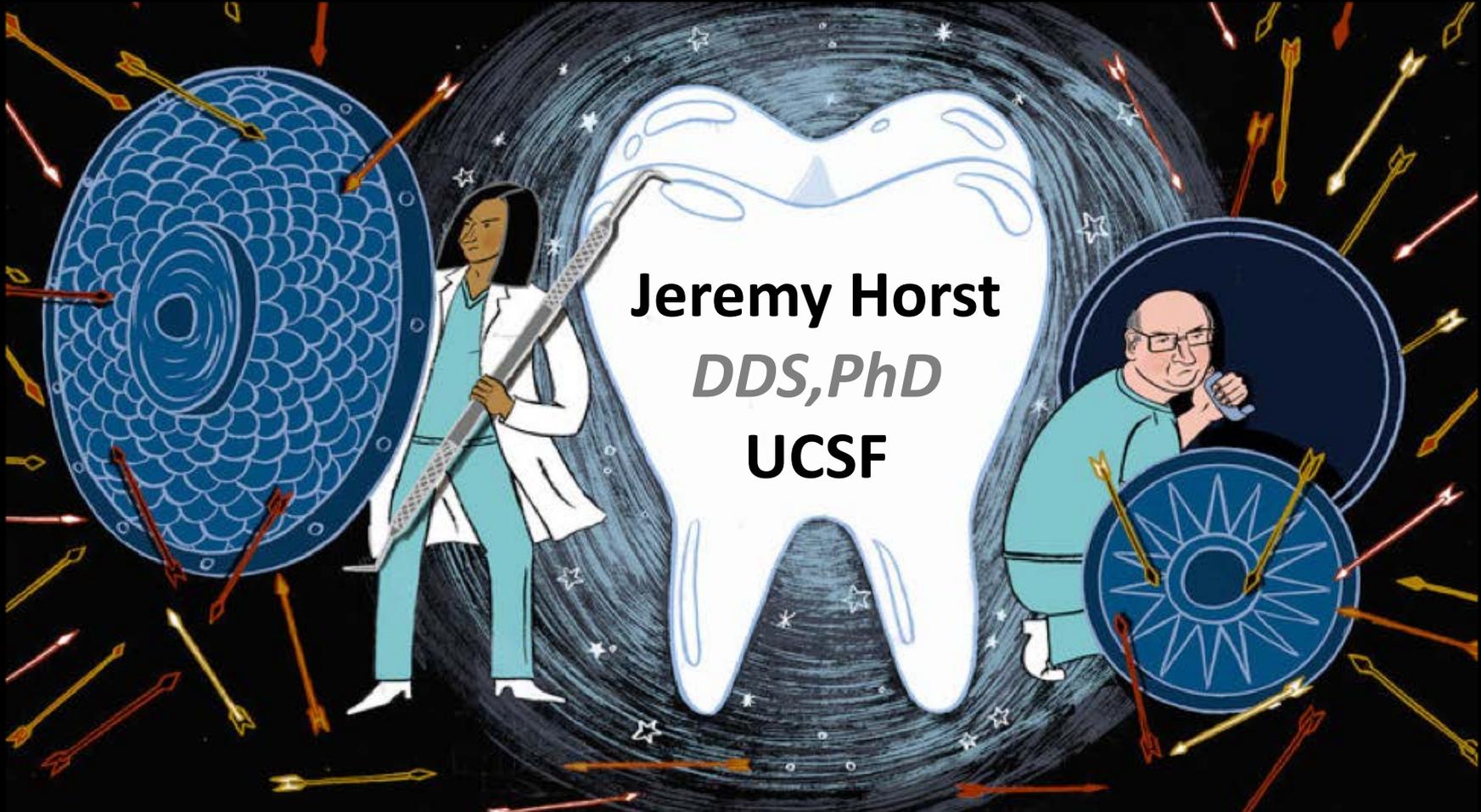


Silver Diamine Fluoride is a Treatment for Dental Caries



Jeremy Horst
DDS, PhD
UCSF

disclosures

My research is funded by gifts & grants from:

Chan-Zuckerburg BioHub

Advantage Silver Arrest

Howard Hughes Medical Institute

National Institutes of Health

Jeremy Horst

downloads

You can get these slides and more at:

[sites.google.com /site/ JeremyAHorst /
OrOHC-201810](https://sites.google.com/site/JeremyAHorst/OrOHC-201810)

youtube.com/watch?v=zUAJkqcltco

youtube.com/watch?v=iPgcccl9qrsA

ncbi.nlm.nih.gov/pmc/articles/pmid/26897901

3 year outcome – severely fragile 3 to 7 year old



1 year later



3 years later

No excavation SDF + GIC



3 years post-SDF
2 years post-GIC

SDF Outline

1. SDF – what is it?
2. SDF adoption
3. SDF clinical evidence
4. SDF clinical use
5. SDF treatment failure
6. SDF mechanisms

SDF - what is it?



Colorless liquid

25% **silver**: antimicrobial

8% ammonia: solvent

5% **fluoride**: remineralization



SDF vs SN + FV



SDF

25% silver

8% ammonia

5% fluoride

> effect data

SN + FV

16% silver

9% nitrate

2.5% fluoride

> safety data



BOTH are safe & effective.



SDF - what does it do?

- Arrests dental caries
- Prevents dental caries
 - *directly & indirectly*
- Decreases dentin hypersensitivity



How do you use it?



Accessible cavity.

1. Isolate with cotton.
2. Air dry.
3. Apply with microbrush.

Arrested cavities after 1 year



RIVA STAR SDF + KI



Cathy Boyce, Oral Health Therapist, AU

SDF Outline

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Esthetics? SSC or SDF



Dr. Jason Hirsch



SDF is now available in the U.S.



~60¢/drop

D1354 caries arrest CDT code
active January 2016.

FDA clearance =
hypersensitivity.

Off label use =
caries treatment.

This is the same as
fluoride varnish.



