



SILVER DIAMINE FLUORIDE AND ITS USES

Nicholas Pray DMD
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WHO WE ARE



Dr. Nick

Board Certified Pediatric Dentist

Education:



1. BA: Bates College
2. DMD & Residency- Univ. of Connecticut

Moved back to Maine in 2022

Dr. Mills

Board Certified Pediatric Dentist

Education:

1. BA: Westminster College
2. DDS SUNY at Buffalo & Residency- Univ. of Connecticut
3. COHN Board of Directors



SOUTHERN MAINE PEDIATRIC DENTISTRY 2007

- Located in Portland, Maine
- Services provided
 - Preventative
 - Restorative
 - Surgical (IV sedation with PDAA & GA at MMC)
 - Minor Orthodontics
- Team



CARIES

- Most common chronic disease among youth ages 6-19
- Infectious and communicable disease
- Untreated can lead to pain and infection
- NOT self limiting



CARIES MANAGEMENT/ PREVENTION

- Early detection is vital (thus AAPD recommends first dental visit by age 1 or by eruption of the first tooth)
- Reduction in intake of freely fermentable carbohydrates
 - Limit the frequency of snacks
- Reduce dental plaque (through brushing, flossing, dental hygiene visits)
- Use of fluoride and topical antimicrobial agents (IE SDF)



TREATMENT OPTIONS FOR CARRIES

- Surgical approach

- Excision of the diseased tissues and restore tooth/ extract
- Irreversible



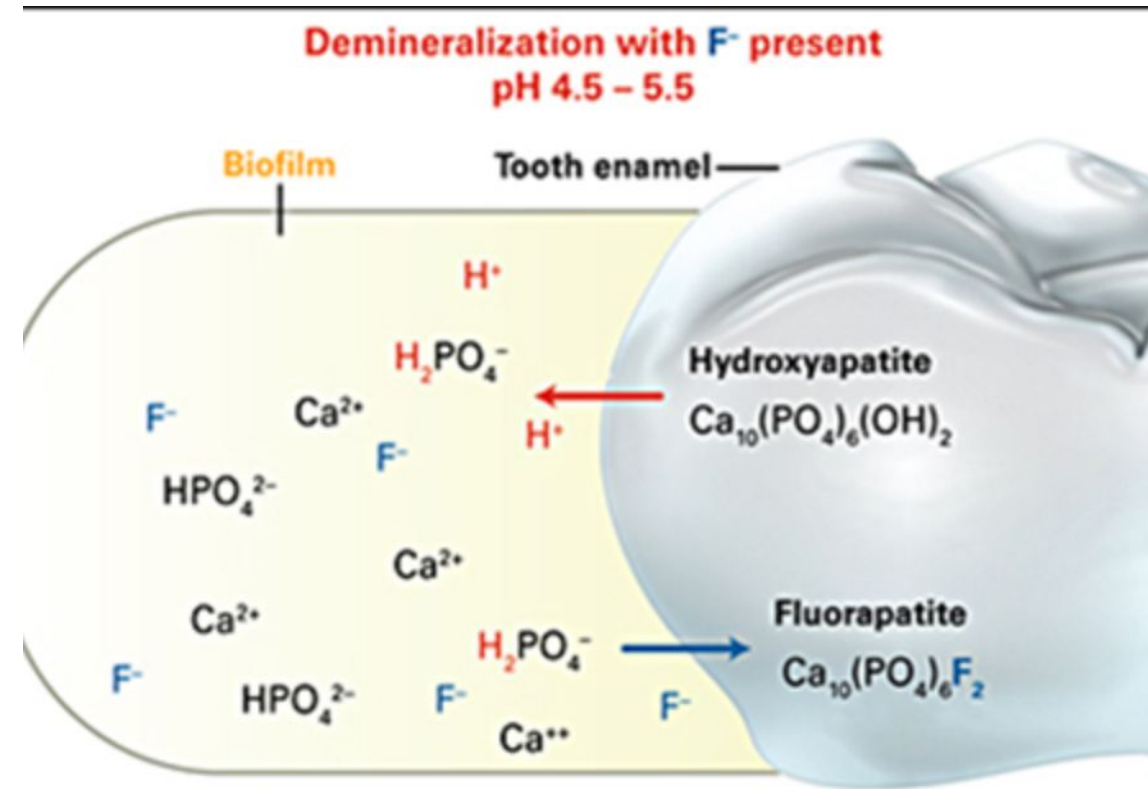
- Medical approach

- Use of fluoride therapy and antimicrobial agents (IE SDF)



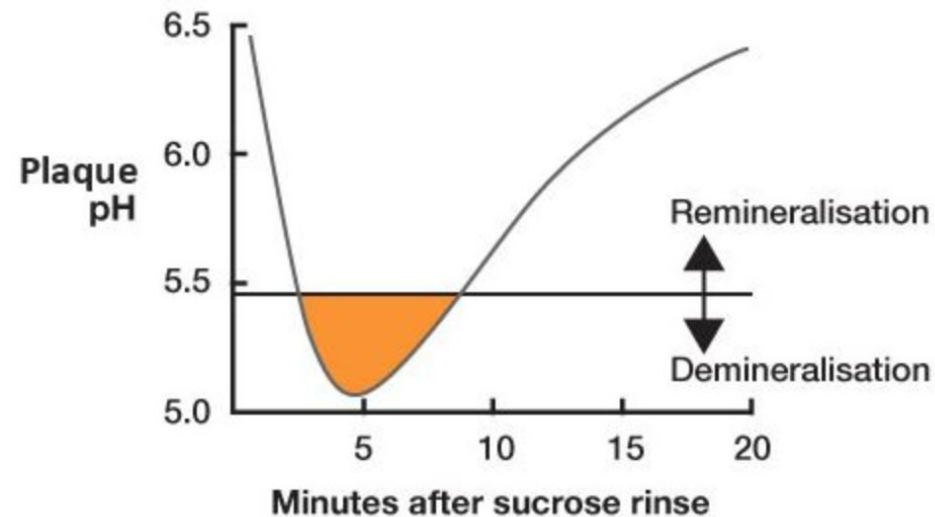
Fluoride mode of action

- Fluoride:
 - Acts in three important ways to prevent caries
 - 1: strengthening of enamel through fluorapatite
 - 2: remineralizing enamel
 - Enables parietal repair of the damaged crystals
 - Aids calcium phosphate precipitates at the enamel surface to recrystallize into a more acid resistant surface
 - 3: reduces acid production/ affects microbial metabolism in cariogenic bacteria



Fluoride antibacterial effects

- Saturates in plaque
- Inhibits plaque colonization through suspension of salivary proteins absorption onto enamel
- Forms hydrofluoric acid at low plaque pH
- Disrupts bacterial enzymes systems involved with glycolysis
- Enhances the proton permeability of the bacterial cell membranes



Communal water fluoridation



- Equitable and cost effective
- AAPD recommends standardization of water sources to 0.7ppm F level
- Balance the benefits of preventing dental caries while reducing the chance of fluorosis
- Recent studies suggest associated 18-30% decreases in caries prevalence

