

Journal

CALIFORNIA DENTAL ASSOCIATION

cda

February 2018

Silver Diamine Fluoride
in Elder Care

The Warm Springs Model

Radiographic Changes After
Silver Fluoride Treatment



PART II
SILVER DIAMINE
FLUORIDE ~
THE NEW OLD

Paul Reggiardo, DDS, and Gregory J. Sabino, DDS, PhD



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Journal

CALIFORNIA DENTAL ASSOCIATION

Volume 46, Number 2
February 2018

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Journal of the California Dental Association (ISSN 1043-2256) is published monthly by the California Dental Association, 1201 K St., 14th Floor, Sacramento, CA 95814, 916.554.5950. Periodicals postage paid at Sacramento, Calif. Postmaster: Send address changes to *Journal of the California Dental Association*, P.O. Box 13749, Sacramento, CA 95853.

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One-Stop Shopping Equals Savings and Support

Ruchi K. Sahota, DDS, CDE

There is nothing better than being complimented on a pair of shoes we got on sale. Nothing. Seeing the word “discount” on a receipt is exhilarating and gives a feeling of true accomplishment. But perhaps some dentists may not understand why this is so thrilling. Let me explain. Traversing through sales aisles, knowing where to look and recognizing exactly when to buy is much like the feeling of navigating the MB2 canal in a maxillary molar. Can you feel it? Getting a deal is a beautiful feeling!

Dental product purchasing can garner similar emotions. Many adventurous staff members have mastered the hunter/conqueror mentality of ensuring the office acquires the “best deal.” They call around to various retailers, compare prices, count how many additional free products the best price will get them and *then* in due course — after all that data gathering — they order. We love that our staff works so hard for us to obtain the best deal. But how can we bypass the time and energy it takes to get the best deal? Because in fact, time is money.

CDA conducts surveys, gathers input and verifies research on a continual basis. Members have been reporting strains on their overhead budgets for many years now. Costs must be managed. Quality must be faultless and genuine. If we cut expenses for a nifty deal, but in turn receive a product that is not authentic, we place our integrity at risk. We need competitive prices *and* genuine high-quality products. In today’s world, that is hard to obtain — which is why nothing is more exhilarating than getting a good deal.

So CDA listened. CDA put in the work. And CDA launched The Dentists Service Company’s Marketplace to all members in June 2017. On behalf of



The Marketplace most significantly not only preserves CDA’s mission to support its members, the savings actually work to offset the cost of our dues.

all CDA members, TDSC negotiated prices on more than 25,000 products for us so we do not have to do so much work to get the best deal. CDA’s goal is to help our practices thrive. By keeping our best interests in mind while helping reduce our overhead costs, the Marketplace does exactly that.

Is this not why we pay our dues for organized dentistry every year? We want someone to stand up for us. We want someone to advocate on our behalf. We want someone to better the benefits for our patients. We want someone to help our offices to do well. We want collective bargaining so that we can maintain costs. CDA has championed our issues throughout the years. However, the Marketplace most significantly not only preserves CDA’s mission to support its members, the savings actually work to offset the cost of our dues.

The first two times my office shopped the Marketplace, the savings on those purchases paid for one year’s worth of ADA, CDA and local dental society dues. Another member reports that her order subtotal with the Marketplace was 50 percent less compared to her usual subtotal with the big supply company she usually purchases from. And TDSC Marketplace *always* provides free shipping. Amazing.

Buying products from the Marketplace saves money and is easy to do. The website is set up brilliantly. There is a search bar, an ability to

compare prices and products, the cart can be saved to be able to return to later, products and orders can be reordered with just a click and the design is easy on the eyes and easy to follow. The shopping experience is very similar to our other favorite shopping page — Amazon. You can even set up automatic orders so there is never a shortage situation on products you use routinely — like gloves, masks, burs or cement. The Marketplace is simple, gratifying and FREE. Using this CDA member benefit keeps costs down for our offices, and therefore for our patients.

The best part is that the Marketplace works just like CDA. If I have a question, I call TDSC. A real person in Sacramento answers the phone. Often, I can speak to the same person I spoke to previously. They recognize my name and are eager to help in any way they can. If the product I desire is not part of the Marketplace, I can call or email and request it. TDSC then starts the process of negotiating and acquiring my product.

Big dental supply companies set prices the way they want to because they can. They have an immense buying power. And now, so does TDSC’s Marketplace. If we want these amazing prices to stick around then we have to buy. We have to utilize the Marketplace. The more we buy, the bigger TDSC’s buying power becomes. The more we buy, the more TDSC can negotiate prices.

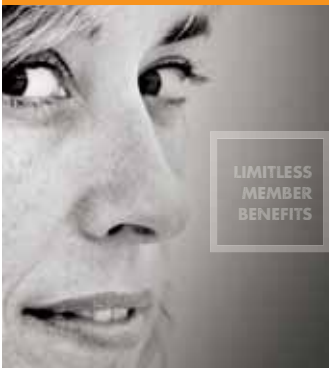
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CDA is our union. It is our voice. It is our representative. If we buy from and support TDSC, we then support CDA. If we support it, it continues to fight to support us and help us and our offices thrive.

You can enter the Marketplace simply by going to tdsc.com — the password and login are the same you use for cda.org. And unlike Amazon, you do not have to be “prime” members to get free shipping. CDA members are automatically VIP clients and receive free shipping every day. No need for a minimum purchase. No need for a special relationship with the “right” person. And no need to worry if you are getting the best price.

The big dental supply company representatives are still members of our dental office teams. We still purchase from them. We still look to them to share information about the newest and brightest goodies and gadgets for dentistry. They are still our go-to people for equipment, maintenance and often C.E for new technologies from their companies. They are like the personal trainer we visit twice a week. They keep us fit and informed of the best ways to stay healthy. But the foundation of good health is inevitably our diet. Just like fatty foods and sugar need to be contained for a healthy life, the cost of the bread and butter of our dental overhead needs to be maintained for a healthy office budget. Take a chance. Try the Marketplace. And watch the savings build.

Helping us is what CDA does. When there was a critical malpractice claims predicament, TDIC was formed. When I was a new dentist and large numbers of associates were transitioning into practice ownership, Practice Support was formed. So when it is important for us be mindful

of how much we are spending in order to do well for our patients and do well for ourselves, TDSC has come through with the wonderful and exhilarating experience of saving money through the Marketplace. Because there still is nothing better than getting a great deal. ■

Ruchi K. Sahota, DDS, CDE, practices family dentistry in Fremont, Calif., and serves as faculty at the University of the Pacific, Arthur A. Dugoni School of Dentistry. She is also a certified dental editor, a consumer advisor for the American Dental Association, past president of the Southern Alameda County Dental Society and a fellow of the American College of Dentists, International College of Dentists and the Pierre Fauchard Academy.

The Journal welcomes letters

We reserve the right to edit all communications. Letters should discuss an item published in the Journal within the last two months or matters of general interest to our readership. Letters must be no more than 500 words and cite no more than five references. No illustrations will be accepted. Letters should be submitted at editorialmanager.com/jcaldentassoc. By sending the letter, the author certifies that neither the letter nor one with substantially similar content under the writer's authorship has been published or is being considered for publication elsewhere, and the author acknowledges and agrees that the letter and all rights with regard to the letter become the property of CDA.

The Ethics Help Desk

David W. Chambers, EdM, MBA, PhD

Many people use the terms “morals” and “ethics” interchangeably. I do not. Morals is our behavior, especially our habits, which affect others for good or not. Ethics is what we say about it. Morality is a life-time pattern of conduct, mostly evident in not taking advantage of others. When people start talking ethics, I fear they are looking to justify something they recognize as questionable. Sometimes ethics talk is about “somebody else” doing something the speaker disapproves of.

There are some really wonderful people who can not spell nonmaleficence or explain the difference between the CDA Code of Ethics and the ADA Code of Professional Conduct positions on justifiable criticism.

The *Mabinogion* is an ancient Welsh collection of tales. There is a useful one in the story of Culhwch and Olwen. King Arthur met a spirit, rather small and indifferent in form. As the spirit approached, it gradually resembled an incompletely formed man — and it challenged King Arthur to wrestle. The king declined, disdaining the effort and realizing that he would gain little credit for defeating such an inconsiderable character. Repeated challenges were put aside as the creature grew in size. Eventually, Arthur was forced to engage and only barely succeeded in overcoming the spirit. Its Welsh name means “half man;” it is also translated as “habit.”

Morality is a habit, laid down in small pieces over a lifetime. Rarely does it rise to the level of consciousness. It is just part of our identity. It controls the way we see the world. And most of us are not morally deficient, we are morally blind. We have created a world that is comfortable to live in and which distances us from the inconvenience of others. Habits are self-protective.

Moral crises are extremely rare. We have constructed the world so as to avoid them. A common response when we might be thought to be off base is to fabricate a justification for this being a special case. Facility with ethical principles helps; we consult the ethical help desk. But perhaps, like King Arthur, this is a signal that we have waited too long.

“Do I really have to . . .?” The likelihood of doing an online search, reading several chapters in an ethics text or reflecting for a few hours on a moral decision is vanishingly small. The chances of getting advice at the help desk that leads to an ethical conversion is also tiny.

Amos Tversky, the lifetime collaborator of Nobel Laureate Daniel Kahneman, held that the big decisions, such as who one falls in love with, one’s school or first job and what equipment one buys, have a large element of chance in them. It is the small decisions made every day about margins, relating to patients, honest billing and being open to one’s colleagues that define who we are. ■



The nub:

1. Morality is a habit, built over a lifetime.
2. The best time to work on morality is now.
3. Needing ethics often signals a failure of moral identity.

David W. Chambers, EdM, MBA, PhD, is a professor of dental education at the University of the Pacific, Arthur A. Dugoni School of Dentistry, San Francisco, and the editor of the American College of Dentists.