BREAKTHROUGH THERAPY

US acceptance

FDA clearance

UCSF protocol & guidelines

FDA “breakthrough status”

Advantage, Willamette protocols

Medicaid funding

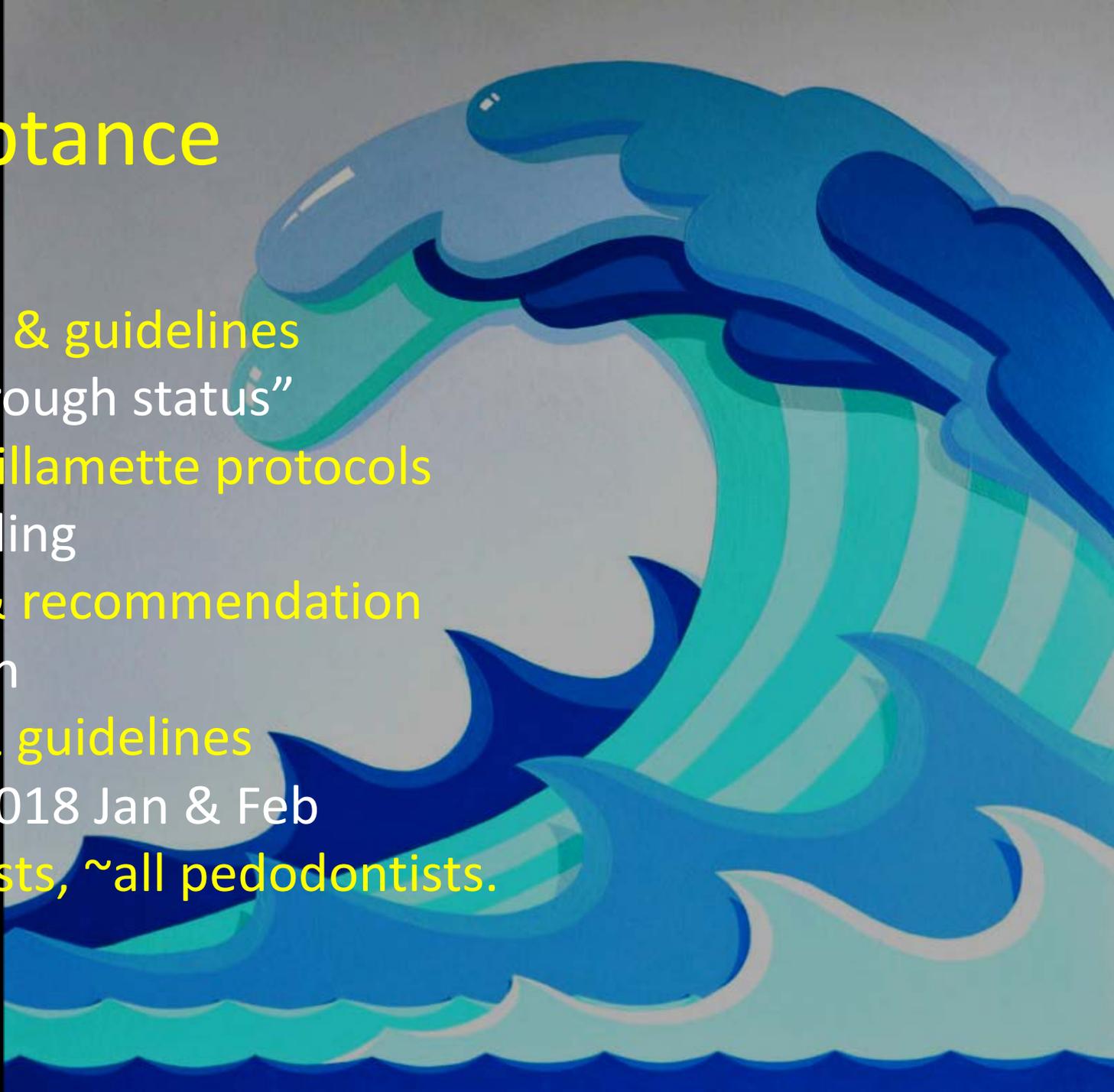
IHS protocol & recommendation

ADA resolution

AAPD policy & guidelines

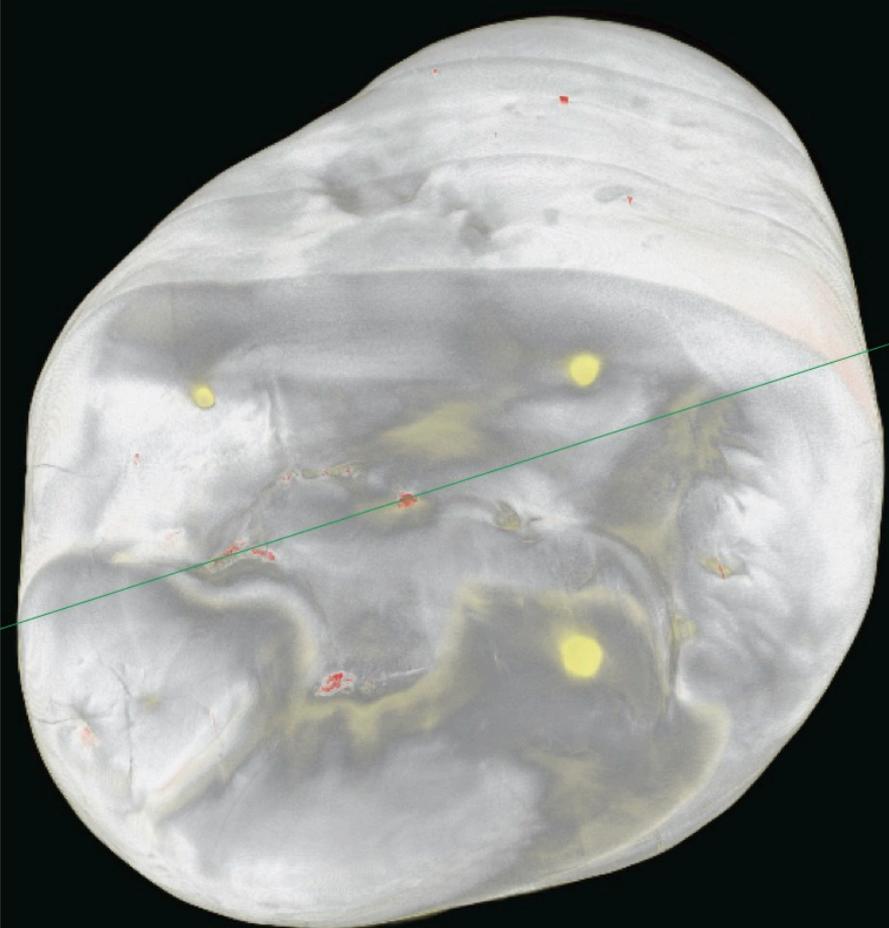
CDA Journal 2018 Jan & Feb

~20% of dentists, ~all pedodontists.