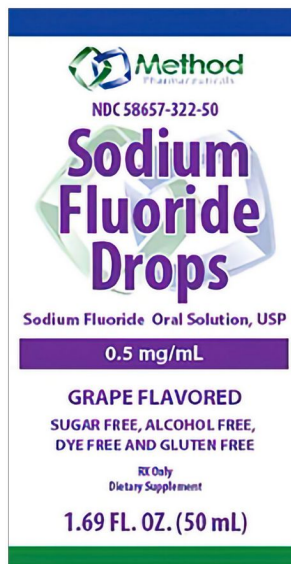
Food and drink fluoride

- “Halo effect” from foods and drinks prepared or grown in fluoridated communities and consumed in non-fluoridated communities
- USDA National Fluoride Database of Selected Beverages and Foods (ppm F)

Fats and oils:		
	Mayonnaise	0.09
	Margarine	0.05
	Margarine-like spread	0.25
	Salad dressing, mayonnaise type	0.04
	Salad dressings	0.27
	Vegetable oil, corn	0.01
Finfish and shellfish products:		
	Crab, canned	2.10
	Fish, cooked (includes broiled and fried)	0.18
	Fish sticks, baked	1.34
	Shrimp, canned	2.01
	Shrimp, fried	1.66
	Tuna, light, canned in water	0.19
	Tuna, canned in oil, drained	0.31
Fruits and fruit products:		
	Apple, raw, with peel	0.03
	Applesauce, sweetened	0.05
	Avocado, raw	0.07
	Bananas, raw	0.02
	Cantaloupe, raw	0.01
	Cherries, sweet, raw	0.02
	Cranberry sauce	0.02
	Fruit cocktail, canned	0.09

Fluoride supplementation

- Research suggest effective in reducing prevalence of caries
- Available as drops and chewable tablets
- Consider for children at high caries risk who drink fluoride deficient water
- Review all other fluoride sources before prescribing to help limit risk of fluorosis



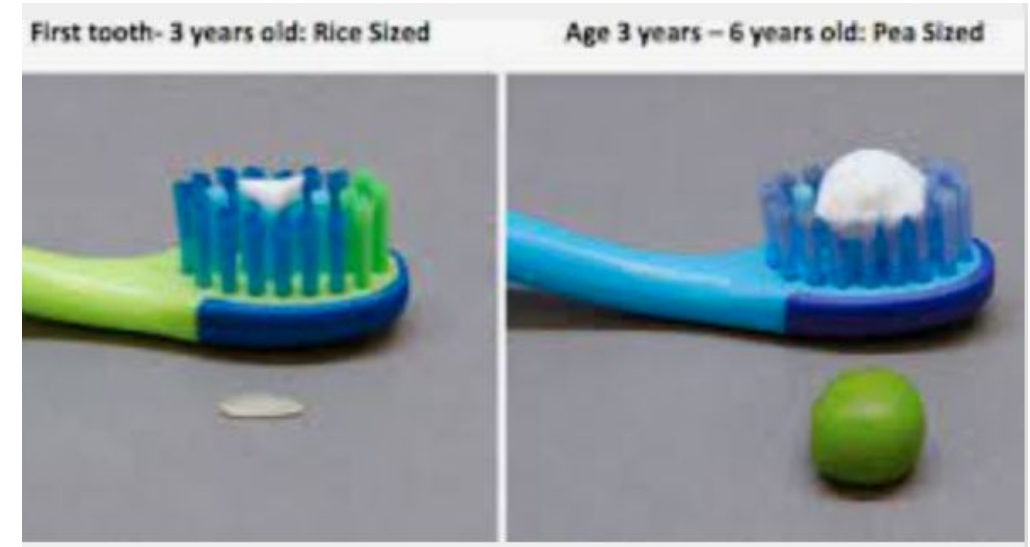
Supplementation Schedule by Age

Table. DIETARY FLUORIDE SUPPLEMENTATION SCHEDULE

Age	<0.3 ppm F	0.3 to 0.6 ppm F	>0.6 ppm F
Birth to 6 months	0	0	0
6 mo to 3 years	0.25 mg	0	0
3 to 6 years	0.50 mg	0.25 mg	0
6 to at least 16 years	1.00 mg	0.50 mg	0

Toothpaste

- More than 70 studies support its effectiveness
- More effective with regular supervised use for children
 - Best to minimize or eliminate rinsing afterwards
 - Amount based upon age
- Should be used from eruption of teeth to age 3: smear
 - From age 3-6: a pea sized dollop
- Children should spit out and not swallow toothpaste
- Have parents brush as long as needed, on average kids at 7 can become independent



Mouthwash

- 0.05% sodium fluoride 200 ppm F
- Most intended for use once daily
- Some research indicated more pronounced effects on maxillary teeth and proximal surfaces

CURBSIDE



(price/case)listerine Smart Rinse
Berry Splash 6-500 Milliliter



Listerine Smart Rinse for Kids 6+
Mild Berry 500ml

Prescription fluoride toothpastes mouthwashes

- Gels and pastes (0.5% fluoride)
 - Pastes contain abrasives
- Mouthwashes (0.09% fluoride)
- Studies support their use in preventing caries
 - Less research on permanent teeth and root caries
- NOT recommended for children under the age of 8
 - Swallowing risk outweigh the benefits

Professionally applied topical fluorides

- Effective in decreasing caries prevalence
- research supports the use of fluoride varnish over foam
- Recommended every 6 months for children at risk of caries



Fluoride foam and varnish

- Foam:

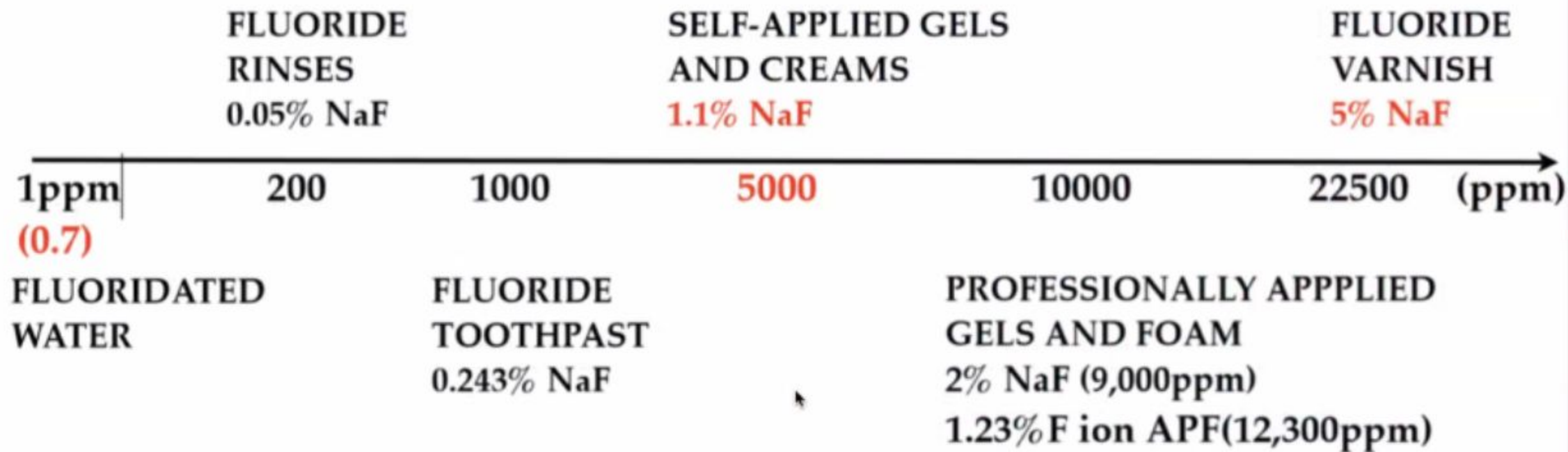
- 5% acidulated phosphate fluoride foam contains 12,300 ppm F
- Recommended 4 min treatment time
- fill trays $\frac{1}{3}$ - $\frac{1}{2}$ full
- Place both trays simultaneously
- Patient upright and leaning slightly forward