Immune Deficiency Explains Rampant Caries in Children

Researchers at Umeå University in Sweden have made a novel discovery connecting genetic innate immunity deficiencies to rampant caries and increased risk of dental caries affecting about one in five children. The results could lead to a better way of identifying high-risk patients and treat their caries, according to the study published in the journal *EBioMedicine*.

When saliva and isolated bacterial strains from a large number of children were analyzed and the dental health monitored, the research group established that some high-risk children have a more virulent variant of the caries bacterium *Streptococcus mutans*. The same research group now shows that high-risk children also have genetic defects in innate and adaptive immunity, making them more vulnerable against oral bacteria and streptococci in general.

For the study, the research group followed 452 children (between ages 12 and 17) over a five-year period. After genetic analysis of their DNA, the children were divided into various risk groupings based on genetic variation in PRH1 and PRH2, encoding salivary acidic proline-rich proteins. At a five-year follow-up, the researchers could see how caries had developed in the various risk groupings.

The results showed that children with high susceptibility or risk for caries had defective proteins in their saliva. The defective salivary proteins in question were acidic and basic proline-rich proteins and the adhesive protein salivary agglutinin (or DMBT1).

Natural Herb Can Fight Cavities

A new discovery may one day lead to natural anticavity products, researchers report.

Scientists from West China School of Stomatology and Academic Centre for Dentistry in Amsterdam have figured out the main active ingredient of *Galla Chinensis*, a natural herb, and further improved its anticaries efficacy, according to a study published in *The Open Dentistry Journal*.

Galla Chinensis was revealed to inhibit the acid production of caries-associated bacteria as well as make teeth more resistant to acidic attack. However, the main active ingredient of *Galla Chinensis* is unknown, which restricts the application in dentistry.

In the study, several *Galla Chinensis* extracts with different main ingredients were obtained and determined by liquid chromatography-mass spectrometry (LC-MS) analysis. The antibacterial capacity was determined using the polymicrobial biofilms model, which can generate reproducible plaque-like biofilms that occur in vivo. The effect of inhibiting tooth demineralization was tested using an in vitro pH-cycling regime, which mimicked the periodic pH change in the mouth.

"Medium molecular weight gallotannins are the most active constituent in terms of caries prevention," said Xuelian Huang, PhD, DDS, the lead author.

In dental caries, significant reductions in caries prevalence and incidence have been made by the introduction of fluoride. It is not a total cure, however, and there is still a need to seek products complementary to fluoride. With these new findings, the research team is working with the industry to develop new oral care products.

Read more of this study in *The Open Dentistry Journal* (2017); doi:10.2174/1874210601711010447.

(Photo: KENPEI/Wikimedia Commons)



According to the researchers, the defective proteins probably fail to mediate the same innate and adaptive immunity responses that serve to protect individuals with small-to-moderate caries risk from the oral bacterial flora.

The researchers describe how allelic variation in PRH1 and PRH2, encoding acidic proline-rich proteins, separate children into different caries susceptibility or risk groupings. As expected, children with a low-to-moderate

susceptibility or risk for caries along with a genetically intact set of proteins were found to develop caries from bad eating and oral hygiene routines and *S. mutans* infection. However, the children with high susceptibility from the immune deficiency develop caries independent of eating or oral hygiene routines or *S. mutans* infection.

Read more about this study in *EBioMedicine* (2017); doi:org/10.1016/j.ebiom.2017.11.019.

Sugar Industry Manipulated Science To Protect Interests

The sugar industry buried scientific research almost 50 years ago that pointed to negative health effects of sugar and stopped funding the research when it reflected negatively on the industry's interests, according to a new University of California, San Francisco study published in November 2017 in *PLOS Biology*. The study's authors said their analysis of internal documents bolsters

evidence that the sugar industry has manipulated science in order to protect commercial interests and to influence regulations and public opinion.

According to the study, the Sugar Research Foundation (SRF) funded animal research, called Project 259, to evaluate the effects of sucrose on cardiovascular health. Then when evidence from the project seemed to indicate that sucrose



might be associated with heart disease and bladder cancer, the foundation ended the research without publishing the results or revealing any evidence of harm.

"The Sugar Association proved to itself that calories from sugar had different metabolic effects than calories from starch in 1969," said lead author Cristin E. Kearns, DDS, MBA.

The Sugar Association, a U.S. sucrose industry trade group, has consistently denied that sucrose has metabolic effects related to chronic disease beyond caloric effects. But Kearns and her UCSF colleagues previously uncovered a cache of documents revealing that the sugar industry began working closely with nutrition scientists in the mid-1960s to single out fat and cholesterol as the dietary causes of coronary heart disease, downplaying evidence that sucrose consumption was also a risk factor. The researchers reported that the Sugar Research Foundation secretly funded a 1967 review in the *New England Journal of Medicine* discounting evidence linking sucrose consumption to blood lipid levels and coronary heart disease.

In the new study, the researchers provided data suggesting that the SRF nearly five decades ago withheld evidence from the public that the microbiome might be an important contributing factor to sucrose-induced hypertriglyceridemia — or high levels of triglyceride fat — and that sucrose consumption, compared to starch, might be associated with bladder cancer.

If Project 259's findings had been disclosed, sucrose would likely have been scrutinized as a potential carcinogen, the authors said. Learn more about this study in *PLOS Biology* (2017); doi.org/10.1371/journal.pbio.2003460.

Fluoride Test Could Prevent Crippling Bone Disease

A simple color-changing test to detect fluoride in drinking water could in the future prevent the crippling bone disease skeletal fluorosis in developing countries such as India and Tanzania, according to research conducted by the University of Bath and published in the journal *Chemical Communications* in November 2017.

While low amounts of fluoride are beneficial for healthy teeth, high levels of fluoride can weaken bones, leading to skeletal fluorosis. This disease causes crippling deformities of the spine and joints, especially in children.

When water passes over certain minerals, it can dissolve fluoride, which results in elevated levels of fluoride in drinking water sources in parts of East Africa, India, China and North America.

Levels of fluoride in drinking water are routinely monitored and controlled at treatment works in developed countries. However, in areas of the world where there is no piped water system or treatment works, people rely on drawing untreated water from wells that can often be contaminated with higher than recommended levels of fluoride.

The color-changing test detects high levels of fluoride quickly and selectively. It is currently in the proof-of-concept stage but the research team aims to develop it into a disposable test strip that is low cost and easy to use by anyone.

The Bath researchers are partnering with the Nasio Trust, a charity that works to protect and support vulnerable children in East Africa, to develop their system for ease of use in the field.

Learn more about this study in *Chemical Communications* (2017); doi: 10.1039/C7CC07416F.

The test changes color from purple to blue when fluoride levels are too high. (Credit: University of Bath)





Oral Microbiota Indicates Link Between Periodontal Disease, Esophageal Cancer

An analysis of bacteria present in the mouth showed that some types of bacteria that lead to periodontal disease were associated with higher risk of esophageal cancer, according to a study published in *Cancer Research*, a journal of the American Association for Cancer Research.

Jiyoung Ahn, PhD, an associate professor and associate director for population science at the Laura and Isaac Perlmutter Center at New York University Langone Health, said that esophageal cancer is the eighth most common cancer and the sixth leading cause of cancer death worldwide. Because the disease is often not discovered until it has reached an advanced stage, five-year survival rates range from about 15 to 25 percent worldwide.

“Esophageal cancer is a highly fatal cancer, and there is an urgent need for new avenues of prevention, risk stratification and early detection,” Dr. Ahn said.

The study examined whether oral microbiota were associated with subsequent risk of esophageal adenocarcinoma (EAC) or esophageal squamous cell carcinoma (ESCC). Dr. Ahn and colleagues collected oral wash samples from 122,000 participants in two large health studies — the National Cancer Institute Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial and the American Cancer Society Cancer Prevention Study II Nutrition cohort.

In 10 years of follow-up, 106 participants developed esophageal cancer. In a prospective case-control study, the researchers extracted DNA and sequenced oral wash samples,

Oral Pathogens May Predict Precancerous Lesions

A study published in the November 2017 issue of the *Journal of Periodontology* provides new evidence that the increase in pathogens associated with periodontal disease could contribute to the development of precancerous lesions of stomach cancer.

In the study, researchers from the New York University College of Dentistry (NYU Dentistry) and the New York University School of Medicine assessed the association between periodontal pathogen colonization and the potential risk of developing precancerous lesions that may predict stomach cancer. They studied 105 individuals scheduled to receive an upper endoscopy. After the endoscopic procedure and histopathologic evaluation, 35 people were diagnosed with precancerous lesions of gastric cancer and another 70 people of the same ages without precancerous lesions were included in the study as a control group.

The researchers performed full-mouth examinations to assess participants’ periodontal conditions. Saliva and dental plaque samples were collected to evaluate colonization by several pathogens — *P. gingivalis*, *T. denticola*, *T. forsythia* and *A. actinomycetemcomitans* — and to characterize oral microbial diversity.

Compared with the control group, patients with precancerous lesions experienced higher prevalence of bleeding when probed (31.5 percent versus 22.4 percent), higher levels of two pathogens (*T. denticola* and *A. actinomycetemcomitans*) and less bacterial diversity in their saliva.

A further analysis, which took into account sociodemographic factors, oral health behaviors and periodontal assessments, revealed additional predictors of precancerous lesions, including elevated colonization of three pathogens (*T. forsythia*, *T. denticola* and *A. actinomycetemcomitans*), decreased bacterial diversity in dental plaque and not flossing regularly.

The researchers concluded that the colonization of periodontal pathogens and the alternated bacterial diversity in the oral cavity are important factors that, when at higher or lower levels respectively, may contribute to an increased risk of developing precancerous gastric lesions.

Read more of the study in the *Journal of Periodontology* (2017); doi.org/10.1902/jop.2017.160829. (Credit: NYU)



allowing researchers to compare the oral microbiomes of the esophageal cancer cases and the cancer-free cases.

