Proactive Intervention Dentistry

Using Silver Diamine Fluoride to Arrest Dental Caries

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My dental world was rocked upon reading the article by Horst et al in the January 2016 California Dental Association Journal.[1] It became the launching pad for my journey of using silver diamine fluoride as a vital part of my caries management tool kit. The article became my 'bible' for an all-out offensive on dental caries and my search for any information I could find about SDF and the arrest of caries. It expanded my already growing use of techniques to practice the "medical" management of dental caries.

I found the first reference to decay arrest by silver products in an article by Yamaga et al, Journal of Osaka University Dental School.[2] A reference was made to a custom common about 1000 years ago in Japan. Ladies were known to create a mixture containing silver fluoride (AgF) to dye their teeth black in a process referred to as 'Ohaguro' to express their married status. Some gentlemen did this as well. It continued for 10 centuries but waned by the 20th century. It was considered tooth cosmetics but it was also found to prevent dental caries. I have found a plethora of similar articles originating in Australia, Brazil, China, and other parts of the world on the use of silver ion products to combat tooth decay.

In 1905 G.V. Black was called to Colorado to investigate 'black stain' on teeth, commonly found on many of the residents of that part of the country. He was baffled. One account describes his observation of walking about the towns and noticing the people he saw had lots of stained teeth, but not much tooth decay. It took another 20-50 years before it was actually discovered that fluoride was the cause of the stain, and at optimum levels in drinking water, it still prevented decay but did not stain teeth.

But even before the use of fluoride, many dentists had discovered silver nitrate for the treatment of tooth decay. In the late 1800s G. V Black described protocols for the use of silver nitrate to arrest dental caries.[3] In 1917, Dr. Percy Howe, Director of the Forsyth Institute in Boston added ammonia and created ammoniacal silver nitrate (Diamine silver nitrate), which made it more stable and effective in arresting decay. It was used widely in the early 20th century, with many dentists compounding their own formulas. By the 1950s, the introduction of local anesthetic to enable painless restorations and fluoride for prevention of caries ended the common use of silver nitrate.

Today effective caries arrest through silver ion products is back in the picture in the US and Canada in the form of silver diamine fluoride (SDF). SDF was approved in Japan more than 80 years ago[1] and has been available in Australia, Brazil, Argentina, Mexico and China for decades. In August 2014, the FDA cleared the SDF product Advantage Arrest by Elevate Oral Care (West Palm Beach, FL) to treat tooth sensitivity. In February 2017, Health Canada approved Advantage Arrest by Oral Science (Montreal, QC) as a caries arresting treatment.

The method of action is as follows: the silver acts as an antimicrobial, the fluoride promotes remineralization and the ammonia stabilizes the solution.[1]

Figure 1: The "Kryptonite" information sheet is given to patients to explain some of their possible weaknesses that contribute to decay.

WHAT IS **YOUR** "KRYPTONITE?"

One of the main factors we find with every patient who begins to develop frequent or multiple cavities, for no apparent reason, is that they have some weakness in the form of a daily, negatively contributing, 'consumption pattern of carbohydrates' (CPC). This creates an Environment that can create acid-decay in almost any mouth, whether you have had SDF applied or not. What can you add to this list? 1/25/17

1. Mt. Dew [drinking it all day-teenage boy]
2. Dr. Pepper [constant can in her hand-busy mother of 4]
3. Coke [small cans on desk, medical secretary]
4. Pepsi [2 patients] [office worker and a manufacturing worker]
5. Gatorade [outside workman]
6. Sweet tea – Gallon a day [laborer]
7. Certs [salesman who drank coffee but wanted fresh breath 1-2 packs a day]
8. Peppermints swirls [retired secretary at home all day now]
9. Cough drops [smoker quitting who coughed a lot]
10. Pistachios [smoker quitting got a new habit and has 3 first cavities]
11. Lifesavers [Chemo CA patient developed dry mouth]
12. Pretzels and peanuts [R.E. agent on the road in car all day]
13. Business man [Cherry Coke cases delivered to his house by distributor]

Think about your daily routines, read product labels and let us add your most frequently consumed carbohydrate to this list. Remember, it's not quality but frequency!