- Varnish

- Colored and white varnishes are available
- 5% sodium fluoride varnish contains 22,500 ppm F
- Apply to clean and dry teeth
- Fast and well tolerated
- Typically avoid eating and drinking for 30min after use (follow enclosed instructions for each product, this varies)



FLUORIDE ION CONCENTRATION (ppm)



SDF: HISTORY AND BACKGROUND

- 38% silver fluoride
- Pioneered by Dr Nishino and Yamaga in Japan. They pioneered it to combine the actions of Fluoride and Silver.
- First SDF product was Saforide in 1970
- Used extensively outside of the US since then
- Classified by the FDA in 2015 as a class II medical device for treatment of dentin hypersensitivity
 - Now used off label for caries management and arrest

SDF: MODE OF ACTION

- Silver is antimicrobial
- Gives strong antibacterial effects on cariogenic biofilm
 - Potent inhibitory effects on activity of matrix metalloproteinases, bacterial collagenases and cysteine cathepsins- proteins that break down exposed dentin
 - Breaks cell wall membranes
 - Denatures proteins
 - Inhibits DNA replication
 - Ionic silver deactivates nearly any macromolecule
- Treated lesions have a increased mineral density and hardness and decreased lesion depth



SDF GOALS OF USE

- SDF is an inexpensive, non-invasive medicament that is applied topically and can arrest caries progress
- SDF does not restore form and function of the tooth
- SDF is an effective interim therapy used as part of a comprehensive treatment plan supervised by a dentist with a dental home



INDICATIONS



- Difficult to treat carious lesions
- Carious lesions in patients with extreme caries risk
- Patients with carious lesions that may not be treated in one visit
- Treatment challenged by behavioral and medical management
- Patients without access to care
- Patients waitlisted for OR based dental tx (long OR wait time)
- Hypersensitive teeth (Molar Incisor Hypoplasia)



DOSE

- One drop (approx 25 ul) contains 9.5mg SDF and it is recommended for up to 5 teeth per treatment
 - For a very small child of 10kg that would equal dose of .95mg/kg
- UCSF recommends 1 drop per 10kg per treatment visit
- It is safe and you really only need one drop!

ADVERSE EFFECTS: SIDE EFFECTS

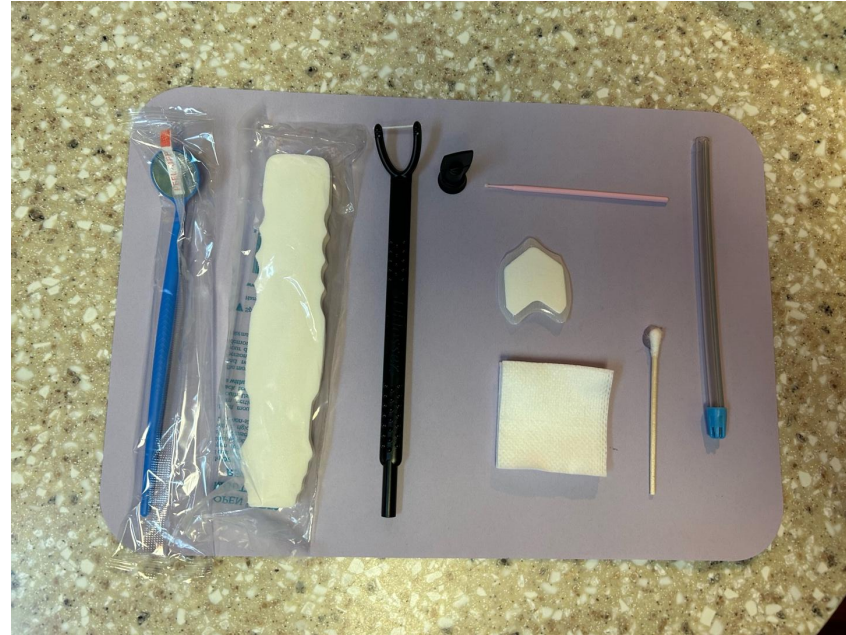
- Most common side effect:
 - Small mildly painful white lesion in the mucosa
 - Disappears in 48 hours without treatment
 - Found in 3 of 1,493 patients in 9 RCTs reviews (Horst, 2016)
- No adverse pulp response noted
- No evidence of fluorosis
- Minimal gingival response (some report mild redness of the gingiva surrounding the treated tooth, goes away after 7 days)
 - Reduce risk by only using 1 drop, using the smallest microbrush possible, dab side of dampen dish to remove excess liquid prior to application

COLOR CHANGE

- SDF causes darkening of the carious lesion
- Bitter taste
- “Temporary tattoo” on skin
 - Resolves without intervention after 14 days
 - Can remove with hydrogen peroxide
- Stains clinic clothing permanently



SET UP



The Reference Manual of Pediatric Dentistry

Definitions
Oral health policies
Recommendations
Endorsements
Resources
2023-2024



Chairside Guide: Silver Diamine Fluoride in the Management of Dental Caries Lesions*

Dental caries affects approximately 40% of children age six through ten years. Silver Diamine Fluoride (SDF) is a naturally occurring silver salt that is included in many of the most commonly used dental products. Clinical studies have shown SDF can be used to arrest dental caries and prevent progression of dental caries. SDF can be used to arrest dental caries and prevent progression of dental caries.