Certain bacteria types were associated with higher risk of esophageal cancer. For example, higher levels of the *Tannerella forsythia* bacteria were associated with a 21

percent increased risk of EAC. The bacteria *Porphyromonas gingivalis* was associated with a higher risk of ESCC. Both species of bacteria are linked with common gum disease.

Learn more about this study in *Cancer Research* (2017); doi: 10.1158/0008-5472.CAN-17-1296.



More than 12,000 records included data on blood lead level and about 5,600 had dental caries examination data. NHANES is the U.S. benchmark for national surveillance of blood lead levels and is the sole national source of dental examination data.

Following an in-home interview, participants visited a mobile examination center where they donated a blood sample, completed a dietary interview and received a dental examination. About 15 percent of the children stated that they did not drink tap water. Tooth decay was defined as the presence of one of more tooth surfaces affected by dental caries as determined by dental examiners using a standardized protocol.

According to the study, children and adolescents who did not drink tap water were more likely than tap-water drinkers to have tooth decay but were less likely to have elevated blood lead levels. Those who drank tap water had significantly higher prevalence of elevated blood lead levels than children who did not drink tap water.

Overall, nearly 3 percent of children and adolescents had elevated blood lead levels and 49.8 percent had tooth decay. Among American children and adolescents, one in five living below the federal poverty level, one in four African Americans and one in three Mexican Americans do not drink tap water, vastly exceeding the one in 12 non-Hispanic white children who do not.

Read more of this study in the *American Journal of Preventive Medicine* (2017); doi: [dx.doi.org/10.1016/j.amepre.2017.09.004](https://doi.org/10.1016/j.amepre.2017.09.004).

Tooth Decay Higher in Children Who Don't Drink Tap Water

American children and adolescents who do not drink tap water, which is typically fluoridated, are much more likely to have tooth decay, according to a study published in the *American Journal of Preventive Medicine*. However, the study confirms that those who drink tap water are more likely to have elevated levels of lead in their blood.

Researchers Anne E. Sanders, PhD, and Gary D. Slade, BDS, PhD, of the department of dental ecology at the University of North Carolina at Chapel Hill, analyzed a nationally representative sample of nearly 16,000 children and adolescents aged 2 to 19 years who participated in the National Health and Nutrition Examination Survey (NHANES) from 2005 to 2014.

New Dental Material Resists Plaque, Kills Microbes

In a new study published in the journal *ACS Applied Materials and Interfaces*, researchers from the University of Pennsylvania School of Dental Medicine evaluated a new dental material tethered with an antimicrobial compound that can not only kill bacteria but can also resist biofilm growth.

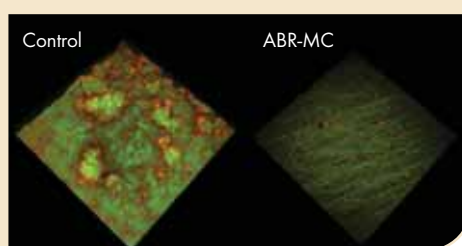
The newly developed material is composed of a resin embedded with the antibacterial agent imidazolium. Unlike some traditional biomaterials, which slowly release a drug, this material is nonleachable, thereby only killing microbes that touch it, reducing the likelihood of antimicrobial resistance.

Researchers put the material through its paces, testing its ability to kill microbes, to prevent growth of biofilms and to withstand mechanical stress. Their results showed it to be effective in killing bacterial cells on contact, severely disrupting the ability of biofilms to grow on its surface. Only negligible amounts of biofilm matrix, the glue that holds clusters of bacteria together, were able to accumulate on the experimental material, in contrast to a control composite material, which showed a steady accumulation of sticky biofilm matrix over time.

Additionally, the team assessed how much shear force was required to remove the biofilm on the experimental material. While the smallest force, such as that equivalent to taking a drink of water, removed almost all the biofilm, even a force four times as strong was incapable of removing the biofilm from the control composite material.

Learn more about this study in *ACS Applied Materials and Interfaces* (2017); doi: [10.1021/acsami.7b11558](https://doi.org/10.1021/acsami.7b11558).

Biofilms composed of *Streptococcus mutans* were much easier to remove when grown on a newly developed dental material (right), compared to a control material. (Credit: University of Pennsylvania)








A photograph of a middle-aged man with a goatee, smiling warmly. He is wearing a dark, button-down shirt over a white t-shirt and a watch on his left wrist. The background is a soft, warm orange. A white-bordered box is overlaid on the right side of the image, containing the text:

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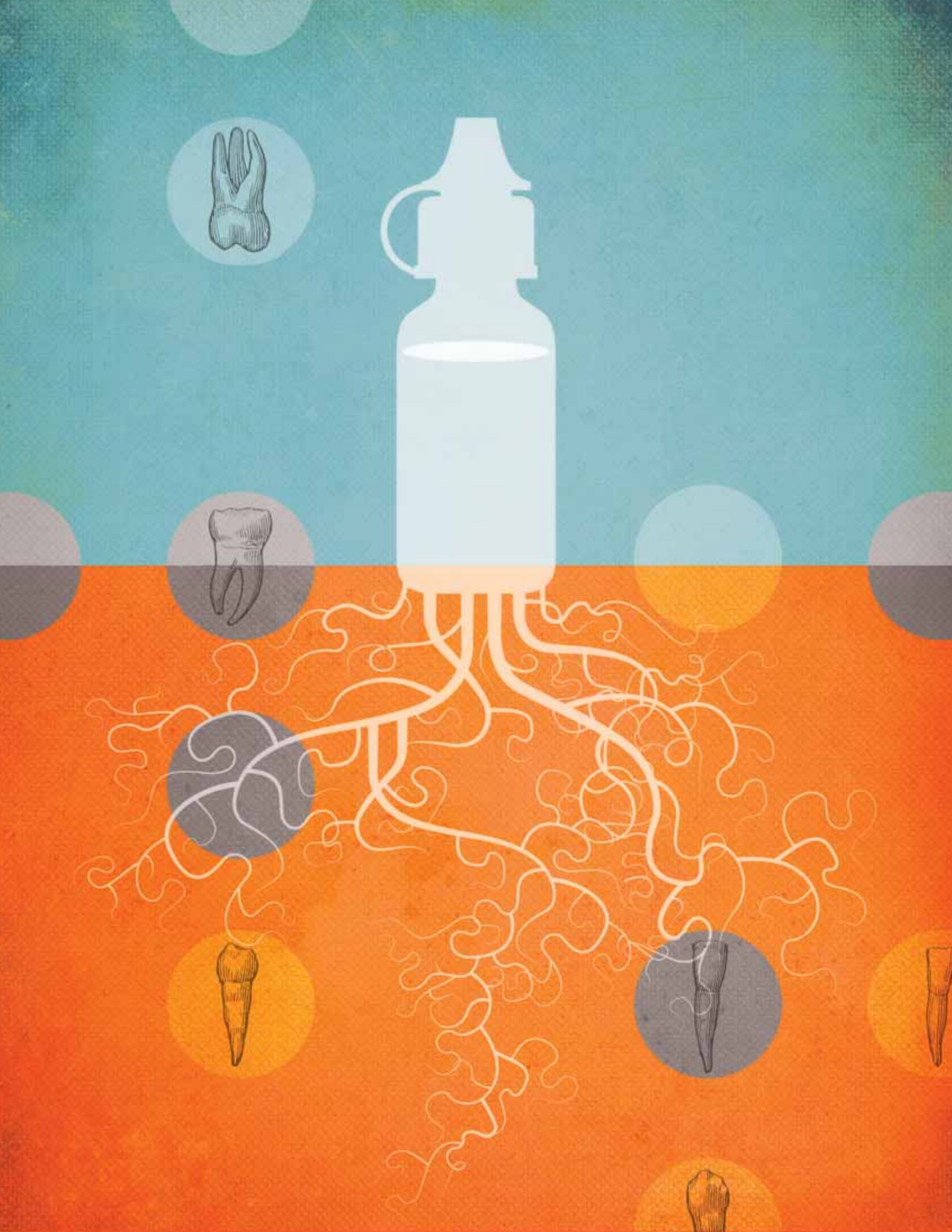
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The logo for the Canadian Dental Association (CDA), featuring the lowercase letters "cda" in a white serif font on an orange square background. The letter "a" has a stylized graphic of three white lines above it, resembling a tooth or a dental instrument.

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Silver Diamine Fluoride — That Old Black Magic Has Me in Its Spell

Paul Reggiardo, DDS

GUEST EDITORS

Paul Reggiardo, DDS, is public policy advocate for the California Society of Pediatric Dentistry. He is a past president of the CSPD and the American Academy of Pediatric Dentistry. Dr. Reggiardo practices pediatric dentistry in Huntington Beach, Calif., and is an adjunct professor of clinical dentistry in the division of public health and pediatric dentistry at the Herman Ostrow School of Dentistry of USC.
Conflict of Interest
Disclosure: None reported.

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Conflict of Interest
Disclosure: None reported.

Well, actually, not that old black magic called love but that new black magic called silver diamine fluoride, which I love. What's not to love in a product and process *The New York Times* labels “better, faster, cheaper” than conventional dental care?¹ In fact, one dental supplier website recommends silver diamine fluoride (SDF) not just for selected cases and populations but “for every person wanting to avoid the anxiety and consequences of dental restorations.”² But, wait a minute. Might we be getting just a little ahead of ourselves here? Following her presentation at the 2017 ADA annual meeting in Atlanta in October, Brooke Fukuoka, DMD, commented, “We can’t just go slapping it all over everybody because it seems like a miracle cure. It does have to be treatment planned and well thought out.”³

So, where does the truth lie and how is the truth applied in the clinical setting? In the first of this two-issue series of the *Journal*, we attempted to frame the answers by presenting a series of articles

on the background and history of the use of silver compounds in dentistry, the role of SDF in caries chronic disease management, lessons learned from the first randomized clinical trial of SDF in the United States and the first evidence-based guideline on the use of silver diamine fluoride to treat caries in pediatric and special needs patients. Developed by the American Academy of Pediatric Dentistry from a systematic literature review, the guideline contained practical guidance on the application of 38% SDF and an application protocol supported by the best-to-date available evidence.

