

Silver Diamine Fluoride (SDF): The Silver Lining in Dental Care

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July 18, 2024



Objectives



1. Emphasize the use of the most current scientific research to optimize patient care.

2. Acquire knowledge and comprehend the rationale and appropriate timing of SDF.

3. Master techniques for precise placement of SDF in clinical practice.





Disclosure(s)

None!

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Mr. Percy Donald Lewis - my father



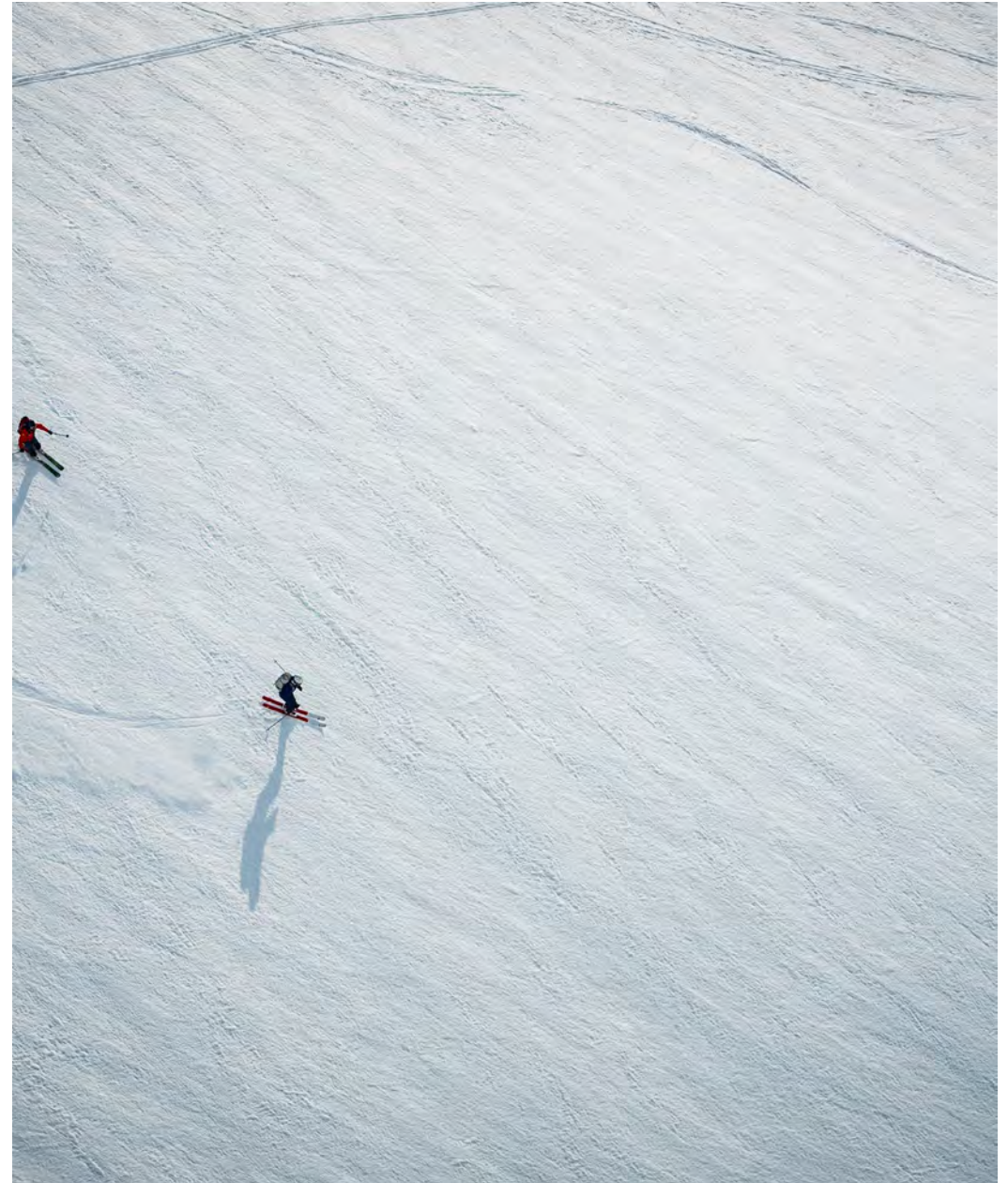


What is Silver Diamine Fluoride (SDF)?

SDF is a clear or blue liquid that combines the antibacterial effects of silver with the remineralizing power of fluoride.

According to the 2017 clinical practice guidelines of the American Academy of Pediatric Dentistry (AAPD),

SDF may be used in certain circumstances as a non-restorative management technique for the arrest of progression of small cavities and cavity-susceptible areas on primary teeth and permanent teeth.



ADA vs WHO

ADA Statement on the Use of Silver Diamine Fluoride (SDF) to Arrest Carious Lesions (*Trans.*2020:304)

38% Silver Diamine Fluoride (SDF) is a topical antimicrobial and re-mineralizing agent which was cleared by the FDA as a Class II medical device to treat tooth sensitivity. In certain circumstances, SDF may be used as a non-restorative treatment to arrest carious lesions on primary and permanent teeth.