- Characteristics for application of silver diamine fluoride**
- Patients who may benefit from SDF include those:
 - with high caries risk who have untreated caries
 - treated in caries or previous caries
 - presenting with behavioral or medical challenges that hinder oral care and caries lesions
 - with multiple untreated caries lesions that have not all been treated or cured
 - with dental appointments that are difficult to attend
 - without access to or only difficulty accessing dental services
 - Patients do not exhibit contraindications:
 - are free of signs of pulpitis/pulpitis or signs of local inflammation/pain
 - untreated caries lesions that are not extending to the pulp. If possible, radiograph should be taken to assess depth of caries lesions
 - untreated caries lesions are not active or large or that are severely weak or break the surface of SDF. Precautionary application may be used in fully grown areas to prevent future?
 - SDF can be used after restorative placement and a set of white enamel bonding. SDF should be used periodically highlighting repaired caries. It should be used periodically on all teeth and should not be used on the temporaries for those cases, if appropriate.
- Clinical application of silver diamine fluoride**
- Remove gross debris from caries or other forms of tooth decay (dental debris)
 - Remove dental restorative prior to SDF application to avoid caries beneath the restorative. If this is not possible by clinical means, SDF should be applied to the restorative.
- Application of silver diamine fluoride**
1. A generous amount may be applied to the top and sides of the caries to completely cover the area. Avoid the use of SDF on the lingual surface of upper teeth.
 2. Rub the paste on the tooth with a cotton swab or a similar tool. The paste should be applied to the tooth for 1-2 minutes. Avoid the use of SDF on the lingual surface of upper teeth.
 3. Consider about 10 days after applying SDF to the caries. SDF should be applied to the caries for 1-2 weeks. SDF should be applied to the caries for 1-2 weeks.
 4. Consider application with a cotton swab or a similar tool. The paste should be applied to the tooth for 1-2 minutes. Avoid the use of SDF on the lingual surface of upper teeth.
 5. The silver diamine fluoride should be applied to the caries for 1-2 minutes. Avoid the use of SDF on the lingual surface of upper teeth.
 6. The silver diamine fluoride should be applied to the caries for 1-2 minutes. Avoid the use of SDF on the lingual surface of upper teeth.
 7. The silver diamine fluoride should be applied to the caries for 1-2 minutes. Avoid the use of SDF on the lingual surface of upper teeth.
 8. The silver diamine fluoride should be applied to the caries for 1-2 minutes. Avoid the use of SDF on the lingual surface of upper teeth.



INSTRUCTIONS FROM AAPD

- Remove gross debris from cavitation to allow better SDF contact with denatured dentin
- Carious dentin excavation prior to SDF application is not needed.
- Protective coating of Vaseline may be applied to the lips and skin to prevent temporary henna- appearing tattoo
- Isolate areas with cotton rolls ideally. Ideally have teeth dry when applying



INSTRUCTIONS FROM THE AAPD

- Dry lesion with gentle flow of compressed air
- Bend micro brush. Dip brush into SDF and dab on the side of the plastic dappen dish to remove excess liquid before application. Apply SDF directly to only the affected tooth surface. Remove excess SDF with gauze, cotton roll, or cotton pellet to minimize systemic absorption.
- Application time should be at least one minute if possible (application time likely will be shorter in very young or poorly behaved patients)
- If treating caries between teeth, use super-floss (place cotton portion between the teeth and then dab SDF onto cotton super-floss)
- Try to keep isolated and dry for 3 minutes after application
- The entire dentition may be treated after SDF treatment with 5% sodium fluoride varnish to help prevent caries on teeth not treated by SDF.

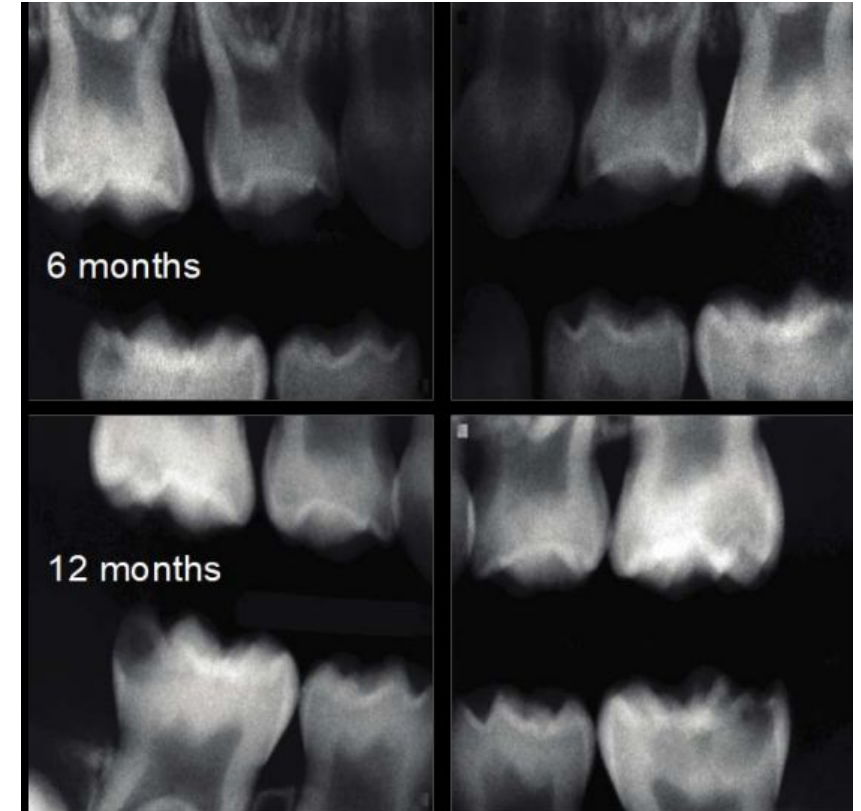
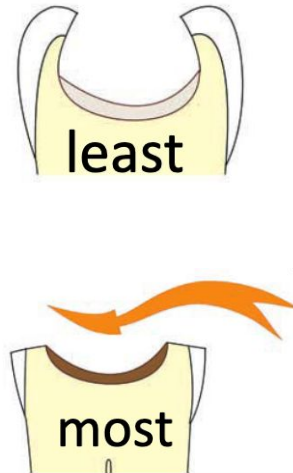
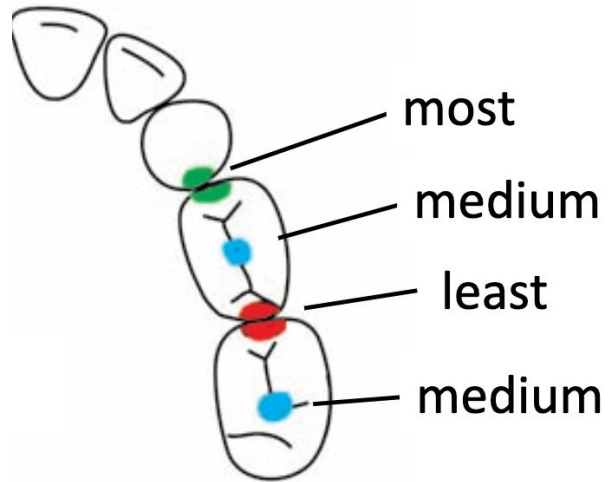


APPLICATION FREQUENCY AND FOLLOW UP

- 47-90% estimated efficacy and one time application
 - Depending on the size of the cavity and tooth location
 - Anterior teeth have higher rate of caries arrest
- Follow up at 2-4 weeks after initial treatment
 - Check to see if lesion is arrested
 - Reapply if the lesion is not dark and hard
- Ideally restore lesion after SDF treatment when able
- If lesions not restored, biannual reapplication shows increase caries arrest rate

WHICH CAVITY TYPE IS BEST TREATED WITH SDF?