With this as background, in the second of this two-part series our authors take the clinician further to demonstrate that SDF is not just the stuff of university projects, research grants and clinical theory but a day-to-day part of their patient practice. The intent in this issue is something translational to take the practitioner from “I have heard and read about this” to “I am ready to give it a try, but how and what are the reasonable considerations I need to fit it into my total picture of patient care?”

Gary Sabbadini, DDS, a pediatric dentist in clinical practice in Pinole, Calif., leads that effort with a personal account of how he has incorporated SDF into his patient care flow, the decision-making tree he uses to determine, from the available options, the appropriate treatment of each child, and some of his own experiences using SDF.

Jane Gillette, DDS, who provides nursing home oral health care in Bozeman, Mont., through her group practice, provides an entirely different perspective and involvement base.

She describes her experiences treating aging adults with cognitive decline, physical frailty or infirmity, advanced xerostomia, root caries and end-of-life care with chemotherapeutics such as SDF. Like Dr. Sabbadini, she shares her successful clinical protocols.

Looking at another vulnerable population, American Indian/Alaska Native children, Lawrence Robertson, MD, reports on the success of Frank Mendoza, DDS, a 30-year career Indian Health Services (IHS) pediatric dentist, in treating children's non-asymptomatic carious teeth in one

Oregon IHS dental program with a series of applications of 25% silver nitrate followed by 5% sodium fluoride varnish. Using the caries-control protocol explained in the article, the need for dental treatment under general anesthesia in this high-risk population was dramatically reduced.

Adding a cautionary note to the expected success of silver compound therapy, Jeremy Horst, DDS, and co-authors looked at 93 carious lesions in primary teeth treated with silver fluoride compounds in a private practice setting for which pre- and posttreatment radiographs were available and found that further lesion growth was not suppressed or arrested in fully 25 percent of these teeth. The authors speculate that certain carious lesions, perhaps a high percentage, may be unresponsive to silver fluoride compounds and that practitioners must be prepared to provide alternative restorative strategies when lesion progression occurs, rather than continuing with the same regimen.

Augmenting in the final article the discussion as to the optimal SDF protocol, Awra Owais, BDS, and co-authors at the University of Iowa use their research findings on silver compound caries-arresting mechanisms to suggest that application of silver diamine fluoride should be extended to two to three minutes instead of the commonly accepted one-minute application if caries arrestment is to be achieved.

The future is bright, if black. ■

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Silver Diamine Fluoride: A Clinical Perspective From a Pediatric Dentist

Gary D. Sabbadini, DDS

ABSTRACT This commentary reviews how silver diamine fluoride (SDF) has been incorporated into the author's pediatric dental office and the decision-making process for its use.

AUTHOR

Gary D. Sabbadini, DDS, is a diplomate of the American Board of Pediatric Dentistry and a fellow in the International Association of Dentists and the Pierre Fauchard Society. He practices pediatric dentistry in Pinole, Calif. Dr. Sabbadini is the former editor for the California Society of Pediatric Dentistry.
Conflict of Interest Disclosure: None reported.

Silver diamine fluoride (SDF) is one of the hottest topics in dentistry. When an article in *The New York Times* entitled “A Cavity-Fighting Liquid Lets Kids Avoid Dentists’ Drills”¹ was published on July 11, 2016, my office began receiving phone calls and emails from all over the country asking about this “new” treatment. While this article certainly captivated many around the country and gave some people hope that they or their children would no longer be required to have their teeth “drilled,” it may have caused more confusion for the public and for the dental professionals who care for their oral health.

The purpose of this article is not to describe how SDF works or propose a protocol for its use. Many articles have been written for this purpose including two in the *Journal of the California Dental Association*: “Back to the Future: The Medical Management of Caries Introduction” by Steve Duffin, DDS,² and “UCSF Protocol for Caries

Arrest Using Silver Diamine Fluoride: Rationale, Indications and Consent” by Jeremy A. Horst, DDS, PhD, et al.³ This article explains how SDF has been incorporated into my practice and the thought process behind its use.

I have what I consider to be a fairly typical pediatric dental practice. I am a solo practitioner in a working-class area. My practice has a diverse mix of children and young adults of varying ethnicities and socioeconomic backgrounds. Many of my patients have moderate to extensive tooth decay. When I see these patients, I begin to go through a decision-making process on the treatment options taking into account factors such as their age, cooperation level, health, access to care and/or financial constraints (**FIGURE**).

For cooperative children with carious lesions, I will typically recommend that treatment be completed utilizing nitrous oxide/oxygen. Nitrous oxide has the following benefits: anxiolysis, mild analgesia, helps block the dental odors and shields the passing of the dental

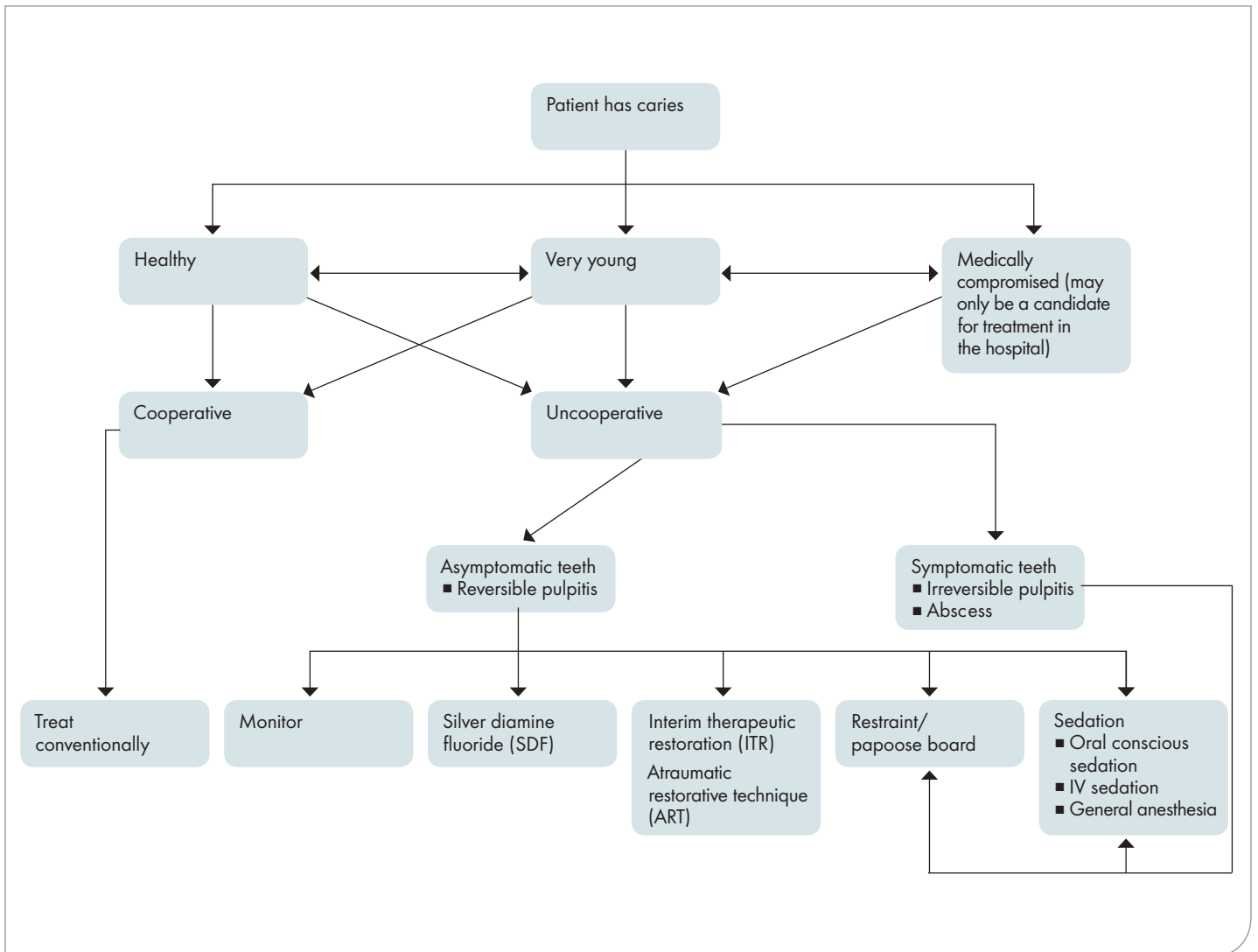


FIGURE. Silver diamine fluoride decision-making tree.

instruments so the patient's anxiety is further reduced. While not ideal, no treatment is always an option for the patient. Whether it be from apprehension, finances or other reasons unknown to us, some parents elect not to treat their children. They are informed that depending upon home care and diet, the caries may get worse potentially leading to pain and/or infection, premature loss of teeth, loss of arch length and more complicated/expensive treatment in the future. Emphasis is placed on decreased frequency and amount of sugar/carbohydrate consumption and improved

home care including increased frequency of toothbrushing and flossing. Prescription 5,000 ppm fluoride toothpaste may be recommended. Some practitioners recommend MI Paste (GC America), although in the literature, results are inconsistent.^{4,5} Xylitol products (wipes, toothpaste, etc.) are also recommended by some pediatric dentists.⁵ For cooperative children, I will typically only recommend SDF if the parents indicate that they do not want to do treatment.

The treatment choices for uncooperative/precooperative patients are much more extensive and complicated.