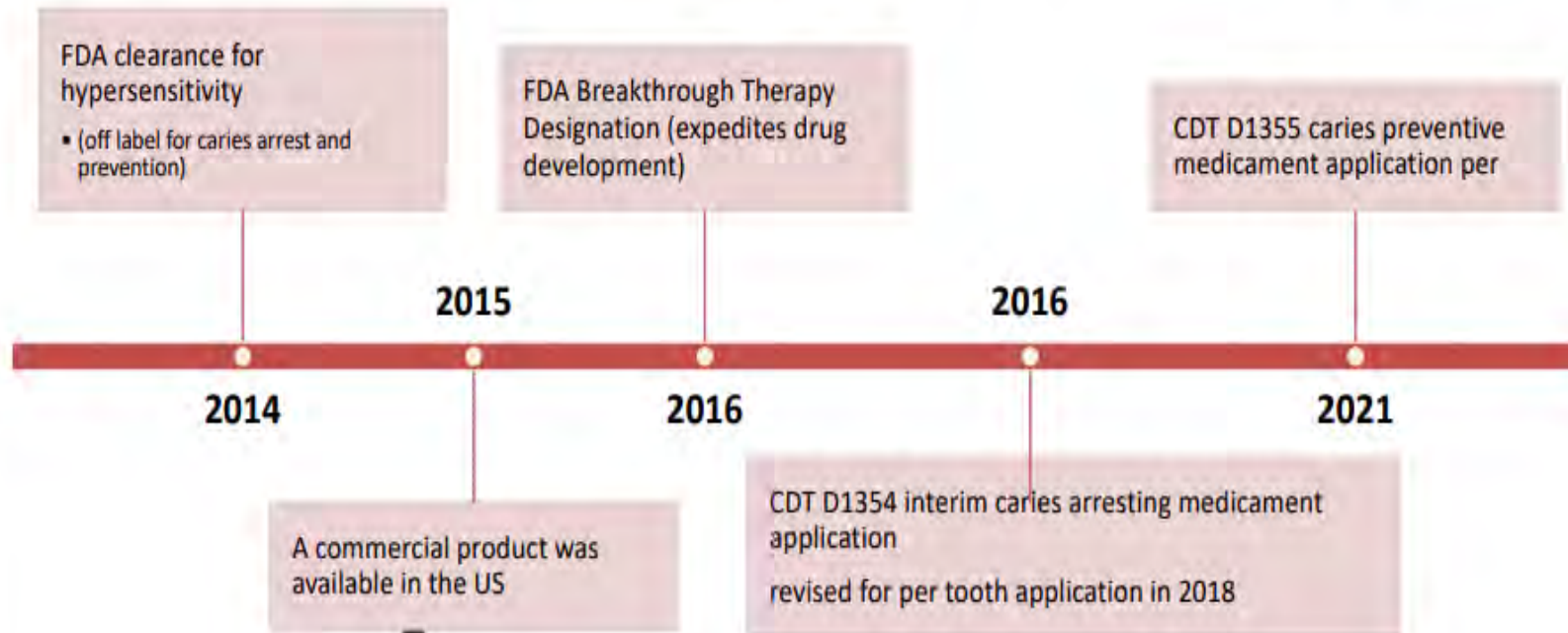
- <https://www.ada.org/resources/ada-library/oral-health-topics/silver-diamine-fluoride>

- In 2021, the WHO included SDF in the WHO Model List of Essential Medicines for both adults and children. The WHO considers that SDF is a medicine to which everyone should always have access and that all governments should ensure SDF is available and affordable to their populations.


- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9463534/>

Unprecedented Adoption of SDF

D. Young



PRACTICE GUIDELINES | COVER STORY | [VOLUME 149, ISSUE 10, P837-849.E19, OCTOBER 2018](#)


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Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions

A report from the American Dental Association

[Rebecca L. Slayton, DDS, PhD](#) • [Olivia Urquhart, MPH](#)   • [Marcelo W.B. Araujo, DDS, MS, PhD](#) • ...

[Lauren Pilcher, MSPH](#) • [Laura Banfield, MLIS, MHSc](#) • [Alonso Carrasco-Labra, DDS, MSc](#) • [Show all authors](#)

DOI: <https://doi.org/10.1016/j.adaj.2018.07.002> •  [Check for updates](#)

What is SDF?

J.Horst

Colorless liquid with a pH 10 -13

24.4 – 28.8% Silver:

Antimicrobial

8% Ammonia:

Solvent

5 - 5.9% Fluoride:

Remineralization

44.800 ppm



TABLE 4. The American Dental Association Clinical Recommendations for Professionally Applied Fluoride⁶

Product Type/Delivery	Fluoride ppm	Indications*
1.23% Acidulated Phosphate Fluoride Gel	12,300 ppm	Every 3 months to 6 months for caries risk
2% Sodium Fluoride (NaF) Gel	9050 ppm (0.90% fluoride ion)	Every 3 months to 6 months for caries risk
5% NaF Varnish	22,600 ppm (2.26% fluoride ion)	Every 3 months to 6 months for caries risk
38% Silver Diamine Fluoride	253,870 ppm Ag/44,800 ppm fluoride (24.4% to 28.8% silver, 5.0% to 5.9% fluoride, 8% ammonia)	Extreme risk, limited access to care, cariostatic agent, frequency of application varies

**Professionally applied fluoride treatments are indicated for patients at moderate to extreme caries risk. Patients who present with low caries risk may not benefit from in-office professional fluoride therapies.*

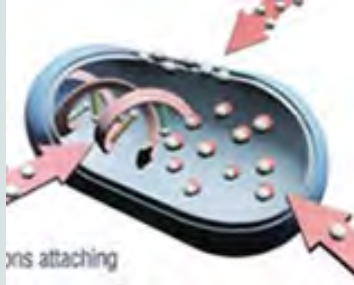
SDF - What does it do?

1. Arrests dental caries (81% - 1+ /yr)
2. Prevents dental caries (62%) – directly or indirectly
3. Decreases dentin hypersensitivity
4. Turns de/hypo-mineralized areas dark or black

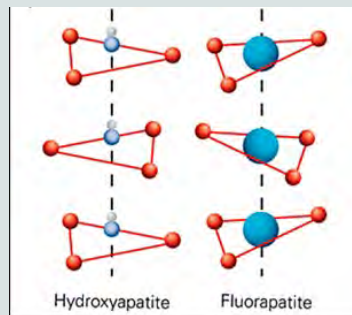


SDF: How does it work?

