485 completed (9 yrs) fissures	24 mo duration 1. Sealant 2. Biannual NaF 3. Annual SDF 4. Cnt		% of decayed fissure sites 1. 1.6% 2. 2.4% 3. 2.2% 4. 4.6%	PF for SDF = 39%
Tan et al. 2010 HongKong	306 elders at baseline 203 completed (79 yrs) Exposed roots	Duration 3 yrs 1. Annual SDF 2. NaF every 3 mo 3. CHX every 3 mo		Mean # of new lesions 1. 0.7 2. 0.9 3. 1.1	PF 1. 71% 2. 64% 3. 57%
Monse et al. 2012 Philippines	704 children (6-8 yrs) Daily F toothpaste program 1 st molars	Duration 18 mo 1. SDF once 2. GIC sealant once 3. Cnt		Caries increment F toothpaste Non-F 1. 0.09 1.0.12 2. 0.01 2.0.06 3. 0.08 3.0.17	

<http://media.news.health.ufl.edu/misc/cod-oralhealth/docs/conferences/2015OHF/Present/tpohsdf.pdf>

Evidence of SDF



NEW YORK CITY COLLEGE OF TECHNOLOGY



Silver is the new Black; Silver Diamine Fluoride

How is it used in dental field?

- 1) Prevent dental caries
- 2) Remineralize early enamel caries
 - "The fluoride ions in SDF help create fluorapatite, a more acid-resistant enamel which can prevent further demineralization of tooth structure" (Chhokar, Salina et al. 2017).
- 3) Arrest dental caries
 - "In October of 2016, the FDA granted the designation of breakthrough therapy to Advantage Arrest 38% SDF as a treatment for arresting dental caries in children and adults" (Chhokar, Salina et al. 2017).
- 4) Decrease sensitivity
 - "As of April 2014, a 38% SDF was cleared for marketing as a Class II medical device by the U.S. Food and Drug Administration (FDA) for the treatment of dentinal hypersensitivity" (Chhokar, Salina et al. 2017).
 - "The first product was cleared for marketing by the Federal Drug Administration (FDA) in 2014 as a cavity varnish for treatment of hypersensitivity in adults over 21 years of age; therefore, its use as a caries pre-ventive or arresting agent is off label." (Bowen, 2016).



SDF is applied to occlusal decay



SDF is applied to root decay

Pros:

- 1) Economical compared to alternative treatments
 - "... one 8mL bottle of Advantage Arrest, costing approximately \$129, is sufficient to treat 1,600 carious lesions" (Chhokar, Salina et al. 2017).
- 2) Non-invasive
 - "Silver diamine fluoride presents a noninvasive option for caries arrest and treatment when applied directly to dentin caries lesions" (Bowen, 2016).
- 3) Easily operated
- 4) Reduced treatment time
 - "These respondents felt that their patients or the parents of their patients would be interested in this treatment due to its advantages, including not requiring local anesthesia and the removal of tooth structure, its low cost and reduced treatment time" (Chhokar, Salina et al. 2017).

Cons:

- 1) Repeated application at 6-month intervals is needed for sustained effectiveness
 - "While a single application of SDF appears insufficient for sustained effects, annual and semi-annual re-applications have been shown to be highly successful" (Chhokar, Salina et al. 2017).
- 2) Can cause black staining
 - "The main disadvantage of SDF is its characteristic black staining of enamel and treated dentinal caries lesions and potential staining of skin, clothing, and surfaces that it comes into contact with" (Crystal, 2017)
- 3) Can cause unpleasant taste (bitter/metallic)
 - "The widespread use of SDF is limited by the fact that it stains the carious lesion black, and sometimes causes a temporary metallic taste" (Chhokar, Salina et al. 2017).
 - "The hallmark of SDF is a visible dark staining that is a sign of caries arrest on treated dentin lesions. This dark discoloration is permanent unless restored" (Crystal, 2017).



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