- SDF likely to arrest cleansable lesions
- SDF less likely to arrest non-cleansable lesions



Okay now it's my turn

Practical Applications



Two brands Currently Available



pH 10



pH 13

Short basic how to



CDT Codes:

Silver Diamine Fluoride

- **D1355 Primary Prevention/Remineralization: Caries Preventive Medicament Application**

- **D135**

- **D991**

**So how am I
using this????**

- **0792T **NEW** CPT Code. Approved Dec 2022, Effective 7/1/2023: Application of silver diamine fluoride 38%, by a physician or other qualified health care professional**

Here are four...or five... examples...
1. Planning for the OR in 6 months



I can restore this Composite strip crown



CLINICAL PHOTOS



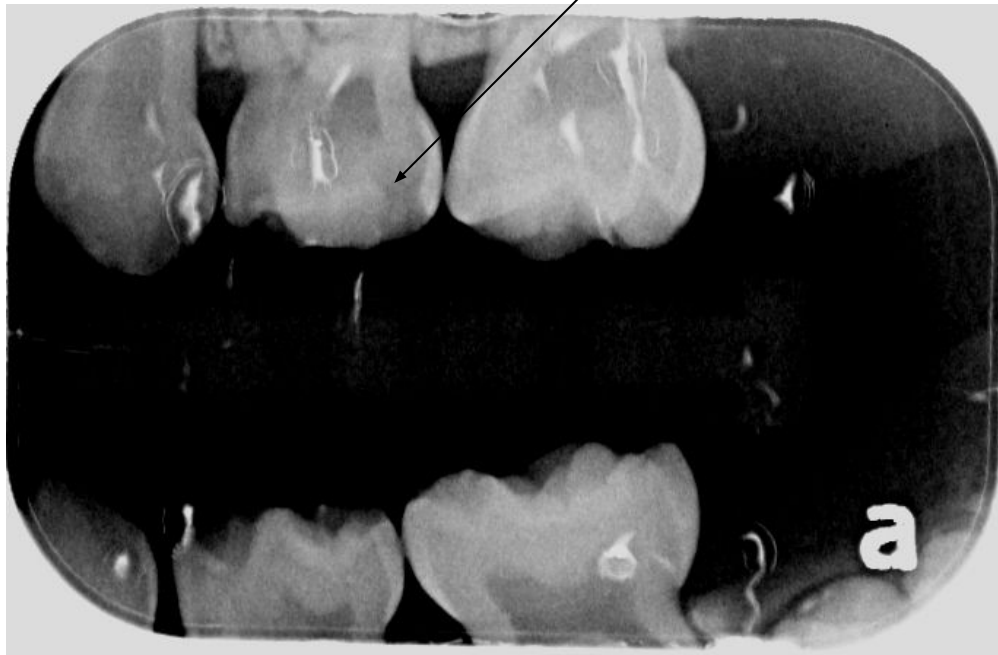
Active cavitated caries lesions before application of SDF

SDF-treated lesions with temporary gingival staining



CARIES ON PRIMARY MOLAR – TX WITH SDF

Large Carious lesion tooth 1



First and second application

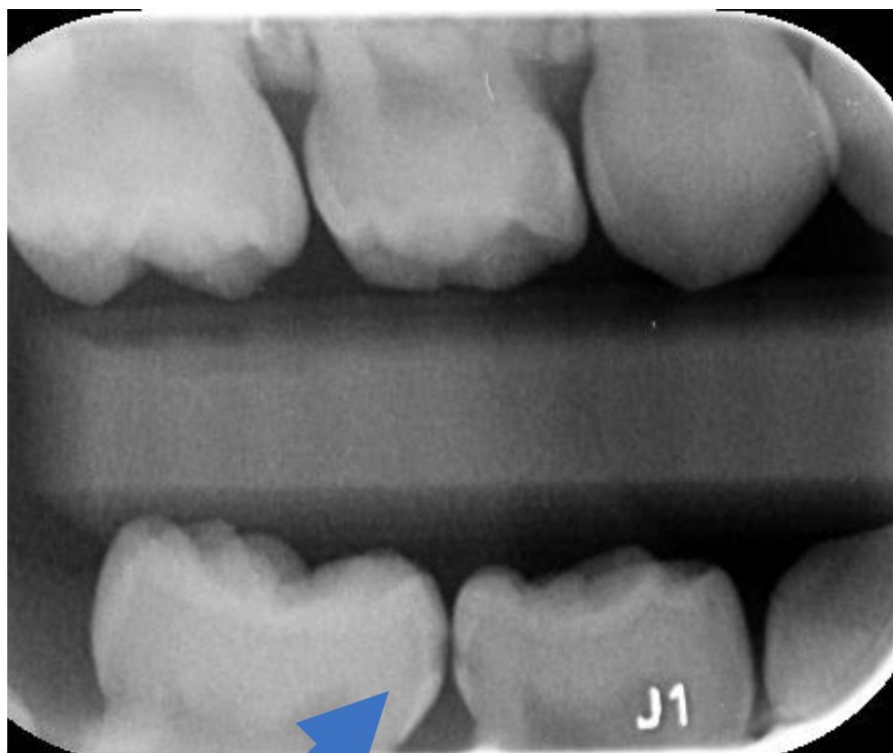


So...Success or Failure?

**2. 9 ½ year old, root resorption has begun
Cried when he heard about a cavity**



3. This used to not be an issue. 4 years old a little nervous

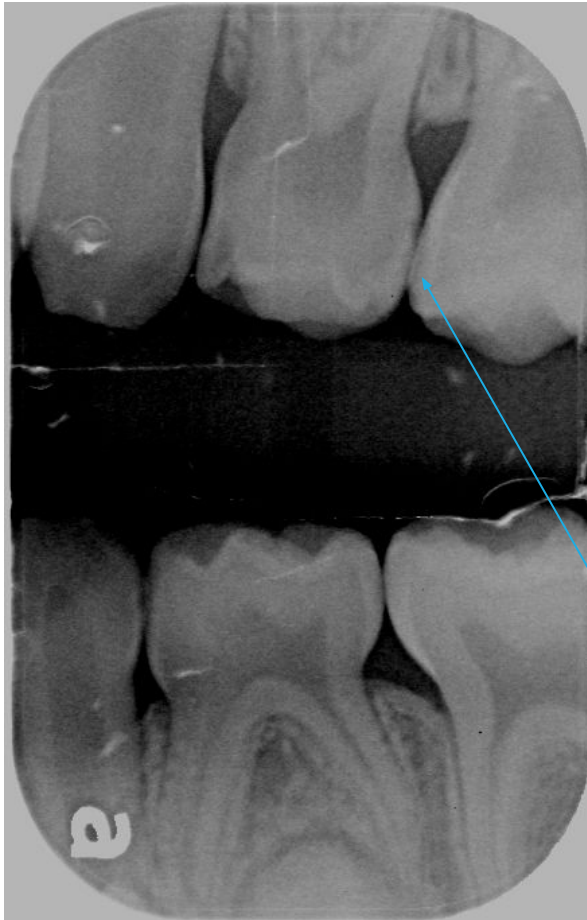


How we would do this (one way)