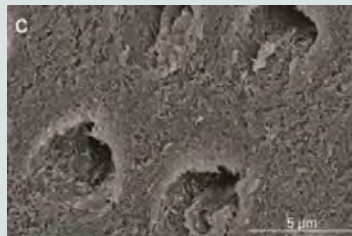
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- Bactericidal
- Prevents bacterial growth
- Deactivates enzymes

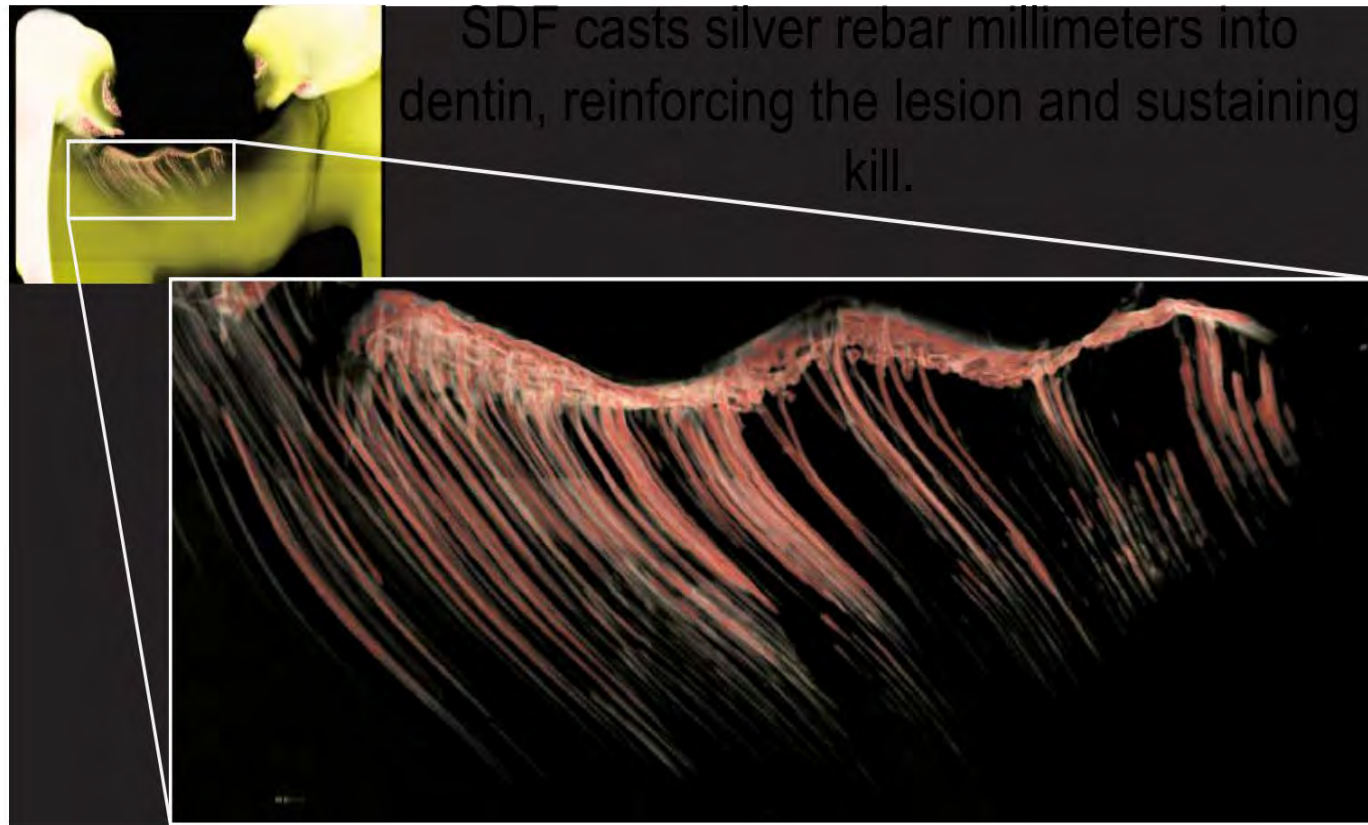


- Re-mineralizes to fluorapatite
- Increases lesion hardness
- Prevents demineralization



- Occludes dentinal tubules
- Penetrates far into dentin

SDF is one of the most effective and longest lasting treatments for hypersensitivity (D9910)



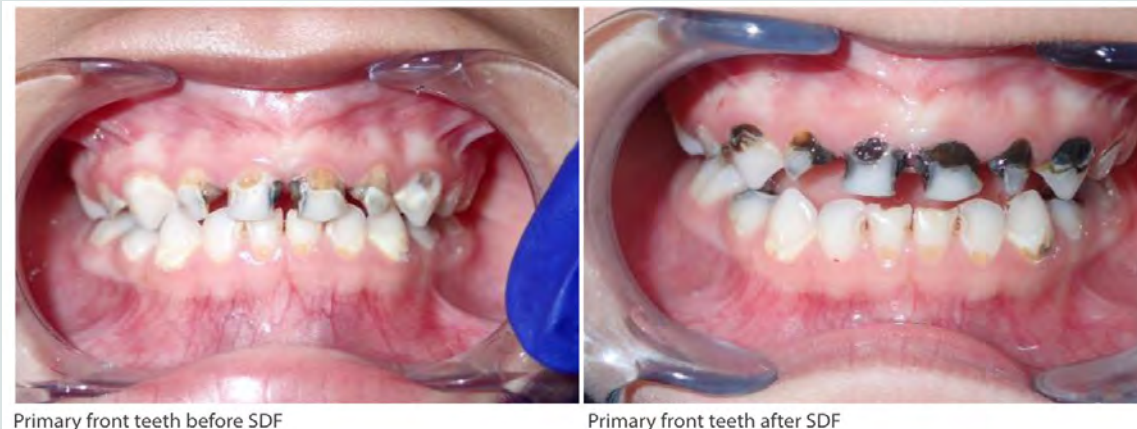
Courtesy of Dr. Jeremy Horst

Advantages of SDF

- Painless treatment, with no need for local anesthetic, since decay removal is not required.
- Applied in one visit as soon as decay is diagnosed.
- Requires little preparation, is easily placed, and takes only a few minutes (1-3 mins.).
- Affordable and often covered by both public and private dental insurance plans

Disadvantages of SDF

- Does not offer a restoration of tooth damage or a long-term remedy for tooth decay – is the way it looks.
- Bad taste
- Stains decay and affected tooth structures black. The stain is permanent, lasting the life of the tooth.



Affordability?