They are no treatment (covered previously), protective stabilization (restraint), atraumatic restorative treatment (ART), interim therapeutic restoration (ITR), SDF, oral conscious sedation, IV sedation or general anesthesia. I typically limit protective stabilization to treating uncooperative emergency patients, special needs patients or very simple procedures on patients younger than 3 years old who are less likely to remember.⁶ TABLE 1 includes the guidelines for protective stabilization from the American Academy of Pediatric Dentistry reference manual.

TABLE 1

Guideline on Protective Stabilization for Pediatric Dental Patients

Indications for Protective Stabilization

- A patient requires immediate diagnosis and/or urgent limited treatment and cannot cooperate because of emotional and cognitive developmental levels or lack of maturity or medical and physical conditions.
- Emergency care is needed and uncontrolled movements risk the safety of the patient, staff, dentist or parent without the use of protective stabilization.
- A previously cooperative patient quickly becomes uncooperative during the appointment in order to protect the patient's safety and to help expedite completion of treatment.
- A sedated patient may become uncooperative during treatment.
- A patient with special health care needs may experience uncontrolled movements that would be harmful or significantly interfere with the quality of care.

Contraindications for Protective Stabilization

- Cooperative nonsedated patients.
- Patients who cannot be immobilized safely because of associated medical, psychological or physical conditions.
- Patients with a history of physical or psychological trauma due to restraint (unless no other alternatives are available).
- Patients with nonemergent treatment needs in order to accomplish full mouth or multiple quadrant dental rehabilitation.⁷

Source: American Academy of Pediatric Dentistry's *Clinical Practice Guidelines Reference Manual*

I rarely employ ART⁸ or ITR⁹ in my practice. My feeling is that if a patient is cooperative enough to allow either technique, they are probably cooperative enough to definitively restore the tooth. With either technique, caries is removed utilizing hand instruments or a slow-speed round bur without local anesthetic, and the cavity is restored with either a glass ionomer, resin-modified glass ionomer or bioactive material (such as Activa). The patient is typically either in the dental chair or in their parent's lap in a knee-to-knee position with the doctor.

When I first began my career, I did quite a bit of oral conscious sedation and in-office IV sedation because I had extensive training in both through my hospital-based pediatric dental residency program. I feel that there has been a cultural shift over the past few years away from sedating children for dental procedures as fewer parents are scheduling these procedures. Parents are expressing concerns over sedation injuries and deaths for both in-office

anesthesia and dental surgery done in the hospital. Parents and clinicians are receiving conflicting reports about the long-term cognitive problems with young children exposed to anesthesia. An article in *Pediatrics* entitled "Cognition and Brain Structure Following Early Childhood Surgery With Anesthesia"¹⁰ suggests that young children exposed to anesthesia can have long-term cognitive problems. Another article published the same year in *Scientific American* entitled "General Anesthesia Causes No Cognitive Deficit in Infants"¹¹ refutes that claim. The cost is prohibitive for many parents. The cost for oral conscious sedation can run anywhere from \$250 to \$400 per visit, and the cost for a 90-minute procedure with a dental anesthesiologist is about \$1,000. In my office, fewer parents want to finance procedures through health care financing (such as Care Credit) and many are unable to qualify because of poor credit (TABLE 2).

In my opinion, the Affordable Care Act has resulted in many patients having worse dental coverage because it is tied in with their medical insurance. For example, as a specialty provider for Delta Care USA, I have many patients referred to me for care. Up until a few years ago, most of those patients had their dental restorative care covered at almost 100 percent and they were only responsible for the cost of nitrous oxide, oral sedation or IV sedation. Now, they are responsible for paying for a large portion of the restorative procedures plus any sedation expenses resulting in fewer parents having their child receive treatment because of the added cost.

Factors such as the above have resulted in more interest in SDF as an alternative to traditional dental treatment. I have received unsolicited emails from parents looking to SDF as a means of treating their child. Here are a few examples:

"Hello, my name is XXXX. I have read a positive article in The New York Times regarding the use of this product. I am interested in the use of this product for my son who is 1 year and 11 months old to avoid having him put under. He has cavities and I've taken him to see a dentist and he has confirmed there are cavities on several of his teeth. I hope that you can help us. If so please let me know if you have had any success stories following the use of this product. Am attaching some X-rays. Please let me know if he is a possible candidate. Thank you. Am currently living in Los Angeles and would have to make the trip over to your office. Am hoping that perhaps you can let me know beforehand. Thank you for your time and consideration."

"Hello, I am interested in the silver diamine fluoride treatment you have. I live in Redondo Beach, and I was wondering if there are other dentists to whom you could refer me that are nearer to my area. Thank you in advance for your assistance."

TABLE 2

Oral Conscious Sedation vs. IV Sedation

Oral Conscious Sedation		IV Sedation	
Pros	Cons	Pros	Cons
Benzodiazepines can provide anterograde amnesia. ¹²	Child may remember and have psychological trauma.	Patient rarely remembers the procedure.	More expensive than oral sedation.
Child may sleep for some/all of the procedure.	Local anesthetic is required increasing the chance of soft tissue trauma.	All of the treatment will be completed during sedation.	Parental fears/perceptions.
Lower cost per visit than IV sedation.	Potential for lower quality treatment if the patient struggles.	Local anesthetic is not required unless extracting teeth because the patient receives narcotics through the IV.	
Benzodiazepines (flumazenil) and Demerol (naloxone) have reversal agents.	Rarely able to obtain radiographs for a thorough diagnosis.	Radiographs can be taken leading to more accurate diagnosis and treatment planning.	
	May require multiple sedations depending upon the amount of treatment and the amount of local anesthetic necessary.	Quality of treatment is increased.	

For those practitioners who are interested in incorporating SDF into their practice, here is some information they may want to consider:

Which types of carious lesions are candidates for SDF?

Because most of the patients I treat with SDF are uncooperative, I have had the most success treating teeth that allow direct access to the carious lesion (i.e., pit and fissure and smooth surface lesions). It is much more difficult to access the interproximal areas of a tooth on an uncooperative patient. Some practitioners use unwaxed dental floss to carry the SDF in the interproximal space and report good results. In my experience, SDF works best on carious teeth that are asymptomatic although it can be used on teeth with reversible pulpitis as long as the parents are informed that it may not prevent odontogenic infection. I have not tried using SDF on patients with irreversible pulpitis as I have not read anything in the dental literature that it is effective in these cases.

What has been my outcome experience with SDF?

While I don't know the long-term results with SDF because I've only been using it for two years, I define success if the lesion is arrested (hardened) and the tooth is asymptomatic. For those children who return for recall examinations after SDF application, most have had the carious lesions either arrest or have had the caries progression slow down. For the parents who elected to have their children's teeth restored when they were cooperative enough to be treated conventionally, the SDF did not seem to affect the ability to restore the teeth. If practitioners choose to immediately restore the teeth with a resin or glass ionomer after using SDF, they should be prepared to see some darkening of the restoration.

What are the risks with SDF?

Other than some side effects such as staining of the teeth and transient staining if the SDF comes in contact with the skin, there have been no reported adverse reports in more than 80 years of use in Japan.

It is contraindicated in individuals with silver allergy and desquamative processes such as oral ulcerations, ulcerative gingivitis or stomatitis.¹³

Can SDF be used on permanent teeth?

The FDA's definition of diamine silver fluoride (dental hypersensitivity varnish) is that it is "applied to tooth enamel to block dentinal tubules for the purpose of reducing tooth sensitivity,"¹⁴ so it can certainly be used for that purpose. It can also be used in hypoplastic or carious teeth that are either too sensitive or too difficult to restore. I have used it on an adult Down syndrome patient with a large, subgingival carious lesion on a first bicuspid, and it has arrested the caries. She requires protective stabilization and is not a good candidate for oral conscious sedation or in-office IV sedation due to her poor airway.

The public is looking for low-cost, safe, nonsurgical methods to treat children's teeth. While SDF is not a remedy for all dental caries, I am glad that I have a nonsurgical option to offer to parents. My typical protocol for applying SDF is to place petroleum jelly on the lips and around the extraoral tissue of

TABLE 3

One Parent's Thoughts on SDF Treatment

Please explain why you chose to treat your child with silver diamine fluoride?

1. It was more affordable than IV sedation.
2. My husband and family members didn't feel comfortable sedating her because she's younger than when my son had it done.
3. I knew I needed to do something as soon as possible to help my daughter's teeth.

Did this treatment meet your expectations?

No, not really, but I'm hoping that it is helping her. I know it is not to cure or solve her cavity problem, but to help slow it down. Of course, it is better than not having done any kind of treatment.

Do you intend to have your child's teeth restored when she is cooperative enough to have treatment completed without sedation?

Yes, but I know that will be a long way from now.

Would you do this treatment again?

No. In all honesty I wanted to do the IV sedation for her to get treated ALL the cavity problems she has including getting X-rays done. Also because I did the sedation to my son a few years back, so I knew what to expect. I'm afraid her caries are way too advanced for the fluoride to help.

Any other comments?

I thought it was going to stain her teeth a lot more. I sometimes forget her teeth have the fluoride and think her teeth are all rotten and ready to fall out.

the mouth to help protect from staining, dry the teeth as best I can by utilizing either air from the air/water syringe or with gauze or cotton, isolate with gauze or cotton rolls, apply the SDF and let it sit for one minute. The patient is dismissed, and we recommend that the patient be reevaluated in three weeks to determine if the SDF needs to be reapplied. So far, I haven't had any parents report staining of the mucosa or skin. Should this occur, I have read that either a salt slurry or hydrogen peroxide applied to the affected area works well to remove the stain.

To get an idea about what parents think about this treatment, I interviewed a parent who had SDF placed on her 3-year-old daughter's teeth in two separate visits (TABLE 3).