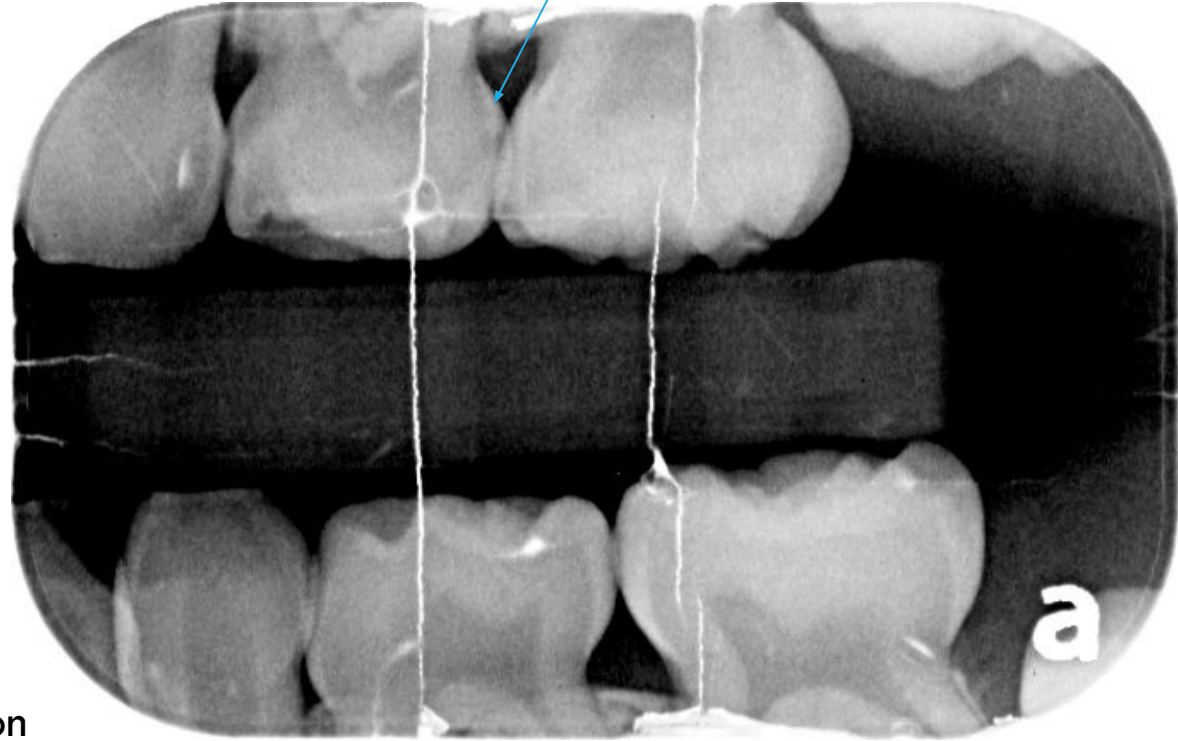


INTERPROXIMAL LESIONS

Growth Past the DEJ



Small lesion
in enamel
only

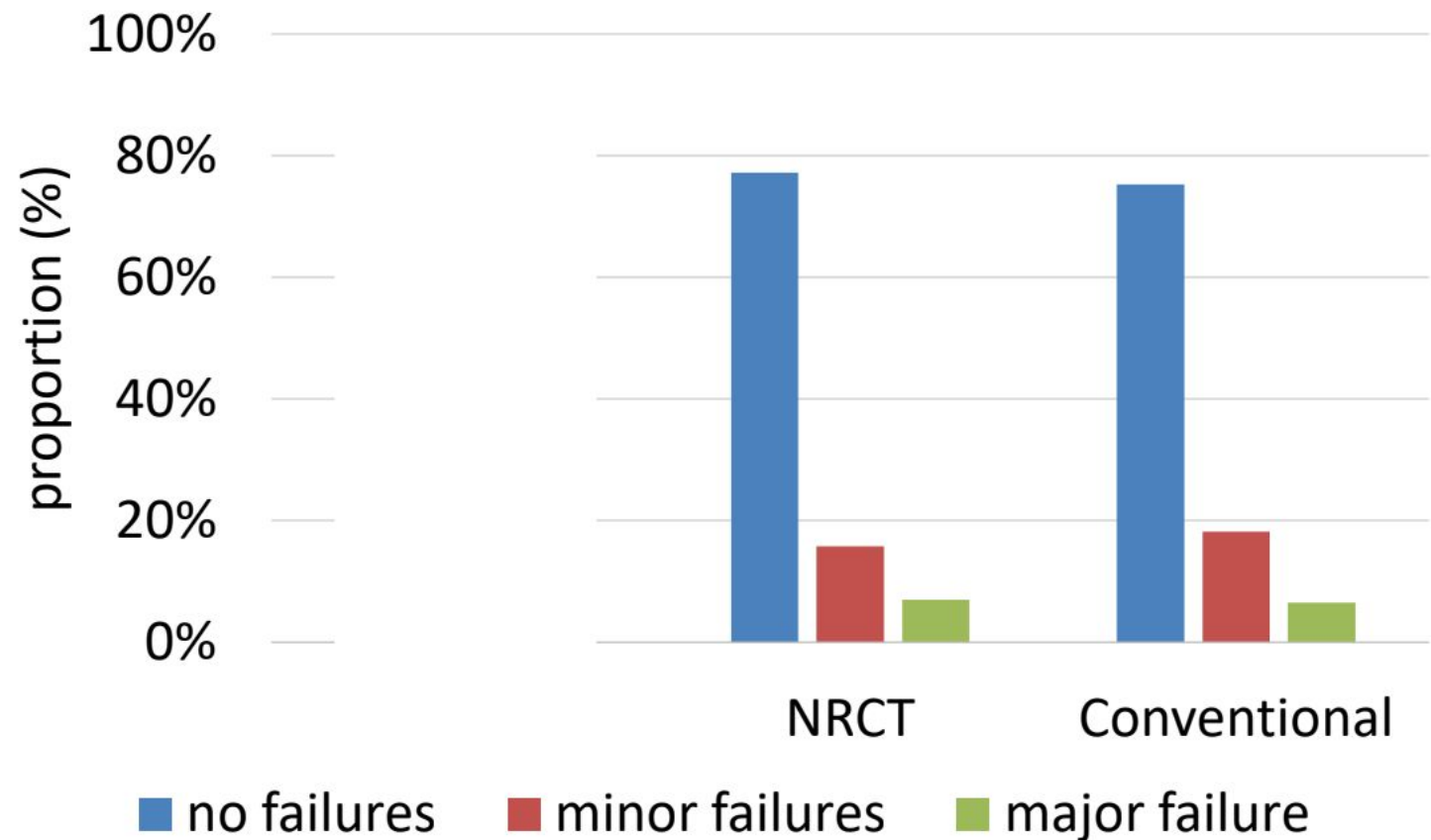


FAILURE



FAILURE RATE

- Clinical trail in Germany by pediatric dentists
- 2.5 year follow up
- n= 148 children
- Minor failure: ~15%
 - Tooth needing restoration
- Major failure: ~7%
 - Tooth needing extraction