- Teeth close to exfoliation
- Too young for the OR
- Medical complications
- Financial issues
- Parents discomfort with/fear of/the OR

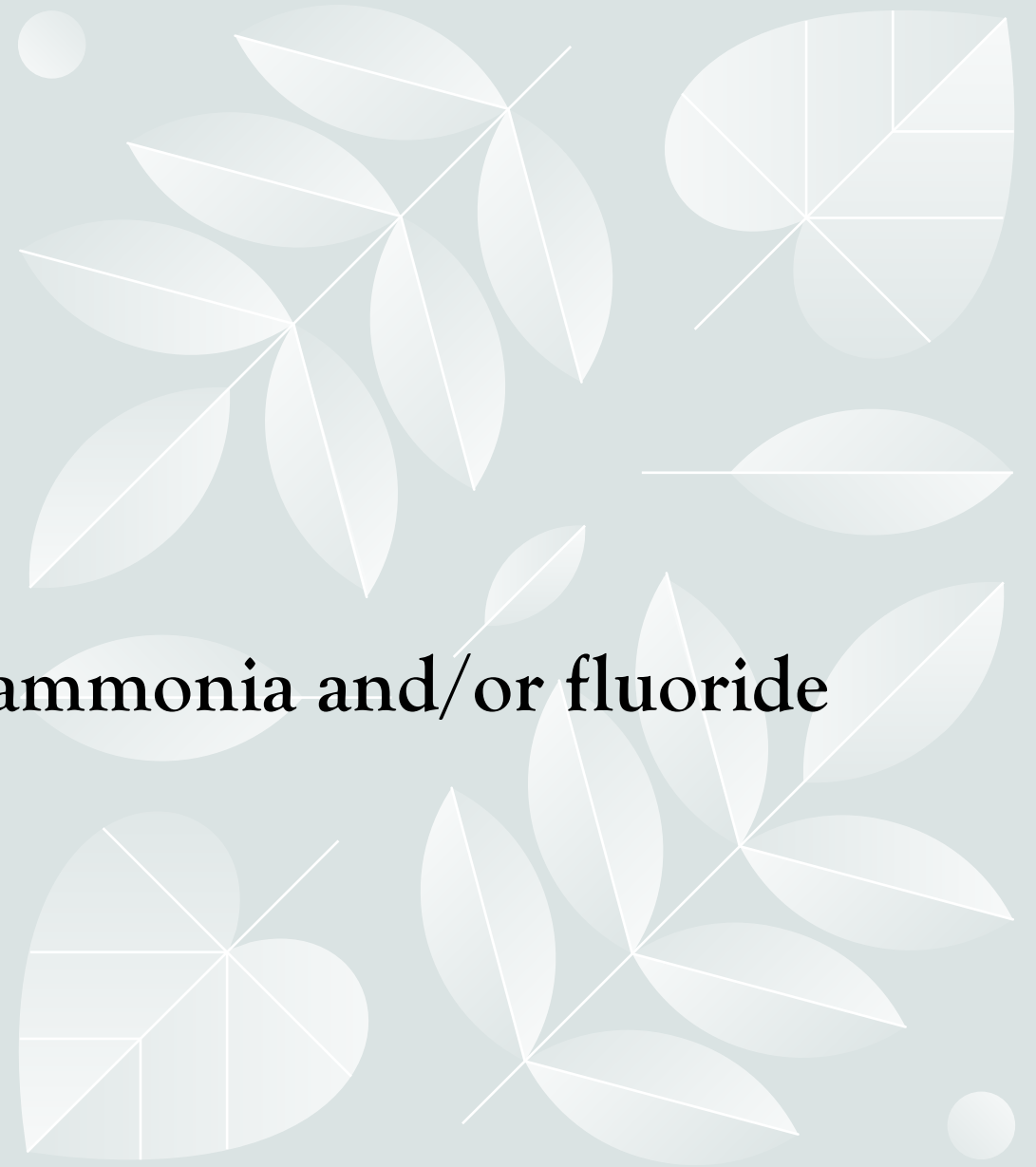


AAPD May 2021

Pros of SDF	Cons of SDF
Quick, easy, painless for the patient	Not a cure for caries
Simple to apply in a variety of clinical settings	Outcome depends on oral hygiene and regular dental visits
Inexpensive	Must be reapplied to cavities if left unrestored
Relieves sensitivity	Does not restore the form or function of decayed teeth
Remineralizes natural tooth structure	Deeply decayed teeth, especially with nerve involvement, are not candidates for SDF
Arrests up to 80 percent of cavities when applied at least twice a year	Does not arrest decay in an estimated 20 percent of affected teeth
Avoids or delays more surgical interventions	Permanently stains areas of decay black
May reduce cost of dental care for some families	Not viable for all patients due to such conditions as silver allergies

Pregnancy: Unknown yet

Obviously any allergies to silver, ammonia and/or fluoride



Pregnancy

- <https://www.aegisdentalnetwork.com/cced/2021/06/clinical-instructions-for-using-silver-diamine-fluoride-sdf-in-dental-caries-management>
- “No studies have yet evaluated the safety of SDF during pregnancy in women or animals, thus the authors cannot make a recommendation on use of SDF in pregnant women and suggest consideration of silver nitrate and fluoride varnish instead. There are long histories of safely using silver nitrate to cauterize HPV warts on the cervix of pregnant women and fluoride varnish to prevent caries lesions in pregnant women.
- **The combination of 25% silver nitrate and fluoride varnish has been shown to have equivalent effectiveness to SDF.“**

Contraindications

- Allergies to Silver, Ammonia and/or Fluoride
- Thyroid gland therapy (specifically with Riva Star)
- Direct pulp exposure
- Irreversible Pulpitis
- Direct exposure to muco/gingival lesions

SDF-hardened dentin supporting restorations with no prep

Molar Incisor Hypomineralization

before



after



MacLean *Decisions* 2018



Horst

Populations used & public health

- Pediatric and Geriatric Dentistry : >80%
- General Dentistry:
 - Special Needs
 - Rural practices - 'equity'
 - Disease treatment and prevention
 - Health promotion

Use in general dentistry

1. Secondary caries on margins to save from replacement or extraction (posteriors)
2. Under crowns and bridges
3. Indirect pulp cap or liner material
4. Posterior/approximal caries lesion (non-aerosol, minimally invasive)
5. Initial caries lesion
6. Root caries or posterior lesions when restorative is delayed or not possible
7. SMART restorations (silver modified atraumatic restorative treatment)