Sadly, many parents in my practice still choose to do nothing because most insurance companies don't reimburse for this treatment and some remark that they don't want their child's teeth to be black. Several of my patients have not come back for recall appointments after application of the SDF. This may be because the parents think nothing else needs to be done,

that the cavities aren't going to get worse or the child isn't in pain. I firmly believe SDF has a place in dentistry as another option for patients. It will be interesting to see if it becomes an accepted treatment modality with the public or if it will fall out of favor like the vaccine for tooth decay that was going to put dentists out of business.¹⁵ ■

ACKNOWLEDGMENT

The author thanks Paul Reggiardo, DDS, and Gayle Mathe, RDH, for inviting him to write an article for this issue of the *Journal*.

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Caries Arresting Approaches for Aging and Medically Complex Patients

Jane Gillette, DDS

ABSTRACT Due to conditions such as infirmity, cognitive decline or xerostomia, older adults frequently experience increased dental disease. Those with advanced frailty or cognitive impairment and dental caries present special challenges for dentists, as comprehensive dental care can be invasive, intensely stressful and sometimes futile in the last years of life. Progressive approaches that use chemotherapeutics, such as silver diamine fluoride, can successfully be utilized to nonsurgically manage dental caries in aging or medically complex patients.

AUTHOR

Jane Gillette, DDS, provides nursing home care in Montana, is a media spokesperson for the ADA on evidence-based dentistry and is the recipient of the 2015 ADA/American Association of Dental Research Evidence-Based Practice Award.
Conflict of Interest
Disclosure: None reported.

With improvements in access to fluorides, oral hygiene products and healthy foods, older adults in the U.S. are not only living longer, but retaining their teeth longer as well.¹⁻³

There have also been gains in untreated disease rates, although still roughly 20 percent of adults aged 75 and older have untreated dental caries.³ This prevalence is arguably higher for low-income adults residing in long-term care facilities, as dental disease rates are higher in low-income populations⁴ and patients residing in long-term care facilities experience greatly restricted access to oral health care services.⁵ A 2011 study conducted in a skilled nursing facility in Minnesota describes this critical issue well.⁶ The study found that depending on cognitive status, 82 to 92 percent of patients entering the nursing home had one or more carious teeth or root retained tips and that those with impaired cognition or dementia suffered disproportionately more.

For older adults, tooth loss can be a serious issue as the presence of teeth can have a substantial impact on socialization, chewing, maintaining adequate weight and nutrition. The consequences of malnutrition in the frail elderly are great, including increased infections, poor wound healing and pressure sores. For those with advanced dementia or Alzheimer's disease, even with the presence of teeth, mealtime can be challenging, as they frequently lose interest in eating, forget how to use utensils and even experience impairments in swallowing.⁷

Caring for the elderly in the last years of life presents special challenges for dentists, particularly for those who are caring for patients who are frail or with brain failure (dementia or Alzheimer's). Foremost, patients with these conditions have a disease trajectory of prolonged dwindling resulting in a slow decline from an already low level of baseline functioning and ultimately to death. However, the time to death is quite variable and may take six to eight years.⁸ It is this variability



FIGURE 1. Jason Tanguay, DDS, assisted in a nursing home by University of Utah first-year dental student Derik Powell. (Photo courtesy of Sydney Judd)

in time to death that makes treatment decisions regarding usual comprehensive dental care versus palliative dental care difficult. The findings of a study that examined dental treatment intensity in the last years of life is revealing in this regard. The study found that most people receive no dental services, but of those who did, a significant number received full comprehensive dental care in their last three months of life.⁵ In addition to being both physically and emotionally stressful for frail elders, this type of care in the last months of life is futile.⁹

Even if dentists could reliably predict the time to death, the time-course of oral conditions (such as dental caries) has its own set of prediction difficulties. Caries is a multifactorial time-dependent disease. Accordingly, carious lesions can remain at a particular stage¹⁰ for months, if not years, or they may progress quickly to an acute phase. The time at which a carious lesion will become an acute dental condition is unknown. It is only known that it *may* sometime in the future become acute. This leaves the dentist with two nearly unanswerable questions which ultimately drive the decision of providing comprehensive dental care versus palliative dental care: When will my patient die and when, if ever, will this caries-affected tooth become an acute dental condition? These are deeply significant issues for dentists to address, because the worst outcome would be for the patient to develop an acute dental condition while at their most vulnerable stage of life.



FIGURE 2A. Second SDF application appointment: before toothbrushing and application of SDF.



FIGURE 2B. Second SDF application appointment: after toothbrushing and application of SDF.

The second factor that dramatically impacts a dentist's decision in providing comprehensive dental care versus palliative dental care is a patient's level of physical and cognitive functioning. A thorough medical history and physical exam can inform a dentist as to the intensity of treatment a patient can safely endure and any needed modifications to care. With respect to cognitive impairment, such as those with advanced dementia or Alzheimer's, Niessen et al. developed a decision support tool dentists can use to assess a patient's ability to cope through dental treatment and to guide the process of deciding appropriate treatment intensity and ongoing care.¹¹ This decision support tool advises intensive prevention at all levels of cognitive impairment, but also advises that patients with mild impairment should be restored quickly to function and patients with advanced brain disease should receive conservative maintenance of the dentition and emergent care.

While the paradigm shift toward treating dental caries as a chronic disease through a medical management approach is not new,¹² dentistry has had a renewed interest in the topic with the relatively recent introduction of Food and Drug Administration-approved silver diamine fluoride (SDF). Silver diamine fluoride, along with other chemotherapeutics, is a valuable treatment option for those caring for aging patients. These nonsurgical approaches for managing dental caries are low-cost, have minimal adverse effects and are easily applied. Silver

diamine fluoride when used alone or in combination can arrest or significantly slow down the caries disease process.

The impact of this rapid halting of the disease is that the unpredictable nature of time to death is no longer an issue. It removes the concern that the patient will endure expensive, stressful and futile surgical care in their last months of life. If the patient's disease trajectory is such that they reach death in five years, the nonsurgical therapy of SDF will have been low-cost and easy for the patient to receive and will have avoided the progression of caries to an acute condition. For a patient with a shorter disease trajectory, if death occurs in the near future, the nonsurgical therapy of SDF will have again been low-cost and easy for the patient to receive and will have avoided the progression of caries to an acute condition in their last, frailest months of life.

Chemotherapeutics for Preventing and Arresting Dental Caries in Older Adults

SDF, alone or in combination with other chemotherapeutics, can successfully treat and prevent dental caries in aging populations. A study evaluating the effects of SDF in arresting root caries in community-dwelling adults found that SDF alone arrested root caries at a rate of 90 percent.¹³ Arguably, those residing in long-term care facilities require special considerations due to their complex medical conditions, severely limited access to routine dental care and insufficient facility-provided daily mouth care.¹⁴ Accordingly, dentists



FIGURE 3A. Third SDF application visit: before toothbrushing and application of SDF.



FIGURE 3B. Third SDF application visit: after toothbrushing and application of SDF.

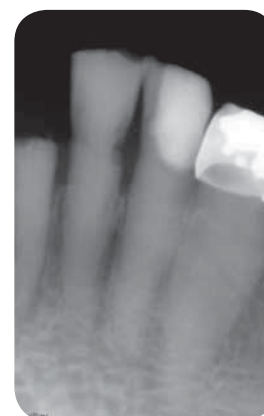


FIGURE 3C. Radiograph of tooth No. 25 shows periapical pathology.

caring for this population additionally use complementary chemotherapeutics such as fluoride varnish, high-dose daily fluoride mouth rinse, chlorhexidine varnish and even povidone-iodine.

For decades, topical fluoride has been the primary approach for preventing and arresting caries. Evidence suggests that three applications per year of 22,500 ppm sodium fluoride varnish may reduce caries in older adults.¹⁵ Daily 0.2% neutral sodium fluoride mouth rinse may have benefits as well, both in terms of preventing and arresting caries. A study conducted in institutionalized adults that compared daily high-dose fluoride mouth rinse to chlorhexidine and placebo reported a 24 percent decrease in new caries and that caries was arrested at a rate of 59 percent.¹⁶ While chlorhexidine mouth rinse in this study was found to increase caries, other evidence suggests that a 1:1 mixture of chlorhexidine/thymol varnish may be effective for managing root caries.¹⁷ Povidone-iodine is another agent that is easy and inexpensive and, if applied at two-month intervals, may have some benefit as well,^{18,19} although studies that have evaluated this approach have been conducted mainly in children. Lastly, though not a caries preventing or arresting agent, pilocarpine lollipops (5g pilocarpine/2g xylitol), which help increase saliva production in patients with xerostomia, have been gaining in popularity. In this technique, patients suck on the lollipop for 15 seconds any time they have the sensation of mouth dryness and/or before meals.

Clinical Technique for Arresting Caries in Older Adults

Federal law requires that skilled nursing facilities ensure that a dentist is available for residents, either by employing a staff dentist or by having a contract with a dentist to provide care. Facilities are additionally required by federal law to ensure residents have access to both 24-hour emergency services and routine dental care (i.e., diagnosis of dental disease, restorations, minor denture care).²⁰ Accordingly, dentists are frequently part of a skilled nursing facility's care team (**FIGURE 1**). The following two cases highlight treatment approaches commonly used by dentists caring for patients in skilled nursing facilities.

Case Presentation One

Palliative care using a caries arrest technique (FIGURES 2A and 2B): Patient is a widowed American Indian who is an 88-year-old female with moderate dental anxiety and has lived in a nursing home for four years. She was diagnosed with advanced dementia, hypertension, hypothyroidism and chronic obstructive pulmonary disease. The patient is being treated with nine medications for her medical conditions, which is resulting in xerostomia. She has restricted mobility, especially in her neck. The maxillary arch is completely edentulous and the remaining teeth on the mandible, Nos. 22, 27, 28 and 29, are carious but not pulpally involved. She has a maxillary denture but does not wear it.

Treatment goals: To provide minimally stressful or invasive care by the delivery of caries arresting chemotherapeutics.