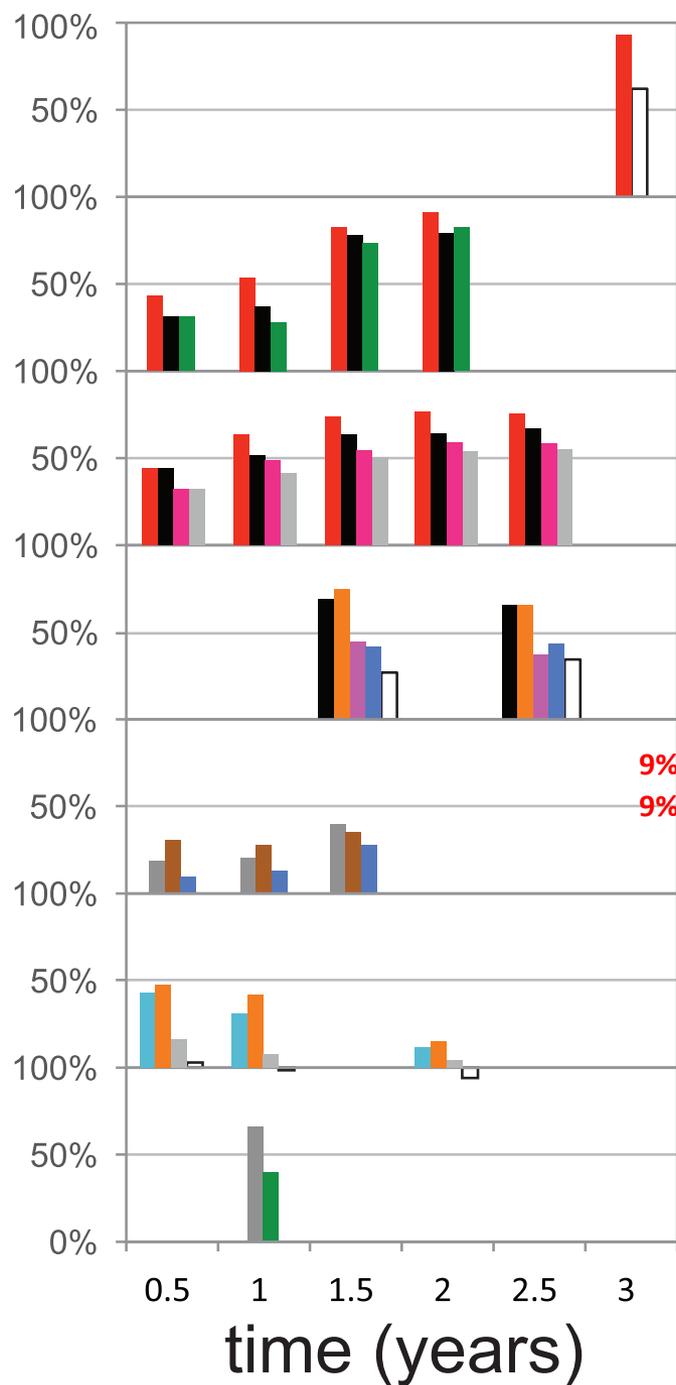
SDF Outline

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Carries Arrest in kids

arrested caries



■ SDF q6mon
□ control

Llodra *et al.*, 2005
373 6 year olds
3.2 lesions at start

■ SDF q6mon
■ SDF q1year
■ GIC q1year

Zhi *et al.*, 2012
181 3-4 year olds
3.4 surfaces at start

■ SDF q1year
■ SDF q6mon
■ 12% SDF q1year
■ 12% SDF q6mon

Fung *et al.*, 2016
841 3-4 year olds
4.7 lesions at start

■ SDF q1year
■ exc SDF q1year
■ exc NaF q3mon
■ NaF q3mon
□ control

Chu *et al.*, 2002
308 3-5 year olds
6 lesions at start

9% ~~30%~~ SDF q1year
9% ~~30%~~ SDF 3x/2weeks
■ NaF 3x/2weeks

Duangthip *et al.*, 2016
275 3-4 year olds
6.7 lesions at start

■ SDF once
■ SDF, tannate once
■ 12% SDF once
□ control

Yee *et al.*, 2009
624 3-9 year olds
6.8 lesions at start

■ 30% SDF once
■ GIC once

Santos *et al.*, 2014
322 5-6 year olds
3.8 lesions at start

Stopping Cavities Trial

purpose: Safety & Arrest Effectiveness

	n	arrested (SD)	95% CI	adverse events
SDF	30	.72 (.38)	.55 to .85	flu, nausea, redness, spot
placebo	36	.05 (.18)	.00 to .16	diarrhea x 2, tummy ache, toothache + diarrhea

Advantage, UW, UCSF

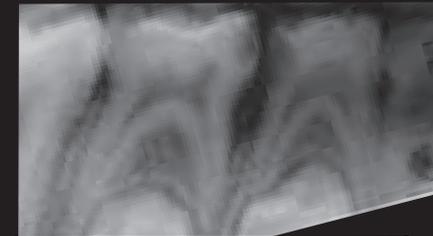
SN+FV trial @Amish U.Iowa

TABLE 2

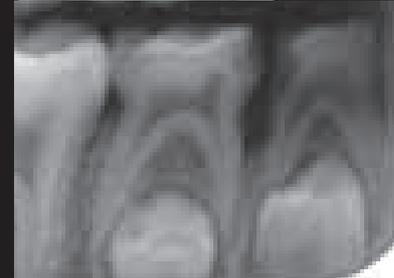
Major and Minor Failures at 24 Months*

Silver Nitrate Group		Conventional Group	
Major Failure	Minor Failure	Major Failure	Minor Failure
17 / 237	5 / 237	3 / 93	0 / 93
7.2%	2.1%	3.2%	0%

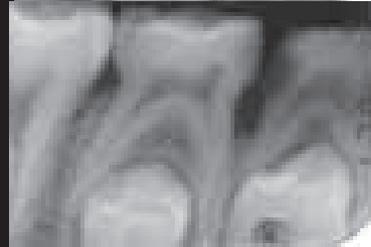
* Reported at the tooth level.