BEFORE & AFTER

2 month follow
up



Small lesion in
enamel

New Carious lesion-
apply SDF



FAILURE



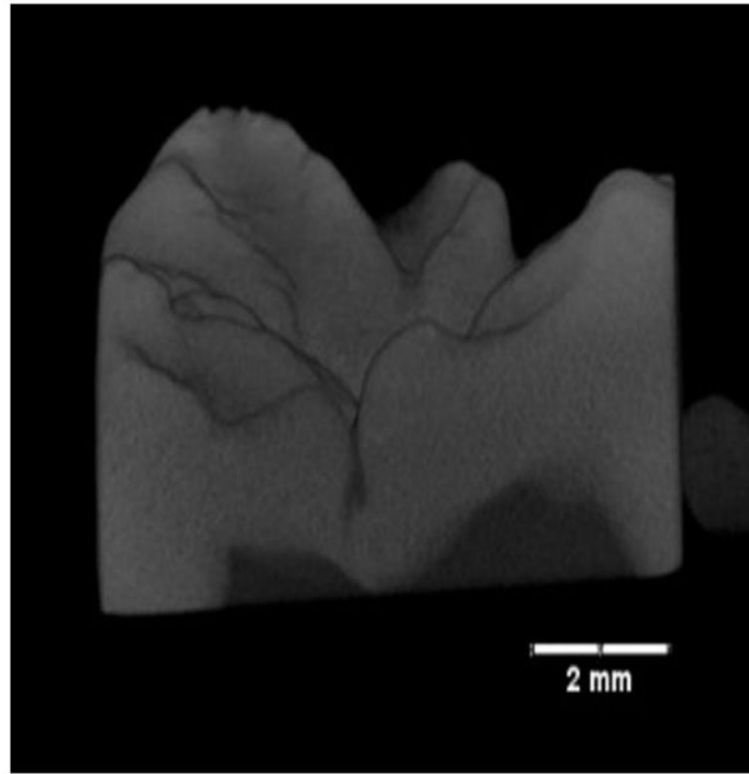
4. Molar/Incisor Hypomineralization MIH



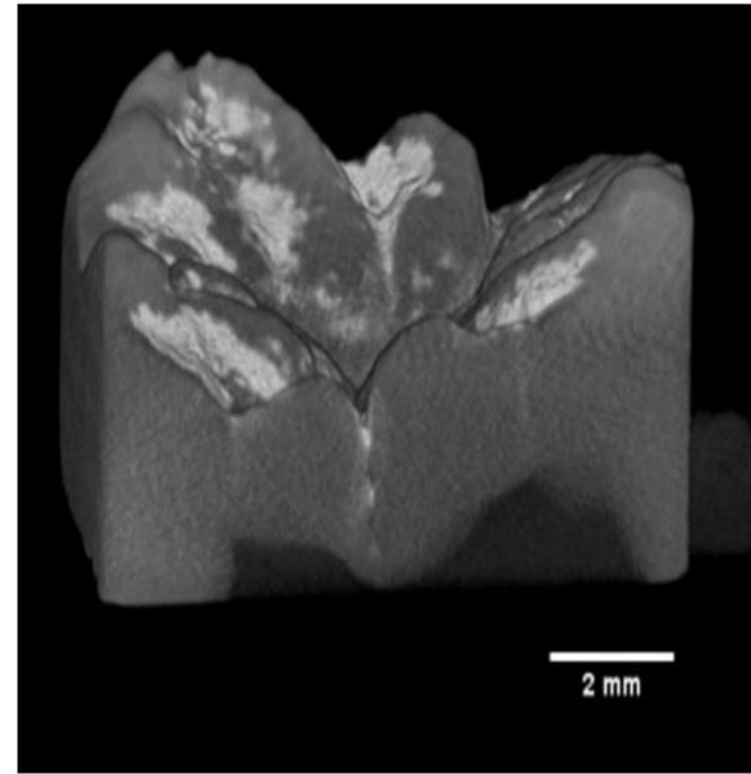
FIG. 1

Something sort of new

3-D CT-scan Shows Silver Sealing Fissures



Before SDF application (cross section)



After SDF application (cross section)

Courtesy Dr. Edward Lo, U Hong Kong

Pre and Post Treatment with SDF




Courtesy Travis Nelson, University of Washington

Nonrestorative Treatments for Caries: Systematic Review and Network Meta-analysis

Journal of Dental Research
2019, Vol. 98(1) 14–26
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for Dental Research 2018



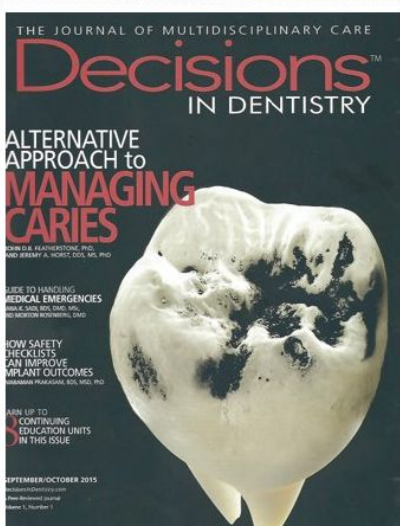
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38% silver diamine fluoride solution applied biannually was the most effective for arresting advanced cavitated carious lesions on any coronal surface (moderate to high certainty).

Abstract

The goal of nonrestorative or non- and microinvasive caries treatment (fluoride- and nonfluoride-based interventions) is to manage the caries disease process at a lesion level and minimize the loss of sound tooth structure. The purpose of this systematic review and network meta-analysis was to summarize the available evidence on nonrestorative treatments for the outcomes of 1) arrest or reversal of noncavitated and cavitated carious lesions on primary and permanent teeth and 2) adverse events. We included parallel and split-mouth randomized controlled trials where patients were followed for any length of time. Studies were identified with MEDLINE and Embase via Ovid, Cochrane CENTRAL, and Cochrane Database of Systematic Reviews. Pairs of reviewers independently conducted the selection of studies, data extraction, risk-of-bias assessments, and assessment of the certainty in the evidence with the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach. Data were synthesized with a random effects model and a frequentist approach. Forty-four trials (48 reports) were eligible, which included 7,378 participants and assessed the effect of 22 interventions in arresting or reversing noncavitated or cavitated carious lesions. Four network meta-analyses suggested that sealants + 5% sodium fluoride (NaF) varnish, resin infiltration + 5% NaF varnish, and 5,000-ppm F (1.1% NaF) toothpaste or gel were the most effective for arresting or reversing noncavitated occlusal, approximal, and noncavitated and cavitated root carious lesions on primary and/or permanent teeth, respectively (low- to moderate-certainty evidence). Study-level data indicated that 5% NaF varnish was the most effective for arresting or reversing noncavitated facial/lingual carious lesions (low certainty) and that 38% silver diamine fluoride solution applied biannually was the most effective for arresting advanced cavitated carious lesions on any coronal surface (moderate to high certainty). Preventing the onset of caries is the ultimate goal of a caries management plan. However, if the disease is present, there is a variety of effective interventions to treat carious lesions nonrestoratively.