Treatment:

- Apply 38% SDF at three-month intervals. Remove debris with toothbrush. Isolate area with cotton rolls and dry tooth surface with gauze. Dispense one drop of 38% SDF into dappen dish and wet microtip brush. Apply SDF to affected tooth surface for 30 to 60 seconds. Blot dry and apply 5% NaF sodium fluoride varnish.
- Apply 5% NaF sodium fluoride varnish at three-month intervals. Dry teeth and apply fluoride varnish to all surfaces of teeth.

Prescriptions:

- Fluoride dental rinse 0.2%
Disp: 16-ounce bottle
Sig: Nursing staff to brush and swab off of teeth one teaspoon once upon waking, once before bed and after staff-assisted toothbrushing. If possible, avoid eating or drinking for 30 minutes after use.
- 5g pilocarpine/2g xylitol lollipop
Disp: One lollipop
Sig: Suck on lollipop 15 seconds before each meal.

Case Presentation Two

Palliative care using a caries arrest technique and active disease monitoring (FIGURES 3A-3C): Patient is a widowed Caucasian 91-year-old female who has

lived in a nursing home for two years. She has a history of stroke and was diagnosed with a urinary tract infection, hypertension, complete blindness and no use of her right dominant hand. The family and nursing home are discussing beginning “comfort care” (withholding futile curative therapies and relieving suffering during the dying process). The patient is being treated with 12 medications for her medical conditions, which is resulting in xerostomia. The maxillary arch is completely edentulous. The remaining teeth on the mandible are Nos. 22–27 and 22, 23 and 25 are carious. Tooth No. 25 is pulpally involved, but without acute signs or symptoms. She has a maxillary full denture and a mandibular partial denture, which she wears.

Treatment goals: To provide minimally stressful or invasive care by the delivery of caries arresting chemotherapeutics and avoid surgical extraction of tooth No. 25.

Treatment:

- Apply 38% SDF at three-month intervals.
Remove debris with toothbrush. Isolate area with cotton rolls and dry tooth surface with gauze. Dispense one drop of 38% SDF into dappen dish and wet microtip brush. Apply SDF to affected tooth surface for 30 to 60 seconds. Blot dry and apply 5% NaF sodium fluoride varnish.
- Apply 5% NaF sodium fluoride varnish at three-month intervals. Dry teeth and apply fluoride varnish to all surfaces of teeth.
- Active disease monitoring of tooth No. 25.*
Nursing staff to assess daily for changes in clinical signs or symptoms. Dentist to provide limited exam including radiographs at three-month intervals to monitor disease state. Extract tooth No. 25 if it develops into an acute condition.

Prescriptions

- Fluoride dental rinse 0.2%
Disp: 16-ounce bottle
Sig: Nursing staff to brush and swab off of teeth two teaspoons once upon waking and once before bed after staff-assisted toothbrushing. If possible, avoid eating or drinking for 30 minutes after use.
- 5 g pilocarpine/2 g xylitol lollipop
Disp: One lollipop
Sig: Suck on lollipop 15 seconds before each meal.

Conclusion

As the U.S. population rapidly ages, dentists are faced with the increased need to conservatively manage dental caries in their frail elderly patients. Variabilities in time to death and the progression of caries to an acute condition make care planning challenging in this population. Progressive techniques for medically managing the disease of dental caries now makes it possible for dentists to conservatively care for patients, even in their most vulnerable stage of life. Silver diamine fluoride, one of the newest available chemotherapeutics in the U.S., can arrest or greatly slow disease progression. This approach can be used as an alternative to surgical care, which can be invasive and stressful for the elderly. Other more traditional modalities that can be used as well include fluoride varnish, daily high-dose fluoride mouth rinse, chlorhexidine-thymol varnish, povidone-iodine and pilocarpine. Avoiding surgical care in the elderly can enhance quality of life, health and happiness in the last stages of life. ■

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*Active disease monitoring is the purposeful, careful and patient/caregiver-informed monitoring of a significant dental condition that could become acute. It requires an education and monitoring plan for the nursing staff, regular nurse-assisted monitoring of the dental condition, regular dentist-nursing staff communication and informed consent of the patient or power of attorney.



The Warm Springs Model: A Successful Strategy for Children at Very High Risk for Dental Caries

Lawrence D. Robertson, MD, MPH

ABSTRACT American Indian/Alaska Native children have the highest dental caries prevalence in the U.S. Over several decades, Indian Health Service (IHS) implemented various caries control programs, including the recently discontinued seven-year “IHS ECC Collaborative” but without documentation of clinically significant improvement. In 2013, a single Oregon IHS dental program implemented an innovative secondary prevention strategy — now known as “the Warm Springs Model” — that dramatically reduced the need for caries treatment for children under general anesthesia.

AUTHOR

Lawrence D. Robertson, MD, MPH, is a retired pediatrician who worked with Indian Health Service from 1981 to 2001. He has led many studies, projects and conferences on caries in American Indian children. He is currently the president of QUEST, a nonprofit organization.

Conflict of Interest

Disclosure: None reported.

Compared to other health problems of young children in the U.S., caries in the primary dentition is extremely common with about 23 percent of 2- to 5-year-old children having had caries experience.¹ However, it has a low severity for many of the children affected and often does not result in any significant decrease in their quality of life.² In contrast, in many American Indian and Alaska Native (AI/AN) communities, a large proportion of young children experience severe caries that cause pain and disability.³ Decades of efforts by the Indian Health Service[§] (IHS) and tribal groups using all the recommended primary prevention strategies have produced no documented evidence of sustained improvement in

this situation. As a result, in 2017 many AI/AN children still develop caries at a young age and still progress to experience aggressive and extensive disease. This often culminates in the need for multiple restorations and extractions under general anesthesia and results in a huge health disparity compared to the U.S. all-races rate.

The Warm Springs Model Project

In the context of the preceding, in 2013 Frank Mendoza, DDS, — a 30-year career IHS pediatric dentist — decided to implement a different approach. His program had previously achieved a high level of performance in implementing all the recommended primary prevention strategies, including community water system fluoridation,

[§] Indian Health Service (IHS) is an operating division of the U.S. Department of Health and Human Services and is charged with providing health care services to elevate the health status of AI/AN people to the highest level.

personalized and culturally appropriate oral health education on diet and oral hygiene, annual screening in Head Start and Early Head Start, fluoride varnish applications, use of xylitol products and interim therapeutic restorations (ITRs). He even had participated in a three-year Phase 3 FDA-sanctioned clinical efficacy trial to reduce caries in young children.⁴ Despite all this, during the prior decade on average well over 50 percent of the children in the American Indian community he serves had developed such severe caries at an early age that they required restorations and extractions under general anesthesia (GA), representing a health disparity of at least 5,000 percent higher than the U.S. all-races rate.⁵ Because of the above, Dr. Mendoza believed that when primary prevention failed it would be in the best interests of the children to utilize a novel secondary prevention* strategy of utilizing a topical treatment protocol of silver nitrate solution followed by fluoride varnish to treat existing carious lesions that were not yet symptomatic. After researching the literature and talking with dentists in his region who were already using this protocol, he did extensive preparation with the local community, explaining all the pros and cons of this new approach. His proposal to implement this new approach was unanimously approved by the local tribal health authority and by the facility chief executive officer. Although he secured the assent of the IHS headquarters (HQ) chief medical officer to proceed with this plan, he received no active support from the national level IHS Division of Oral Health (DOH).

Methods

While continuing to emphasize and utilize all the recommended primary prevention strategies, when primary prevention failed and a child developed caries, Dr. Mendoza first assessed the level of severity of the child's condition. All children who had symptomatic caries, meaning they met one of the pulpitis, ulceration, fistula or abscess (PUFA) index,⁶ received appropriate pulpal therapy, restorations or extractions according to the recommendations of the American

At the time, none of these dentists had credible data on the most important clinical outcomes — safety and effectiveness.

Academy of Pediatric Dentistry.⁷ For the others, he offered parents the option of treating their children's nonsymptomatic carious teeth with a series of five applications of 25% silver nitrate solution followed by 5% sodium fluoride varnish (SN/FV) over a three-month period. This protocol was at that time being used by a small number of dentists in the Central Oregon area in which he practiced and anecdotally they were reporting considerable success in safety, caries arrest and acceptability to children and parents. However, at the time, none of these dentists had credible data on the most important clinical outcomes — safety and effectiveness.

As the first IHS dentist to utilize this new strategy, Dr. Mendoza understood the need for careful documentation of all aspects of his program. The IHS DOH had a long history of adopting caries control strategies based on interventions reported to show some success in other population groups but without any system in place to secure valid measurement of the effectiveness in AI/AN children. A variety of recommended caries control strategies over the prior 20 years — including community water fluoridation, early access to care, oral health education, motivational interviewing, xylitol, fluoride varnish and dental sealants — had been implemented. Unfortunately, to this day there has not been even a single published credible report of sustained improvement in the oral health status of young children in any AI/AN community from IHS DOH preventive programmatic activities.

In contrast, Dr. Mendoza insisted on having a method to assess all aspects of this project, especially the clinically relevant outcomes. Before treating the first child with this new SN/FV protocol, he worked with a private contractor who developed a customized database and tracking system to document all treatment medications, operative procedures and outcomes, including surface-specific, full-mouth exams at baseline and repeated at three- to six-month intervals. This database also had a full set of preprogrammed reports on clinical outcomes at the child, tooth and surface level, plus administrative measures — such as the number of children enrolled, number of protocol-related visits, proportion of children receiving the recommended treatment schedule and many others. As safety is always the primary concern for any medical or dental treatment approach, the database required specific

*"Secondary prevention aims to reduce the impact of a disease or injury that has already occurred. This is done by detecting and treating disease or injury as soon as possible to halt or slow its progress ..." iwh.on.ca/wrmb/primary-secondary-and-tertiary-prevention (accessed June 15, 2017). When primary prevention of caries fails, safe, effective and feasible secondary prevention can achieve our primary goals for these children.