Baseline



6 months



12 months

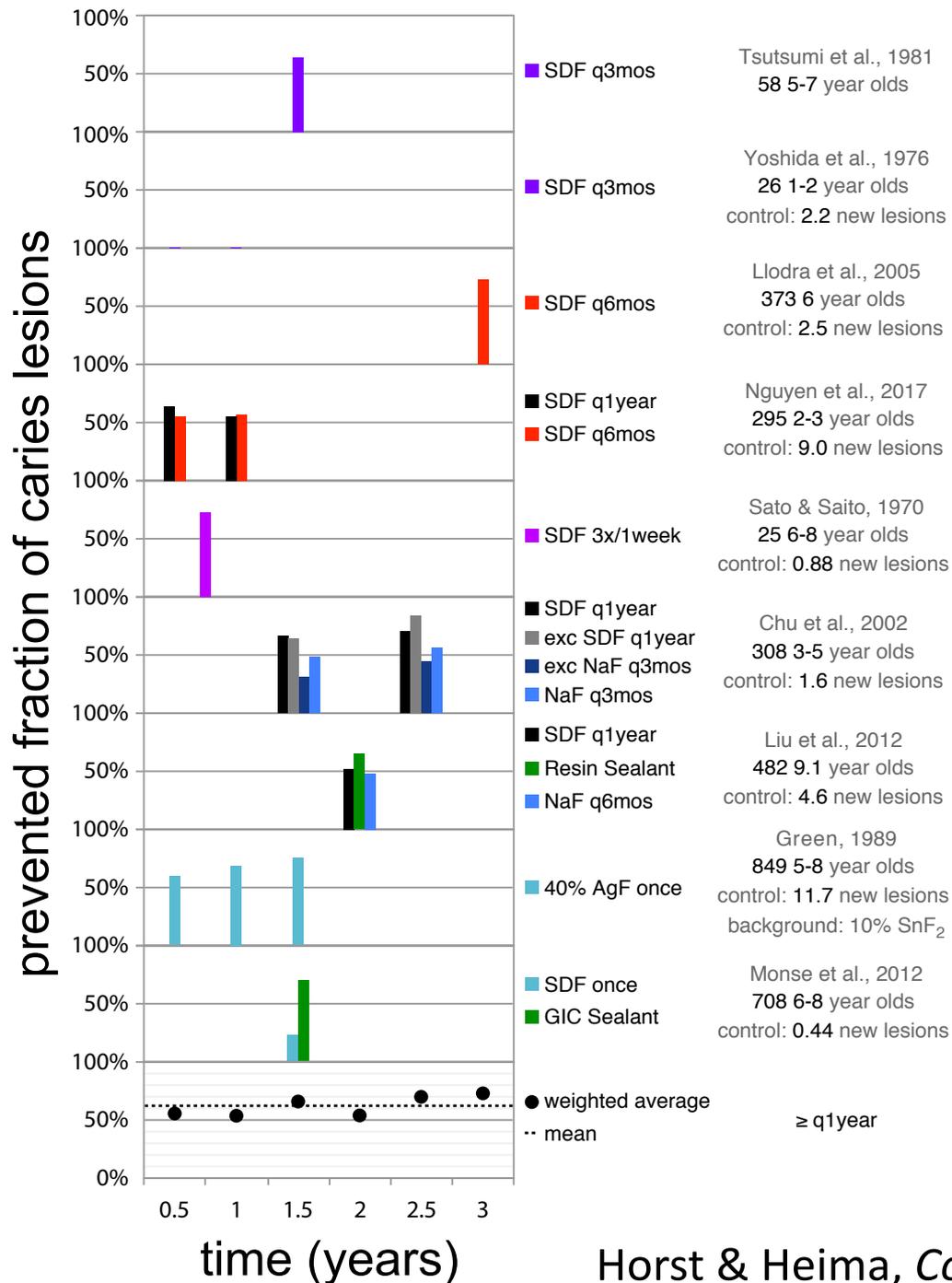


18 months



24 months

Carries Prevention in kids



Learned from clinical trials?

- 12 RCTs with 1,816 patients tx SDF = safe.
- 9 on caries arrest.
70-90% arrest with 1-2/year application.
- 11 on caries prevention.
70-80% prevention in kids by application *only* to lesions.
25-70% prevention, **outperforms everything** by far.

SDF Outline

1. SDF – what is it?
- 2. SDF adoption**
3. SDF clinical evidence
- 4. SDF clinical use**
5. SDF treatment failure
- 6. SDF mechanisms**

How do you use it?



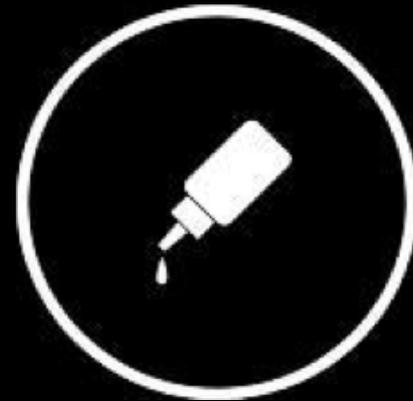
Accessible cavity.

1. Isolate with cotton.
2. Air dry.
3. Apply with microbrush.

Arrested cavities after 1 year

How much do you use?

- microliters per lesion.
- 1 drop (20 μ L) can treat 5+ lesions.



Interproximals?



Hirsch

? OR ?



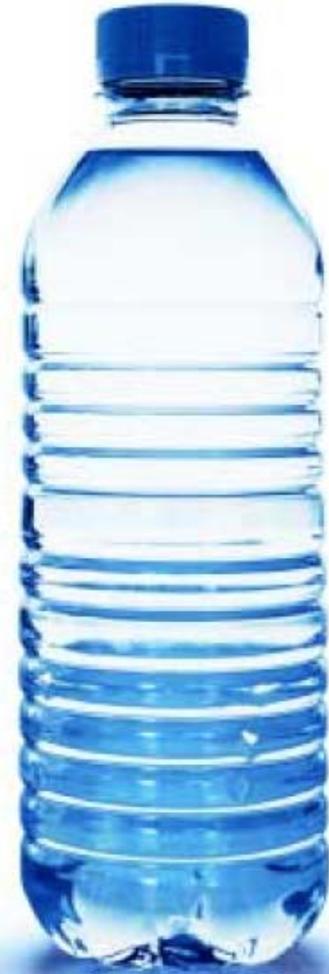
Horst

20 μL
50,000 ppm F

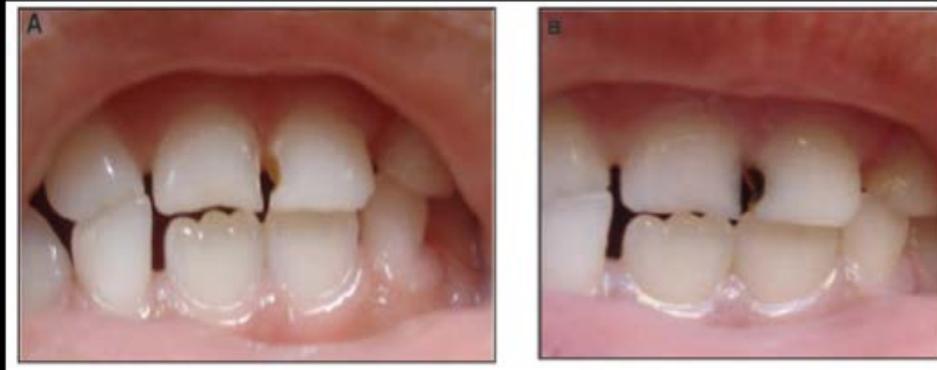


=

1 L
1 ppm F



SDF staining



Duffin, *J Cal Dent Assoc* 2012



time 0

1 day

1 week

Castillo *et al, J Dent Res* 2011

Restoration stain by SDF



SDF + GIC
Fuji 2LC
1 month



SDF + GIC
Fuji 9
1 month



3x SDF
no-prep GIC
Shofu Beautifil
2 weeks

Consent = Conversation

This is a consent document.

- Risks?
- Benefits?
- Alternatives?
- Simple language.
- Show pictures!



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 _____

Issues → prompts

- What are your goals for your oral health?
- Which matters more to you:
looks or comfort?
- Do you prefer:
multiple easy visits, or
fewer visits that are more intense?