There are two SDF products in the US

Advantage
Arrest
pH 10

Riva Star
pH 13

38% SDF (in purified water, pH 10)

Storage: Avoid freezing or extreme heat

Maximum Dose: 260 μ L (eight drops) per treatment visit

Preventive and Non-Surgical (D1354) Use of Silver Diamine Fluoride 38%



Cost Per Treatment

Bottle: \$0.70 per drop

Unit-Dose: \$4.33 per
(0.1 mL)

Unit-Dose Only:

\$9.50 per
(0.05 mL)

Storage & Shelf Life

Room Temperature
3 Years

Refrigeration
2 Years

Tinted for Placement Visualization

Yes (Blue)

No

pH & Barrier

10 pH
Cotton Rolls

13 pH
Rubber Dam - Gingival Barrier
(Soft Tissue Burn on Contact)

Sold

Direct Only

Dental Distribution
Only

Made in USA

Yes

No

Staining

Yes

Yes

Multiple Step Application

No

Yes



Vaseline


Advantage Arrest
Silver Diamine Fluoride 38%
eletec
Now Blue, Easier to Seal

VOCO
Profuorid® Varnish
SingleDose
Caramel
open here
0.40 ml
LOT 1820300
Exp. date 2020-05
CE 0462

Informed Consent

Use of SDF is an integral part of a total program of decay management, after consideration of the medical and dental needs of the individual patient and the informed consent of the parent or guardian.

<https://sites.google.com/site/jeremyahorst/sdfconsents?authuser=0>


 Patient Name: _____
Date of Birth: _____
Medical Record Number: _____

San Francisco Department of Public Health
Dental Services

INFORMED CONSENT FOR SILVER DIAMINE FLUORIDE

Facts for consideration:

- Silver diamine fluoride (SDF) is a liquid that helps stop tooth decay. SDF is applied every 3, 6 or 12 months.
- A small amount of SDF is applied to the decayed tooth area.
- After SDF application no eating or drinking for 60 minutes and no tooth brushing until the following morning.
- The decayed area will stain black permanently. Healthy tooth structure will not stain.
- I should not be treated with SDF if: 1) I am allergic to silver. 2) There are painful sores or raw areas on my gums or anywhere in my mouth.



Benefits of receiving SDF:

- Helps stop tooth decay.
- Fast.
- Do not need to numb teeth.
- Does not hurt.

Risks of receiving SDF:

- The affected area will stain black permanently. This means SDF is working.
- Tooth-colored fillings and crowns may discolor if SDF is applied to them.
- After SDF treatment, a filling or crown might still be needed.
- If accidentally applied to the skin or gums, a brown or white stain may appear that causes no harm, cannot be washed off and will disappear in one to three weeks.
- Permanent dark spots if spilled on clothing.
- Allergic reaction.
- Risk that the procedure will not stop the decay.
- Not every cavity can be treated with SDF.

Alternatives to SDF, not limited to the following:

- No treatment, which may lead to continued break down of the tooth. Symptoms may get worse.
- Placement of fillings or crowns, extractions or referral to a specialist.

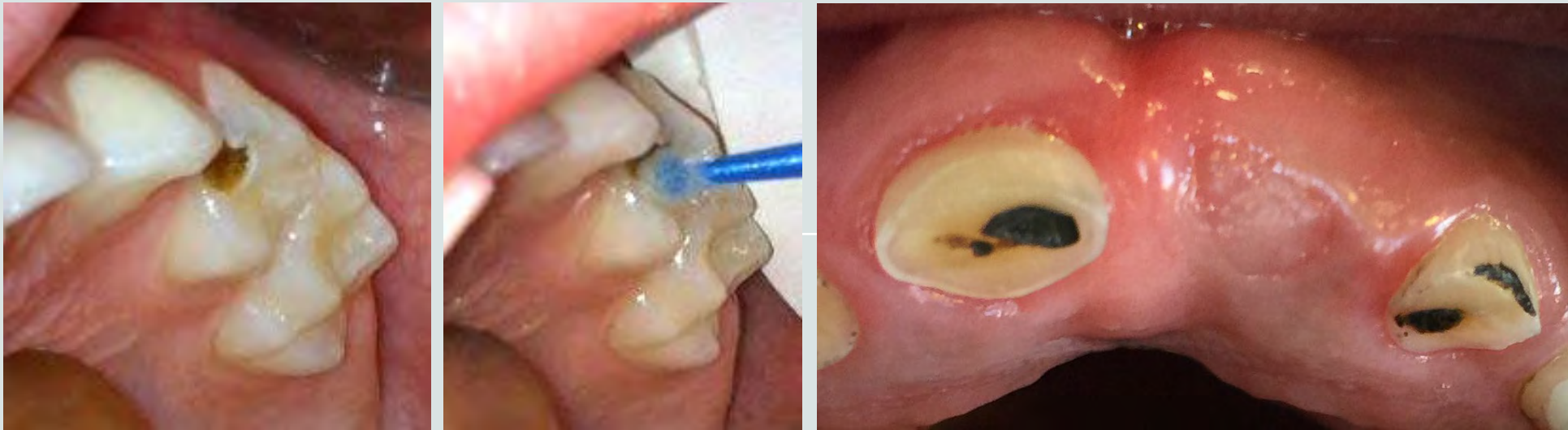
I have read this form. I understand the treatment and have had the chance to ask questions. I have seen the photo of how teeth may look after SDF discolors the cavities. I understand that I may refuse treatment with SDF. I understand that I can decide to have no treatment or I can have fillings, crowns, or extractions done at this or another dental office.

I consent and authorize SFDPH Dental Services to use Silver Diamine Fluoride to help stop tooth decay.

Signature of patient/parent/guardian: _____ Date: _____

Signature of witness: _____ Date: _____

How do you use it?