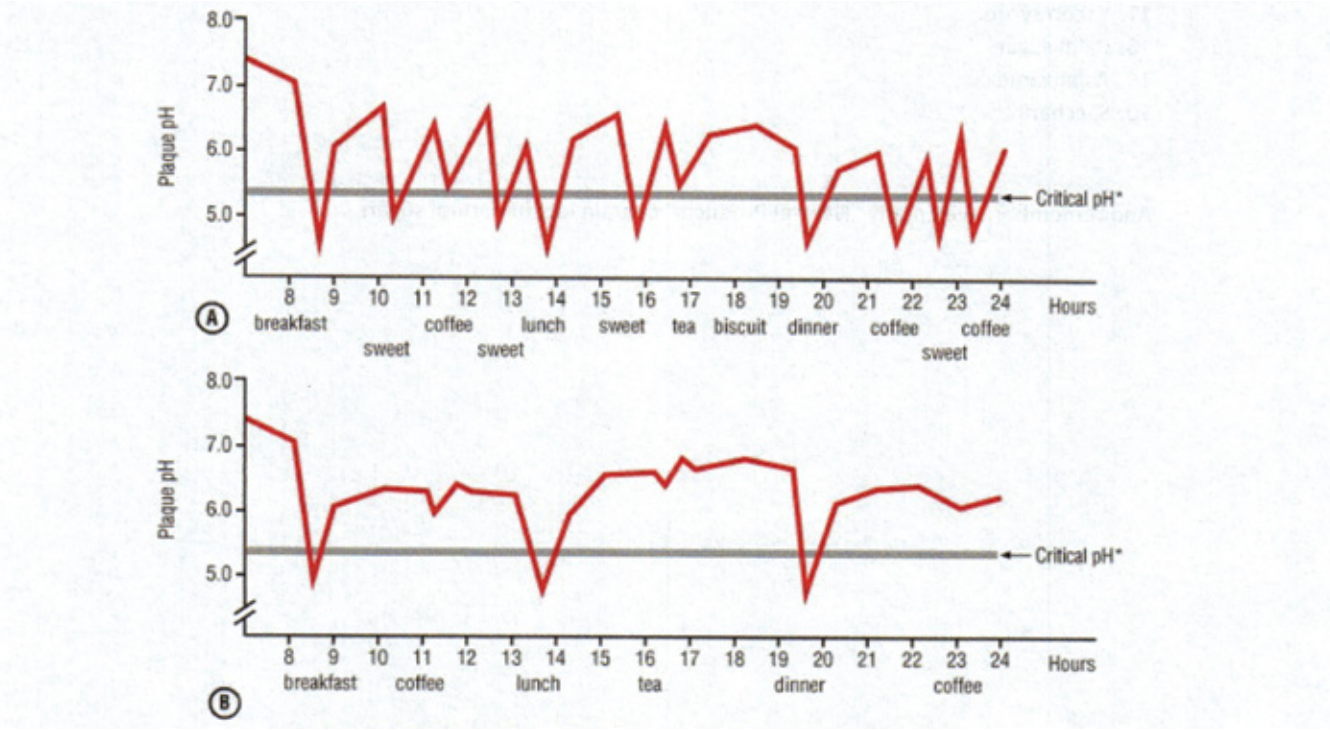

Figure 6. Schematic representation of the changes in plaque pH in an individual who [A] has frequent food and drink intake during the day, or [B] limits their food and drink intake to main meals only. The critical pH is 5.5, below which teeth begin to demineralize.
Marsh, Philip D, Martin, Michael Y, *Oral Microbiology:* 12.