Silver Diamine Fluoride



Before



After

- ✓ No Shots Required
- ✓ No Dental Drill Required
- ✓ Requires about 5 minutes
- ✓ May require laughing gas
- ✓ Turns tooth decay black
- ✓ May need future restoration

Tooth Colored Fillings

- ✓ May require Shots
- ✓ Requires Dental Drill
- ✓ May require 25-30 minutes
- ✓ May require laughing gas
- ✓ Esthetic Restoration (tooth colored filling)
- ✓ Final Restoration



Before



After

Tesoriero & Lee 2016

Billing

- D1354 caries arrest.
- D1208 topical fluoride.
- D9910 desensitization.

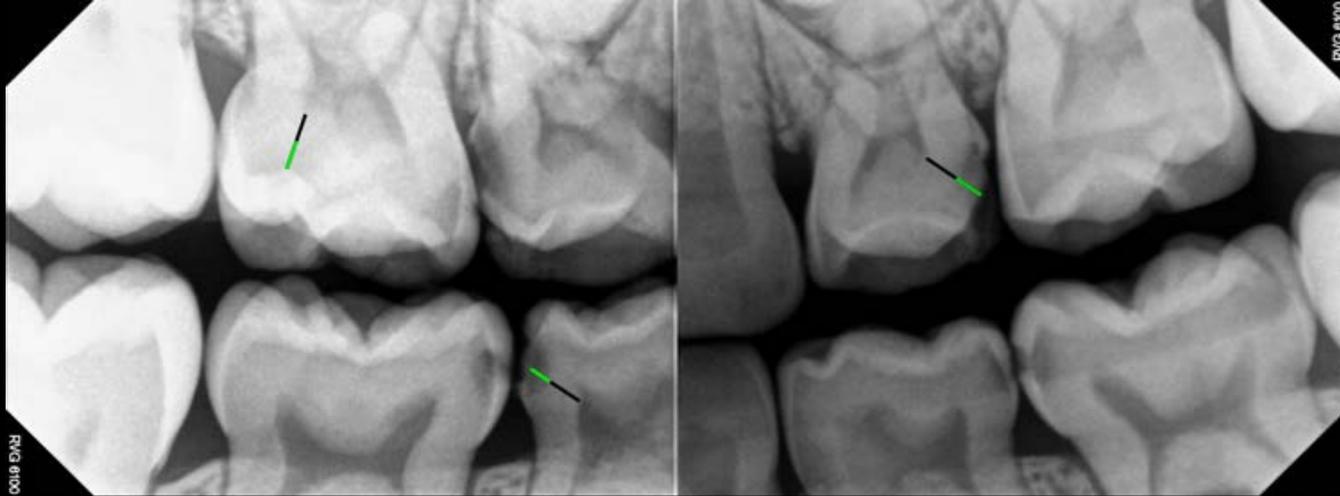
Per tooth / per application

... per quadrant equivalent?

SDF Outline

1. SDF – what is it?
2. SDF adoption
3. SDF clinical evidence
4. SDF clinical use
5. **SDF treatment failure**
6. SDF mechanisms