Lesion

1. Isolate
2. Air Dry
3. Apply with micro brush
4. Leave on for 1 minute
5. Protect with a layer of F varnish

Arrested cavities

How to place SDF (protect from staining)

1. Wear standard personal [protective equipment](#) (PPE), and make sure the patient is wearing safety glasses and plastic-lined bib.
2. [Dispense](#) one to two drops of silver diamine fluoride into a plastic dappen dish, depending on how many teeth you are treating. One drop will treat five surfaces.
3. Apply [scented lip balm](#) to the patient's lips or a dab of toothpaste on tongue to help mask the Slight odor (ammonia)
4. Use a saliva ejector when possible.
5. [Isolate](#) the tongue and cheek from the affected teeth using gauze or cotton rolls. Absorbent triangles work well.

How to place SDF (dry, apply, say goodbye)

6. [Dry](#) affected tooth surfaces with air or a cotton swab.
7. Immerse a microbrush into the solution in your dappen dish and remove any excess on the side of the well. This is best done with a dental assistant to avoid spilling.
8. [Apply](#) it directly onto the affected tooth surface(s) with the microbrush.
9. Allow the silver diamine fluoride to absorb for at least one minute when possible.
10. Remove the excess with gauze, a cotton roll, or a cotton-tip applicator (no need to rinse) or cover with fluoride varnish and say [good-bye](#)
11. Invert all used cotton, the microbrush, and the dappen dish into a glove so it can't drip on any surface or skin. Dispose of it in a trash can.

Protocol (Horst, Adv Dent Res 2018)

- Mild Caries: q 6 months
- Moderate Caries: q 6 months + One 2-6 week loading dose
- Severe Caries: q 6 months + Two 2-6 week loading dose + 3 months

Patient Acceptance of SDF Treatment

- Apple Tree Dental – obtained a Grant to see if SDF was a viable option that patients would select or reject. The results are compelling.

Facilities/Sites	Patients	Treatments Offered	Declined
41	563	1097	30

Only 2.7% Declined

Yasmi O. Crystal, DMD et. al.
JADA July 2017

- Staining on posterior teeth was more acceptable than staining on anterior teeth
- But most parents preferred this option to advanced behavioral techniques such as sedation or general anesthesia.



SDF Application in difficult to reach locations.



Photo courtesy Monica Savalli RDH, DDS



Person and Clinic Protection

Temporary staining of skin

- Rinse
- Will go away in days-weeks
- No harm

Permanent dark staining of clinic surfaces and clothes, instruments, etc.

- Does not come out after setting (exceptions).
- Clean immediately with copious water, ethanol, or high pH solvents such as ammonia.



Riva Star (SDF+KI)

pH :13

Recommendation: Restore with GI to prevent the restoration and margins from staining



SDF with KI is pH 13 and can severely "burn" soft tissues

Rubber dam recommended



Dr. Lina Jasulaityte



Rubber dam or gingival barrier **MUST** be used

Dr. Jeanette Maclean





Silver Modified Atraumatic Restorative Technique (SMART)

Same day SMART = SDF + GIC on the same appointment

The ideal method is to use clean perimeter margins (partial caries removal) after SDF placement. Then no systematic reviews will be violated.

TIPS ON HOW TO

Apply Silver Diamine Fluoride (SDF)

to Initial, Moderate, or Advanced Caries Lesions

1 Isolate



Dispense 1-4 drops in a dappen dish.
Isolate the teeth with cotton.
Protect the patient's eyes.

2 Dry

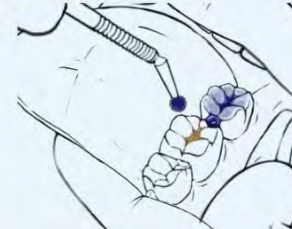


Thoroughly dry with cotton. Compressed air helps desiccate.
Help the patient keep their mouth open.
Removal of decay is not indicated.

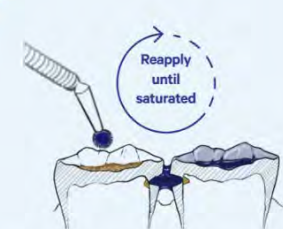
3



4 Apply



5



Apply to dry caries lesions. Re-apply every 5-10 seconds until the entire lesion stays wet.
Be careful of dripping. SDF stains.

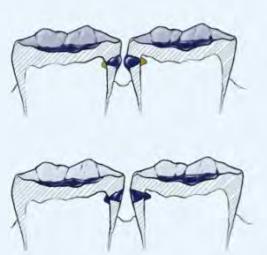
If treating approximal surfaces, simply apply to the embrasures. The liquid/gel will wrap around the contact point and flow by capillary action into the lesion.

6 Wait



Allow at least 10 seconds for SDF to absorb. During this time, the SDF will seep deeper into the caries lesion through capillary action.
Do not rinse. Do not blow compressed air.

7

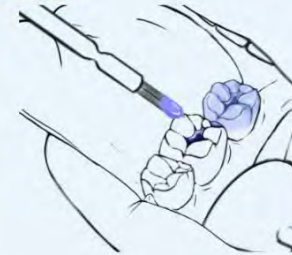


8 Remove excess



Remove excess with cotton.
Leave surfaces moist.