Incorporation of SDF into Clinical Practice

I would be remiss, if I did not stress the importance of including as part of your program, a relevant Oral Health Education (OHE) program with your SDF presentations and follow-ups chairside. Of course, brushing and flossing are important, but I achieve much more success with the inclusion of my "What is your Kryptonite?" **(Fig. 1)** illustration than any other pamphlet we have ever given out. It is very rewarding to see the patients' eyes widen and almost literally see the light bulb go on in their head, as they read this brief story. They become aware of their own risk factors in developing decay. We also gain informed consent at the initial presentation, using a form from University of California San Francisco found in the Horst article.[1]

But before I get ahead of myself, allow me to describe several uses for SDF that I have incorporated into my own general dental practice:

- Younger patients, especially under age three or any age suffering from Early Childhood Caries (ECC) are usually very comfortable with the noninvasive process of applying SDF.
- Elderly patients who have become homebound or in hospice for whom it has become extremely difficult to be transported to the office for dental appointments benefit from the easily applied solution and it can be accomplished at recall visits or even in their home facilities or beds.
- Medically compromised patients, either due to surgeries or other debilitating conditions that make sitting for long periods in a dental chair difficult, can delay treatments or just maintain their current status.
- Any adult patients with asymptomatic deep or just multiple carious lesions throughout their mouth have a more favorable prognosis when **pretreated** with SDF.
- Hypersensitive root areas or cracked teeth that have become hypersensitive due to the stress of chewing can be treated before a crown is placed.
- Around orthodontic brackets to control bacterial invasion and harden decayed areas. When the brackets are removed I restore the dark stained areas.
- General use for patients with multiple lesions to control/arrest the caries infection before prepping and restoring any teeth. I am considering making this a standard protocol for any patients who present with active tooth decay.
- One patient chose to have SDF applied every three months until here dental insurance took effect so she could preserve tooth structure and possibly avoid symptoms developing.
- A pregnant mother with a very deep lesion also accepted the SDF option to arrest the decay until she delivered, rather than risking a potential toothache or abscess with conventional treatment.

You may think of many more once you incorporate the process into your practice on a daily basis.

Treatment Protocol

My protocol involves:

1. Applying SDF to any carious area (if possible after cleaning it and **thoroughly drying** it to achieve maximum absorption) three times within a one to two-week period.
2. Evaluating which teeth need to be restored.
3. Following up every three to six months with further applications.

Depending on the patient's risk factors and status of the re-hardening process, we may elect to begin some restorative work immediately or review the oral hygiene process and just try to continue maintenance with regular SDF applications. We also use laser fluorescence (Diagnodent) to help determine if bacterial activity has decreased at all follow-up appointments to direct future treatments. Our Diagnodent readings seem to be a reliable indicator as to success or failure of the treatment.

I really find this to be a great addition to the dentist's toolbox in accomplishing the arrest of decay in the elderly, who may have extensive lesions in furcations or other hard to reach areas and for medically compromised patients who might otherwise require extractions of teeth devastated by decay. A new area I want to explore is possible use in long term care or rehab facilities where dental access is limited, or even nonexistent.

Many patients, due to their addictive diseases, have devastating amounts of decay (i.e. 'meth mouth') and are required to undergo extended periods of drug rehabilitation. SDF therapy is a perfect solution for the six-week, or three-month or even six-month rehab programs. If SDF is applied at the beginning of their rehab treatment, the patients will have some teeth to restore once they accomplish their rehab goals and are released to live their normal lives.

Safety

Not one adverse event has been reported to the Japanese authorities since they approved SDF more than 80 years ago.[1] Slight gum irritation may occur but it heals quickly. If gum staining occurs due to inadvertent touching of the tissue, this will disappear within three to seven days. Some patients may experience a transient metallic taste.

The only objectionable side effect is that the treated carious lesions become stained. Sound undecayed areas remain unchanged. This is by no means a contraindication. Several of my patients with extensive areas of decay were treated with

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Case 1

Patient presented with rampant decay. He was placed on SDF protocol prior to restorative treatment. Fourteen restorations were placed followed by six-month SDF recalls. Patient has been compliant with the recommendations. He has stopped contributory poor habits, has been committed to the SDF regimen and has remained caries free for one-year since the restorations were placed.

SDF and when we began restoring their teeth after the third SDF application, and covered the stained areas, this became a non-issue.