baseline

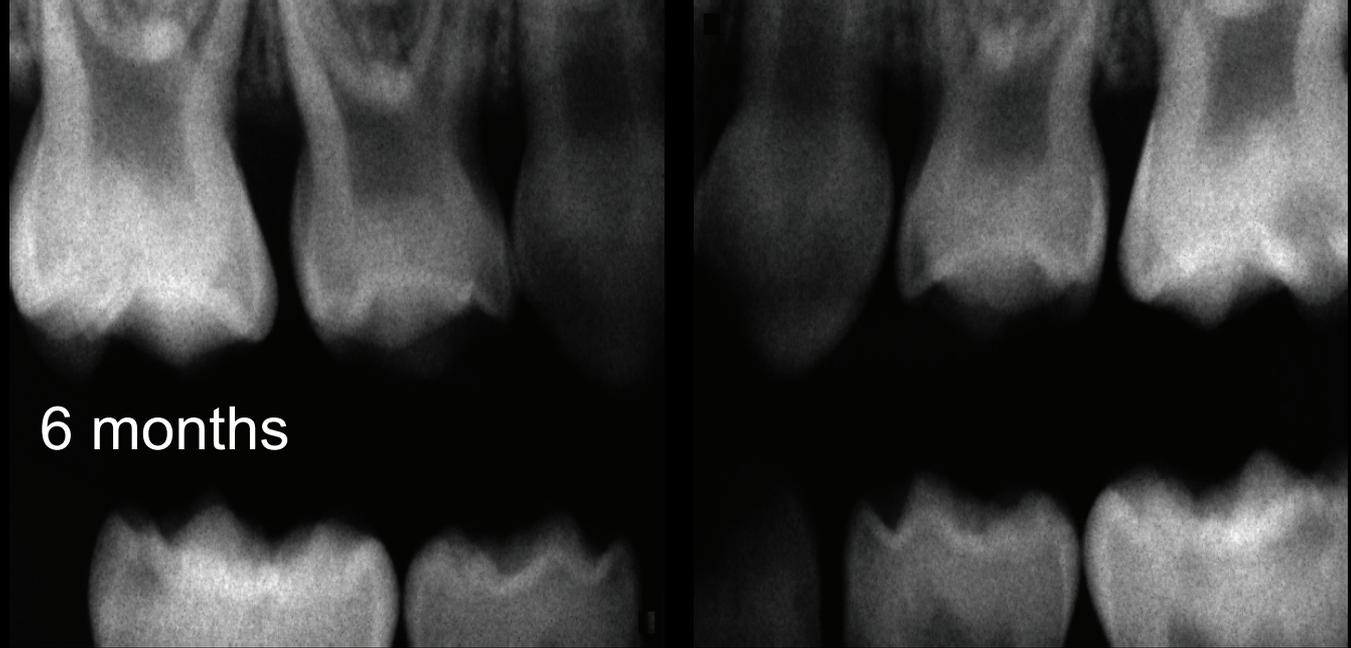


1 year

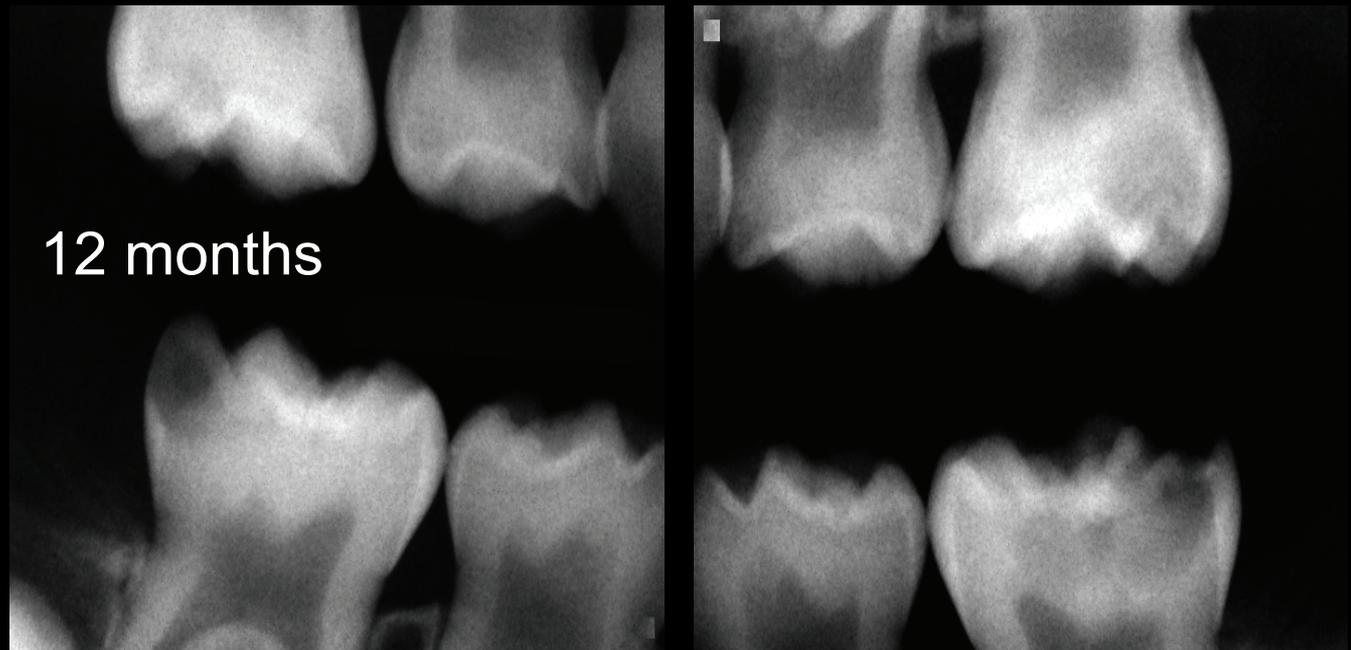
2 years

@ 2 years:
0 new cavities

2 treatments



2 treatments



@ 1y4m: 0 new cavities

What to watch for:



@ 6 months.

SDF Outline

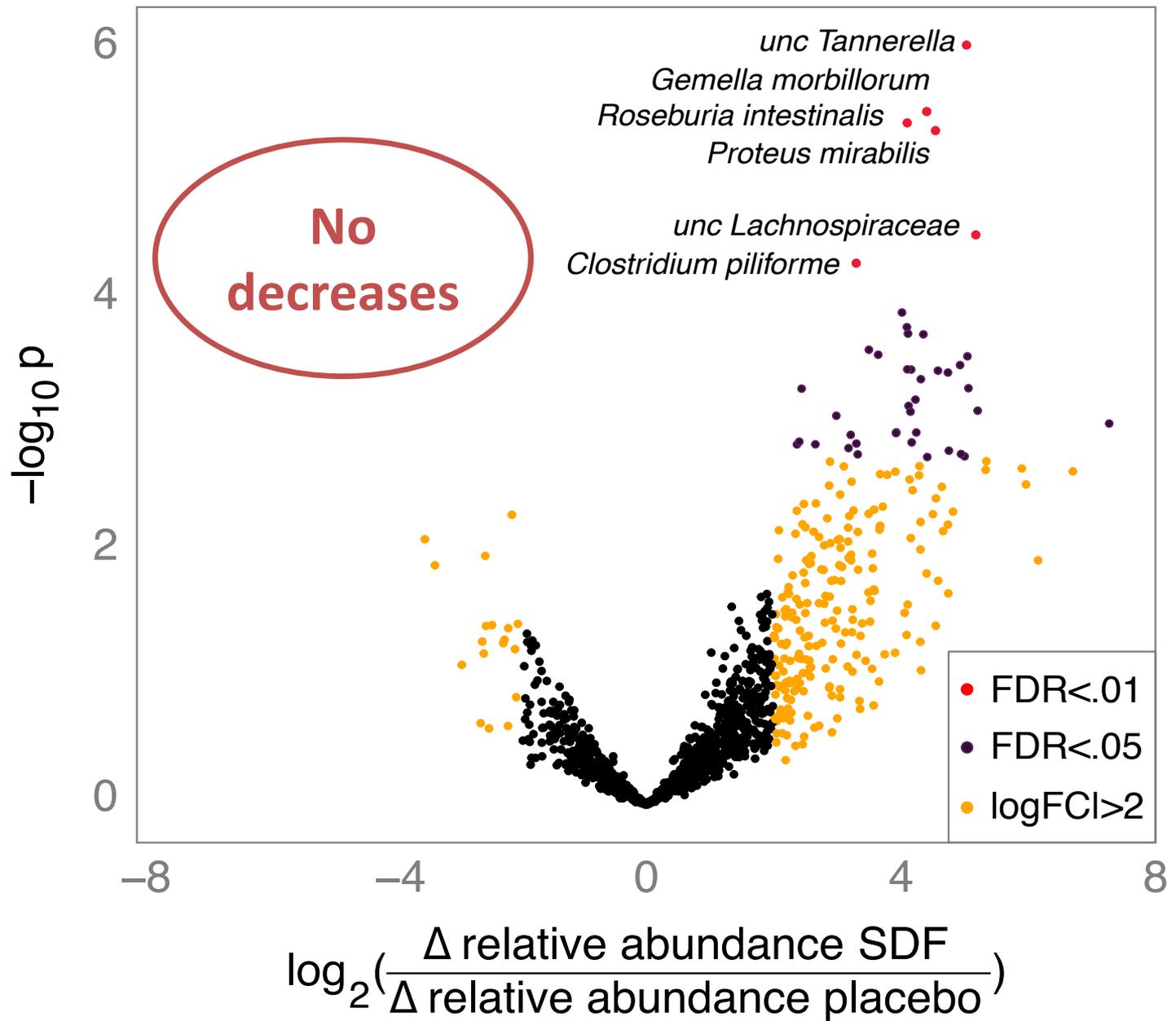
1. SDF – what is it?
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SDF: sustained antimicrobial effects

- Treated dentin resists plaque formation.
 - *demineralized* dentin resists *more*.
- **Zombie Effect**: Silver-killed bugs kill active bugs.
 - Ideal substantivity.