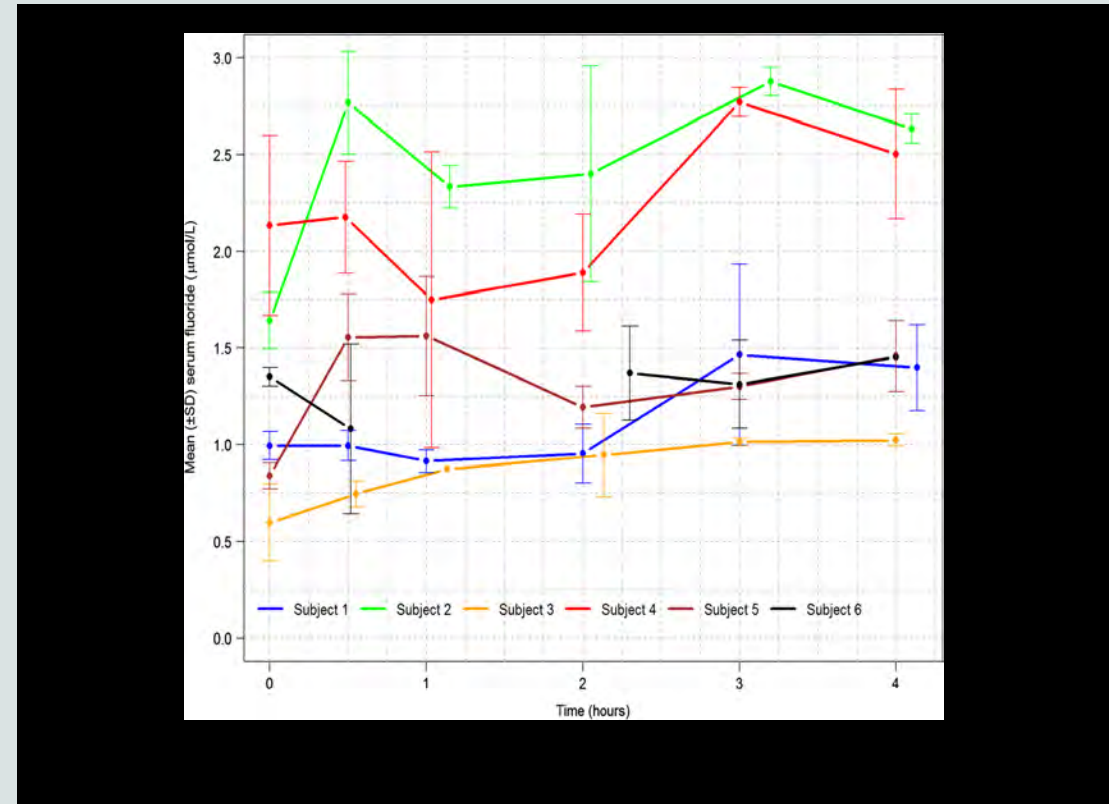
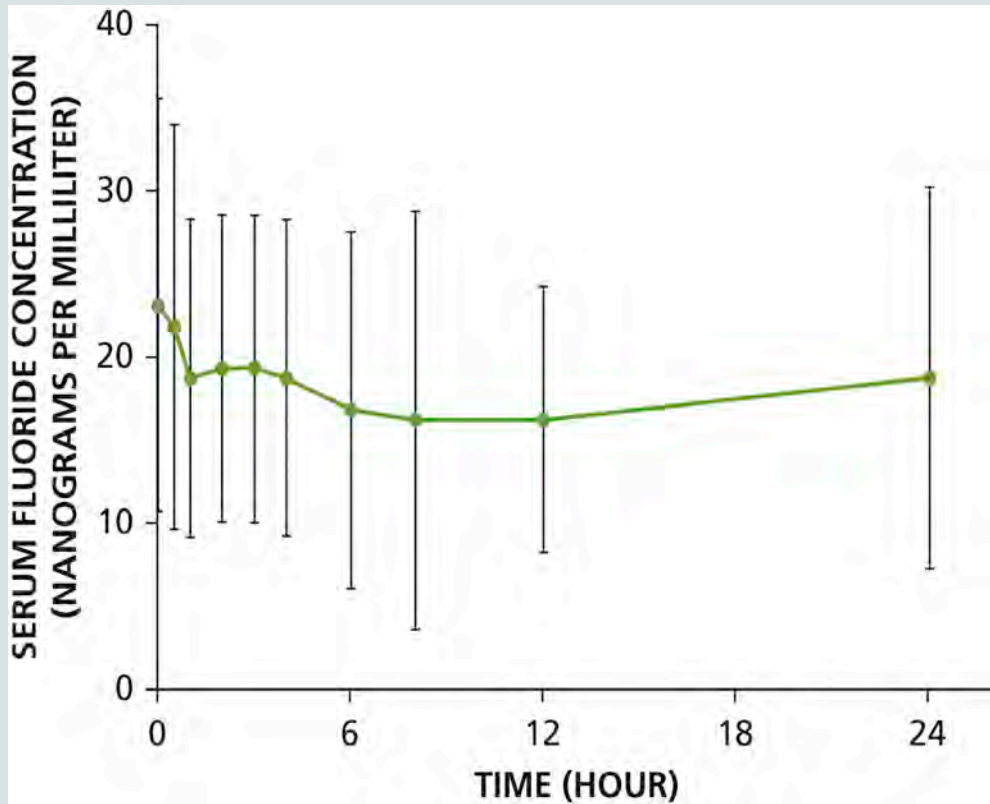
9 Protect



Option 1: cover the treated areas with fluoride varnish or petroleum jelly (e.g. Vaseline), then remove cotton.

Option 2: continue to isolate from saliva for 1 minute.