Clinical Cases

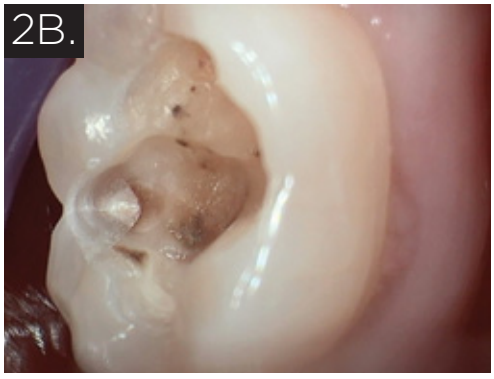
Case 1

A 30-year-old patient presented due to a broken tooth. Rampant decay was noted at the time. The patient was unable to recall when his last dental visit had been and stated that he brushed his teeth every other day. The patient also had a tobacco habit and admitted to drinking a lot of soda and energy drinks. This patient was started on once weekly SDF treatments for one-month prior to starting the restorative phase. The SDF was applied to every tooth for two minutes then rinsed, working in sextants. The patient had 14 teeth restored over a two-month span and was then placed on full mouth SDF treatments every six months. This maintenance phase included applying SDF to every tooth (with careful avoidance around anterior restorations and applied **lingually only in the anterior zone**) and then immediately applying varnish over all the teeth without rinsing or drying. The patient has been recalled twice since the restorations were placed and has remained caries-free for one-year. This patient was very happy with the appearance of his new smile and it prompted him to quit his tobacco habit and cut down on his soda and energy drink intake.

Case 2

A 27-year-old patient presented for her initial exam and cleaning with no complaints of pain. At that time tooth #46 had a Diagnodent reading of 68 around the existing sealant with a dark shadow. The decay could not be detected on the bitewing x-rays. A plan was made to restore #46 occlusal with composite. The patient became pregnant shortly after her initial visit prompting us to move her restorative appoint-

Case 2



Diagnodent reading of 68 was detected on tooth #46 surrounding an existing sealant. Upon prepping, deep decay was noted therefore SDF and a sedative dressing (IRM) were placed. SDF was applied on all posterior teeth as a preventive measure. Patient has remained asymptomatic since final restoration placement.

ment until she was in her second trimester. The tooth was prepped four months after diagnosis. Upon prepping, the decay extended much deeper than we had initially suspected coming within about 1 mm of the mesial pulp horn (per periapical x-ray). The decision was made to place SDF and a medicated restoration (IRM). When placing SDF as a liner under medicated fillings, we apply the SDF for one-minute and then air dry prior to placing the medicated filling. We do not over saturate with SDF as it will splatter upon air-drying and cause staining to adjacent tissues/teeth. We also decided it best at that time to place SDF on all posterior teeth as a preventive measure due to the unexpected decay depth on tooth #46. The placement of SDF on all posterior teeth was done in quadrants where SDF was placed for two minutes and then rinsed. The final restoration (occlusal buccal composite resin) was placed five months after the sedative restoration, once the patient had given birth. The patient reported no sensitivity with this tooth and the periapical X-ray appeared clear of abscess. The patient has remained asymptomatic. She is now getting SDF applied regularly to all posterior teeth at six-month recalls. We use the technique of: applying SDF, immediately applying varnish over it without drying or rinsing, and working in sextants.

Conclusion

Silver diamine fluoride is a new addition to the Proactive Dental Intervention toolbox in North America. It is an effective, safe method of controlling dental decay in: high caries risk patients, patients where treatment is challenged by behavioural or medical conditions, difficult to treat dental lesions, emergency situations, and patients with limited access to dental care.

By stopping the progression of dental decay with SDF applied at appropriate intervals, each person is given another chance at possibly having their teeth restored someday and a future without the threat of recurrent decay and eventual tooth loss. **OH**

Oral Health welcomes this original article.

References:

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Dr. Parrett graduated from Ohio State University School of Dentistry in 1976. He is a fellow of the Academy of General Dentistry. He remains active in the dental community as a member of the Cumberland Valley Dental Society (Past President), the Fifth District Dental Society (Past President) as well as serving in various positions with the American Dental Association and the Pennsylvania Dental Association. He is on staff at Chambersburg Hospital and has served with the Academy of Laser Dentistry. He has practiced in Chambersburg, PA, for over 40 years.