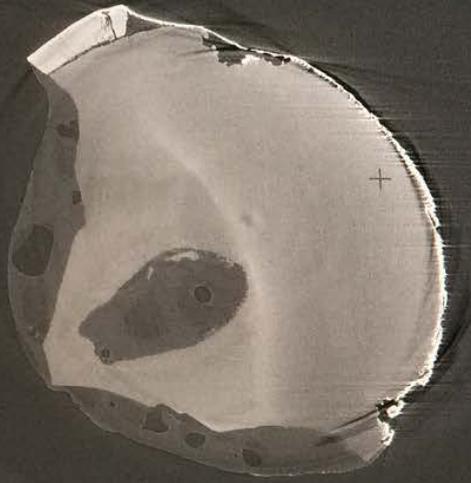
Δ species after SDF



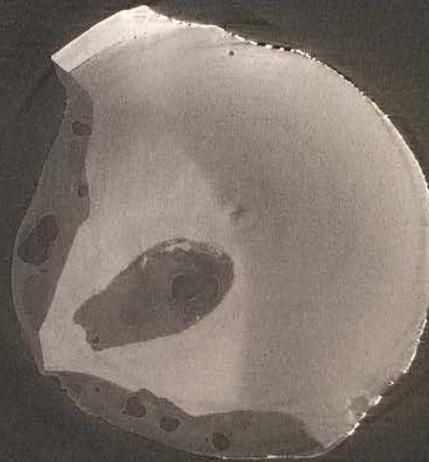
SDF penetration testing



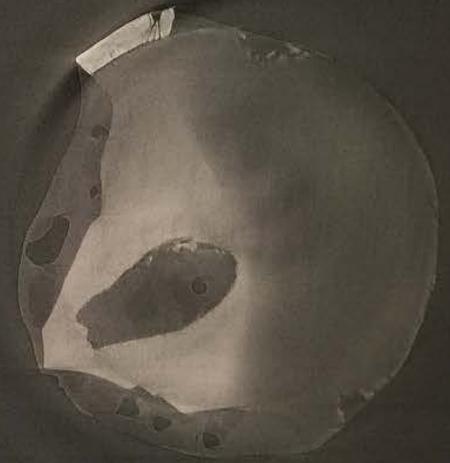
kinetics of SDF penetration



1 hour



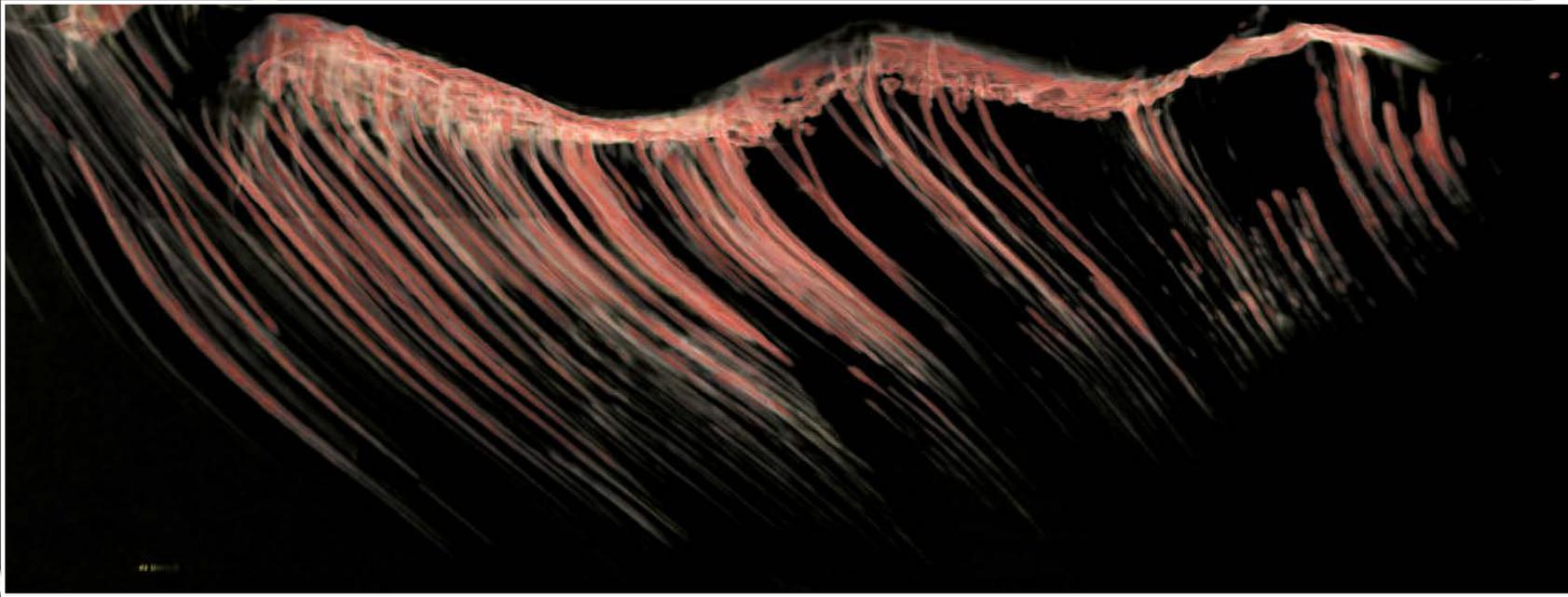
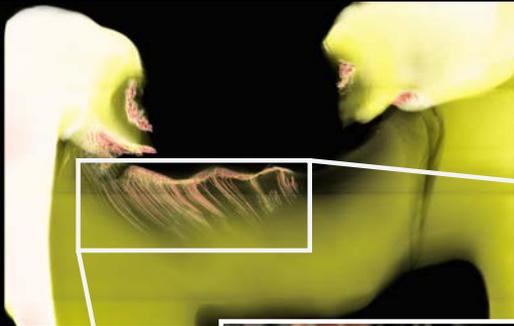
10 minutes