Informed Consent: Critical

Maine Board
of Dental Practice
website accessed
Mar 11, 2024

- "admits to the following: 1) failure to obtain patient written acknowledgment that she was not a dentist and that the services that were to be rendered did not constitute restorative care or treatment during the period January 30, 2021 through February 28, 2021; 2) failure to provide patients a written plan for referral to a dentist for necessary dental care; 3) failure to have a written agreement with a licensed dentist during the period January 30, 2021 through February 28, 2021, providing that the licensed dentist would be available to interpret all dental radiographs within 21 days from the date a radiograph was taken, and that the dentist would sign a radiographic review and findings form; **4) by applying silver diamine fluoride and failing to obtain written informed consent from patients that identified the risks, benefits, contraindicators, and alternatives to the treatment;** and 5) failure to maintain complete patient records."

Handout from Maine Health, and only Maine Health

Patient Name: _____
MRN: _____ DOB: _____
Treatment Location: _____

I. DESCRIPTION, PURPOSE, AND BENEFITS OF TREATMENT: I hereby consent to and authorize my physician or their licensed designee, as appropriate, and others who may be involved in my care (including resident physicians, other trainees, and medical and other students) to perform the following treatment(s): **Dental Application of Silver Diamine Fluoride (SDF)**

Silver diamine fluoride (SDF) is applied to your child's teeth to stop tooth decay and decrease tooth discomfort. SDF is brushed onto the teeth. SDF causes the decayed part of the tooth to be permanently black. It does not hurt. It cannot be used if there are sores or raw areas on the gums. The teeth should remain dry for 1 minute after SDF is applied. You child cannot eat or drink for 1 hour after SDF is applied.

The physician providing the treatment(s) or their licensed designee has explained to me the nature and purpose and the expected benefits of the proposed treatment(s). I, further, consent to such additional treatment as is considered advisable based on findings during the above-described treatment(s).

II. RISKS ASSOCIATED WITH THE TREATMENT: The physician recommending the treatment(s) or their licensed designee has explained to me the usual and most frequent risks and hazards involved in this treatment(s), which may be affected by my particular co-morbidities, including the following:

Allergic reaction, metallic taste, staining of fillings, crowns, gums, skin, and the unhealthy part of teeth not under active treatment. The tooth decay progresses and requires further treatment, such as repeat SDF, fillings, crowns, root canals, and/or teeth removal.

III. ALTERNATIVE COURSES OF TREATMENT: The physician recommending the treatment(s) or their licensed designee has explained to me the risks and benefits of any reasonable alternatives to the proposed treatment(s) and the risks and benefits of refusing the proposed treatment(s). Alternatives to the proposed treatment(s) include, but are not limited to, the following: Not having this treatment. No treatment with SDF. Fluoride varnish may be used instead of SDF but it does not stop tooth decay as definitively as this treatment. Without SDF, decay may worsen which may cause pain. A referral to dentist is an option for a filling, crown, or tooth removal.

IV. COMPANY REPRESENTATIVE: I have been informed that a company representative may observe the treatment(s) to provide technical information or gain knowledge useful in the development of medical devices. The representative will not use devices but will have minimal information about me. I hereby consent to the presence of the representative UNLESS the "Decline Representative Presence" box is checked.

Not Applicable **DECLINE Representative Presence**

I understand that I have the right to refuse any suggested treatment(s). I further understand that the practice of medicine is not an exact science, and practitioners cannot guarantee results. No guarantees have been made to me concerning the results of the proposed treatment(s).

I acknowledge that I have read this form, that I understand the nature and purpose of the treatment(s), benefits and risks, alternatives, and expected results of the planned treatment(s) and services for me, and that I have had ample time to ask questions and to consider my decision.

_____	_____	X	_____
Date	Time AM PM	Signature <input type="checkbox"/> Patient <input type="checkbox"/> Parent <input type="checkbox"/> Guardian <input type="checkbox"/> Authorized Representative	Printed Name
If by telephone consent given by: <input type="checkbox"/> Patient <input type="checkbox"/> Other		_____	Phone number _____
_____	_____	X	_____
Date	Time AM PM	Witness Signature (For phone consent or when patient is physically unable to sign)	Printed Name
Interpreter for: <input type="checkbox"/> Sign Language <input type="checkbox"/> Foreign Language <input type="checkbox"/> Other		_____	Print Name or identifying information _____
_____	_____	X	_____
Date	Time AM PM	Signature of Physician or Licensed Designee	Printed Name

Strongly recommend something like this Handout Color Pictures are GREAT!!!!

Deciding about Silver Diamine Fluoride

Silver Diamine Fluoride (SDF) is a liquid made up of fluoride and silver particles to help stop cavities from getting worse. SDF stops cavities by killing the bacteria in the tooth that causes decay and helps keep the tooth healthy. SDF can be used in a dental office or a doctor's office.

How is SDF applied?

Your provider will take a small amount of the liquid SDF and put it on any areas of your teeth that have a cavity. Your provider will put a fluoride varnish over all of your teeth after they put on SDF. This helps stop cavities in other parts of your mouth and prevents any bad taste from the treatment.

Typically, 2 treatments of SDF are needed. The second treatment is 6 months after the first application.

What are the benefits of SDF?

- SDF treatment is quick and painless.
 - Because you won't have a long wait time, SDF is a good option for small children, young children, or children with intellectual or developmental disabilities that have problems with normal dental treatment or normally require sedation at the dentist.
- SDF can stop cavities from getting worse.
- SDF delays or prevents the need for more invasive dental treatments.
- SDF is an accessible option for children who have limited access to a dentist.

What are the risks of SDF?

- SDF will permanently stain the cavity in your teeth black. The black color means that treatment is working. If SDF accidentally gets on your gum or lips, it will temporarily turn the area brown for up to 3 weeks. Healthy parts of your teeth will NOT be stained.
- SDF contains silver and should NOT be used if you have a silver allergy.



What else is important for me to know?

There are other treatment options that a dental provider can offer to fix a cavity. A dental provider can treat cavities with a filling, crown, or by removing the tooth.

- If your cavity is large and is sensitive to hot or cold items, this could mean the nerve of your tooth is exposed. SDF will NOT be used if the nerve of your tooth is exposed.

MAINEHEALTH

Does insurance pay for this?

MaineCare insurance will cover SDF treatment. Many private insurance companies do not cover the cost of this procedure. Please call your insurance provider to discuss coverage of this treatment if you have questions about what you may owe. You may need to pay for some of the bill up front or we may bill you afterwards.

How does it fit into a work flow?

- For a pediatric dentist it just happens...every day.
- It does take a little set up, so, do you make a seperate appointment for it?
- Assistant can do it.
- It is not easy all the time.
- Do you want the kit or just the liquid/gel?
- Getting consent takes time

And what if it doesn't work???

Liability and responsibility

- I am not a lawyer**
- Some disagreement as to how far you should go with this.**
- You have already heard the this is not infallible**
- In general dentists will have your back.**
- You all have been asked to do new things in the past. (F Varnish for example)**
- Your goal is not to treat the lesion definitively or to treat it forever.**

This is a great *tool*

- **We need your help for the children of Maine**

Okay, let's Play!



THANK YOU!

Freeze the sugar bugs



Black Magic

Silver Bullet