SDF does not increase blood Fluoride levels

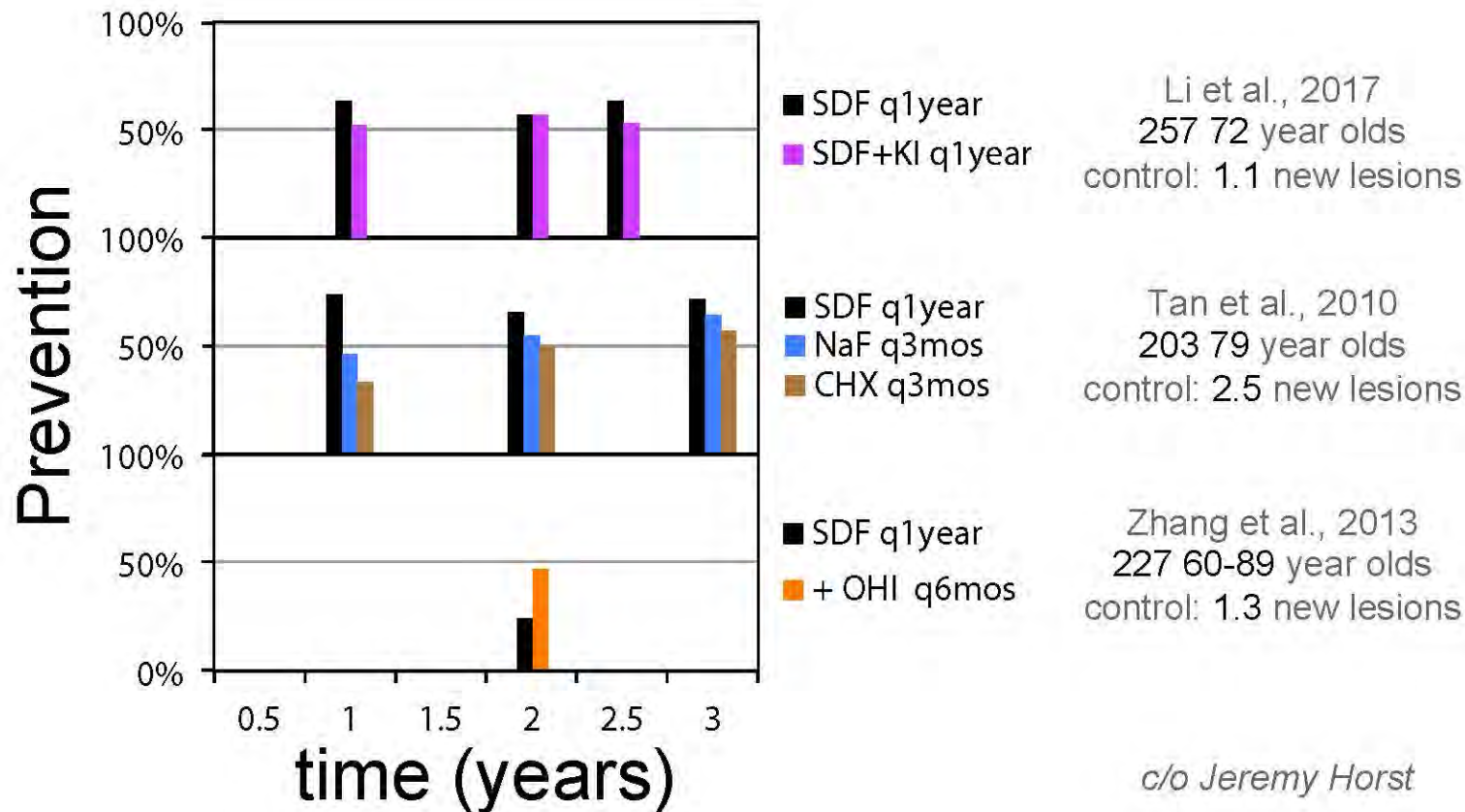


Vasquez.. Milgrom *BMC Oral Health* 2012

Lin .. Milgrom *JADA* 2019



Caries Prevention in the elderly

SDF prevents caries in root surfaces better than FV or CHX-Thymol.





Efficacy of 38% silver diamine fluoride in reducing gingival inflammation and plaque accumulation in older adults living in retirement-homes: A randomized controlled pilot trial

Amal Noureldin ^a, Wedad Alshehri ^b, Helena Tapias ^c, Lisa Mallonee ^d, Lloyd M. Mancl ^e,
Peter Milgrom ^e  , Kathy Svoboda ^f

SDF may have some beneficial effects on the gingival parameters, such as gingival inflammation, bleeding, and plaque accumulation. The mechanism by which SDF improves the gingival parameters is not fully understood, but some possible explanations are: SDF was reported to have antibacterial properties that can inhibit the growth of oral pathogens, such as *Streptococcus mutans*, *Porphyromonas gingivalis*, and *Aggregatibacter actinomycetemcomitans*, that are associated with dental caries and periodontal diseases [15]. By reducing the bacterial load in the oral cavity, SDF may help to prevent or reduce gingival inflammation and bleeding. SDF can also form a protective layer on the tooth surface, which may prevent the adhesion of plaque and biofilm [16].

Results

In the SDF group, within-group comparisons demonstrated significant reductions (adjusted $p < .05$) in GI scores within 3 weeks ($-.93 \pm .37$), as opposed to week 1 ($1.90 \pm .39$). Between-group comparisons unveiled reductions in both mean GI ($p < .05$) and PI ($p < .05$), indicating less gingival inflammation and plaque accumulation in the SDF group at all time points, commencing at week 3.

Conclusions

This study showed that 38 % SDF was effective in reducing gingival inflammation and plaque accumulation in older adults living in retirement-homes.

Codes

- D1354 - Interim caries arresting medicament application/tooth
- D1355 - Caries preventive medicament application/tooth
- D1206 - Professionally applied fluoride varnish
- D1208 - Topical application of fluoride (gels and foams) excluding varnish
- D9910 - Application of a desensitizing medicament, per visit
- D1999 - Unspecified preventive procedure by report

Codes (Contd.)

- D2940 – Protective Restoration

Example: GIC placed on SDF arrested caries with the intent to place a future restoration,

e.g. severely hypoplastic permanent molar

- D2941 - Interim therapeutic restoration

Example: GIC placed on SDF arrested caries with the intent to place a future restoration,

e.g. severely hypoplastic primary molar

- D3120 – Indirect pulp cap

Example: SDF + GIC placed on a deep caries lesion using selective caries removal

- D1351 – Sealant

Example: Low-viscosity GIC, placed over SDF arrested caries in non-cavitated, fissured grooves

- D2930 Stainless steel crown; Hall crown

Example: SDF placed before crown placement

Videos and Online Info

1. Jeremy Horst - YouTube
2. Minimally Invasive Caries Treatments by Dr. Jeremy Horst - YouTube
3. Affiliated Children's Dental Specialists <https://www.youtube.com/@affiliatedchildrensdental>
4. Silver Ion Antimicrobial Video Series - IHS.gov
<https://www.youtube.com/playlist?list=PLO3qFUkgk9V28oZp3cEODmUUmMeDzZv7U>
5. ADA <https://www.ada.org/resources/ada-library/oral-health-topics/silver-diamine-fluoride>
6. Care Quest Non-invasive caries therapy guide https://www.carequest.org/sites/default/files/2023-07/CareQuest_Institute_Non-Invasive-Caries-Therapy-Guide_071023.pdf
7. Curodont
https://info.youngspecialties.com/ce-live-curodont-maclean?fbclid=IwZXh0bgNhZW0CMTEAAR09L3s5IRJbsL8GZfeOIHI7g-BwMS5L_4jdXwGyVdAE-tvNUgmGBTqCj6s_aem_HxStRZpGAjgrqpXPsyPtgg
8. SMART Oral Health - The Medical Management of Caries [Home | SMART Oral Health](#)



Thank you

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