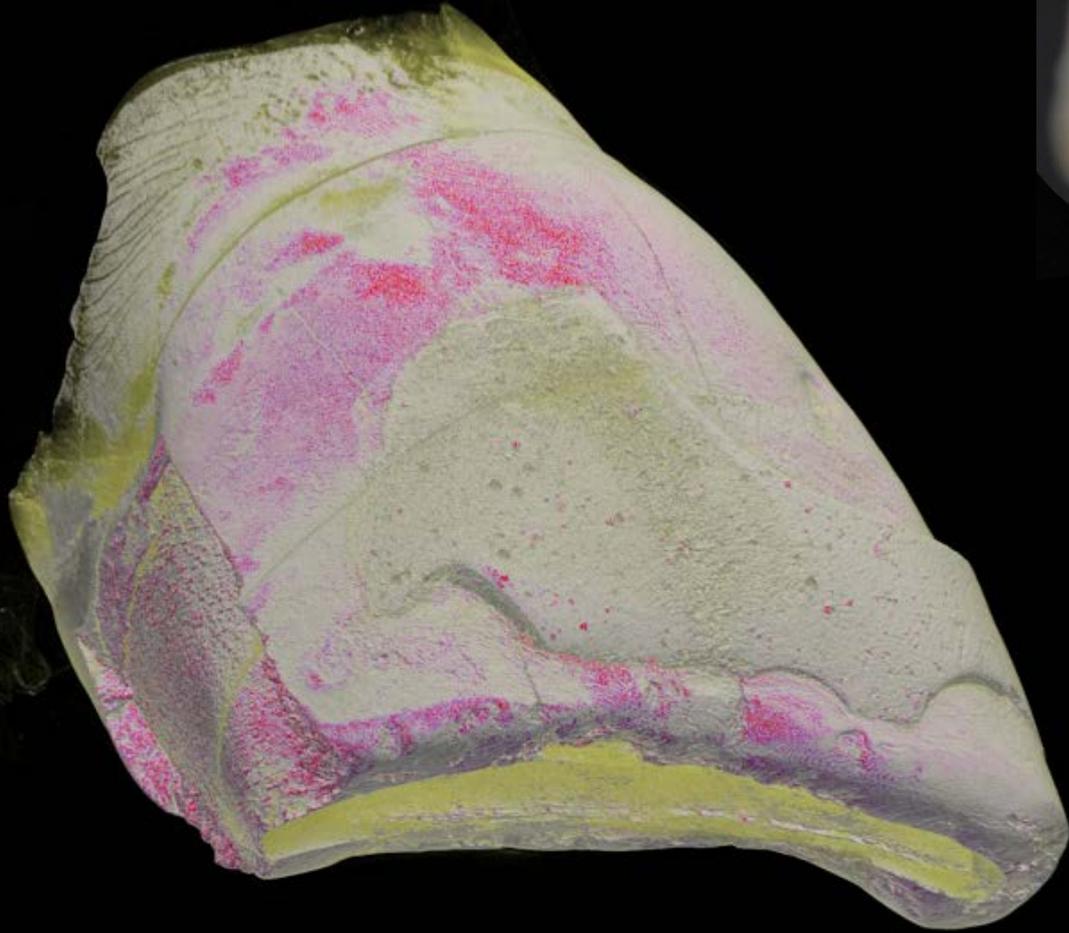


Before

SDF: penetration

SDF casts silver rebar millimeters into dentin, reinforcing the lesion and sustaining kill.





SDF Outline

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4. SDF clinical use
5. SDF treatment failure
6. SDF mechanisms

Kitchen SMARTs

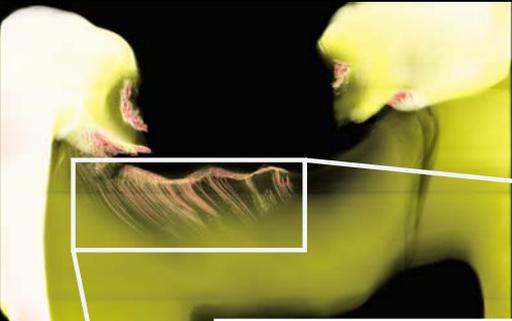


Drs. Steve Duffin & John Frachella

SDF take-homes

1. Arrests 81% of lesions when used 1+/year.
2. Prevents 62% of new lesions.
3. Dry before use.
4. Safe.
5. Stains the crap out of everything.





THANK YOU



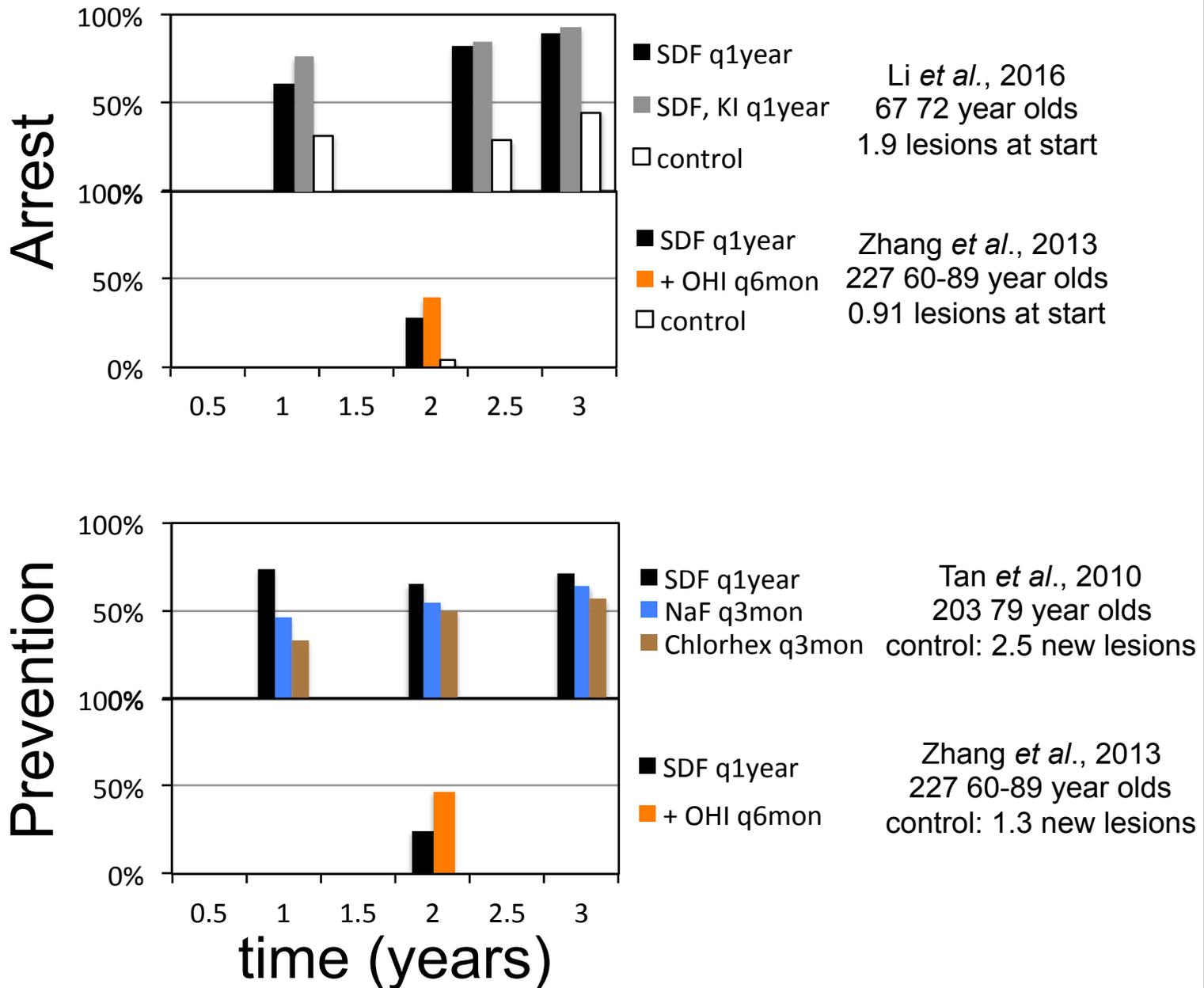
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Older adults



SDF chases bugs
down into tubules