TABLE 1

Caries Severity at Baseline for Children in Program Year One by Age Group

Baseline age (m)	Number of children	Mean dmfs*	Mean dmft*	Number of children CIPD = 4 [§]	Percent of children CIPD = 4
12-23	11	10.2	5.7	10	91%
24-35	21	8.0	4.5	14	67%
36-47	27	9.5	6.4	19	70%
48-59	27	19.8	8.2	17	63%
All	86	11.9	6.2	60	73%

* decayed, missing, filled surfaces or teeth; [§] the highest level of severity

documentation at each visit whether the child had experienced any adverse events as a result of this new treatment approach.

Before beginning to offer this new treatment option to parents, Dr. Mendoza and his dental assistant did extensive community preparation so that the parents would understand the need for this new approach. This included presentations at local meetings of Head Start and Early Head Start, local radio public service announcements and a three-part series in the local newspaper. He also fully briefed the medical staff of the facility so they would not be surprised if, while doing a medical exam of the mouth, they noted that the child had areas of the teeth that had been stained by the silver ion (Ag⁺) that is the active agent in silver nitrate.

Initial Results

The project was initiated in September 2013 and was readily accepted by the staff, parents and the community at large. Within the first three months, 38 children were enrolled in the protocol, increasing to a total of 60 within the first six months. At that point, it was expected that enrollment would slow down because the backlog of children eligible for the protocol was steadily being reduced. Instead, to everyone's surprise, the rate of enrollment actually *increased* after the six-month point. The most likely explanation is that by this time most of the people in this small community had had some direct or indirect experience with children receiving the protocol and the responses of the children and parents

were highly positive. Thus, it became common for parents to come to the dental clinic and say that the children of their friends or relatives were in the protocol and ask that it be offered to their own child.

Although all aspects of this new project had been locally developed and controlled, Dr. Mendoza was regularly in communication with the IHS DOH to ensure that the senior IHS officials were aware of the purpose and the outcomes of the project. Approximately a year after initiation, based on the very positive and impressive results that were being reported, the IHS HQ chief medical officer authorized a review of the project by two senior IHS dentists. Their evaluation consisted of several metrics:

- **Safety:** Through interviews with staff and patients and through review of the reports available from the customized database, it was obvious that safety was not a concern. Of the 445 treatments administered at that time, there were no clinically significant adverse events.
- **Parent and child acceptance:** The response to this new model was overwhelmingly positive. The IHS HQ reviewers, who were both dentists with extensive experience treating children with severe tooth decay in AI/AN communities, were astonished by how cooperative the young children were — especially on follow-up visits for subsequent treatments. As one of the reviewers noted, “This is the exact opposite of what I

have experienced my entire career. Usually the children are increasingly apprehensive and uncooperative with each successive visit.”

- **Level of disease control:** It needs to be emphasized that the majority of young children who were being treated using this new nontraumatic approach had a very high baseline level of disease, though there is no single accepted metric that defines severity. As noted in a recently proposed caries severity staging system by Robertson et al.,⁸ the commonly used ECC/S-ECC dichotomous nomenclature is of no use when describing high-risk populations of children because it has no inherent linkage with the actual morbidity — i.e., diminishment of the quality of life — the child experiences. The importance of correlating caries levels to the age of the child was noted long ago in the seminal report following the National Institute of Dental and Craniofacial Research Caries Consensus Conference on early childhood caries of 1999⁹ but has never been utilized in a systematic way. The new proposed caries severity staging system defines age-specific stages or “levels” of disease severity, called caries in the primary dentition (CIPD) levels, that are analogous to dozens of medical diseases in which staging is used to describe severity, with cancer staging being the most widely known. According to the staging matrix, CIPD Level-4 is the highest age-specific level and by definition is correlated with substantial morbidity for the child from the disease itself and treatment of the disease.

TABLE 1 shows the baseline caries severity of the children enrolled by Dr. Mendoza during the first 12 months of the project stratified by age group. Of special interest is that the great majority

TABLE 2

Outcomes of the Warm Springs Model Project at 3 ½ Years Assessed in Multiple Dimensions Including Patient-Level and Provider-Level Metrics

	Dimension	Results (210 children)
1.	Baseline patient statistics (which can provide a historical comparison of outcomes)	Baseline data: age: mean=5.9 years; dmft: mean=7.5 (range=1-20); dmfs: mean = 16.2 (range = 1-69); 84.9 percent of children <6 years old at the baseline exam were in the highest level of severity (CIPD-4) according to the described recently published caries severity staging system. ⁸
2.	Community, parent and staff acceptance	After 3 ½ years, Dr. Mendoza, the community, the parents and children all remain highly positive about the Warm Springs Model. In this American Indian community, it is now recognized as the “norm” as opposed to the traditional restorations approach.
3.	Emulation by other programs	Dr. Mendoza has received visits from numerous Indian health care dental providers to be trained in his model of care, plus visits by national leaders in dental public health and caries research.
4.	Proportion of patients who discontinue participation	Ninety percent remain in the protocol, though with declining rates of compliance with the recommended schedule of follow-up exams (~60 percent at 12 months after baseline, 40 percent 18 months later).
5.	Patient-level clinical outcomes	
	Adverse events	No serious adverse events after > 1,000 treatments.
	Fewer traumatic visits	Children consistently are more cooperative with subsequent visits because they quickly learn the visits will not be painful.
	Rate of new caries after the initial treatment	Seventy-five percent have no new caries at the 12-month follow-up (baseline data not available, but Dr. Mendoza’s clinical impression is that the rate of new caries after treatment is much lower than before).
6.	Provider-level clinical outcomes*	
	Number of stainless steel crowns	Five percent of children in the protocol needed treatment in the operating room for crowns and extractions (a dramatic reduction).
	Total invasive restorations	Only 14 percent of children had either SSCs, amalgam or resin restorations (a dramatic reduction).
	Restorations with glass ionomer cement	Eighty-six percent of children receiving restorations had only cosmetic or functional (prevention of food trap) restorations after caries arrest.
	Anesthesia used	General = 11; local anesthesia = 17; N ₂ O = 68; none = 142 (a dramatic reduction in use of general and local anesthesia).

*The Warm Springs Model was a clinical practice project, so detailed comparable data for the interval prior to this project are not available for some of the parameters. Fortunately, for the most important single metric – children requiring treatment under general anesthesia – the data are available.

of children (70 percent) were at the highest level of severity (CIPD-4) at their baseline exam. There are many remarkable aspects of the data shown:

- Even the children in the youngest range (12–23 months of age) had, on average, extensive caries. The mean dmfs/dmft scores were nearly as high as those in the next two age groups.
- Because the expected morbidity from a given dmfs/dmft score in children is highly age specific, the older children had a somewhat lower “severity,” as seen by the lower proportion who have the highest CIPD-4 score, yet most still had extensive disease.

The mutual conclusion of the two IHS HQ reviewers was that this project — which during their visit they named the “Warm Springs Model” — was remarkably successful in the clinical outcomes it was achieving and was equally successful in the level of acceptance by the community, individual parents and especially the children. (Anecdote: When asked by an IHS HQ reviewer how his visit with the dentist had gone, one young child in the protocol smiled, threw both hands up as if he had scored a touchdown and said, “No shots!”) Following receipt of the reviewers’ report, the IHS chief medical officer authorized a cautious expansion of this project to three additional IHS sites.

Longer-Range Results

After the very favorable results of the first year described above, the clinical aspects of this project have continued to progress well, with the number of participants continually increasing — largely due to word of mouth in the community. In fact, the only major concern over the intervening three years was an action by a senior IHS Division of Oral Health official who claimed the Warm Springs Model Project, which at that point had been operational for 2 ½ years, was really clinical research. This official then initiated an urgent review by the national IHS institutional review board (IRB). The ramifications of this

TABLE 3

Community-Based Data (i.e., Head Start Screening) on Children Requiring Restorations and Extractions Under General Anesthesia (GA), Pre- and Postproject Implementation

Time frame	Number screened	Number (percent) already had GA Tx	Number (percent) needed GA Tx	Either had or needed GA Tx	Percent reduction
2013	98	42 (42.9)	23 (23.5)	66.3%	
2015-16	175	50 (28.6)	12 (6.9)	35.4%	46.6%



FIGURE. “Collateral benefit” – an unexpected salutary effect of treatment of adjacent teeth with the SN/FV protocol.

action were potentially severe with the imminent threat of having to shut down the project. Fortunately, the IHS IRB promptly concurred with the health professionals who had developed and implemented the project that it was a “clinical practice” project based on the expert opinion of the dentist on the best treatment for individual children. The IRB also noted that the Warm Springs Model Project did not meet even the most rudimentary requirement for a designation of “research” in that it was never designed as an “investigation,” but rather as a secondary prevention treatment strategy.

Clinical Outcomes at 3 ½ Years and Counting

No single metric encompasses all the dimensions needed to evaluate the success of a caries control project in high-risk children, but **TABLE 2** illustrates several important considerations. Since initiating this project in 2013, Dr. Mendoza has collected extensive data on all clinical inputs (medical treatments and operative procedures), all clinical outcomes (adverse events, level of disease arrest or progression and so forth) in addition to administrative details associated with the project (number of children active or inactive in the protocol, number of protocol treatments done, proportion of children up to date on their treatment and follow-up exam schedule and others). However, there is no historical precedent within the IHS dental program for anything approaching this level of detail of documentation, so it is not possible to

get precise pre-post comparisons. Thus, the comments associated with some of the data elements in **TABLE 2** are based on Dr. Mendoza’s clinical impression of the clinical outcome changes for both the children and providers since the project started. Considering the very high baseline disease severity of children in the protocol (**TABLE 1**) compared to the relative rarity of use of invasive procedures and local or general anesthesia since the project started, the comments regarding a “dramatic reduction” can be seen as highly plausible.

Fortunately, the one clinical outcome for which there are comparable pre- and postproject data is the proportion of children in the community who have such severe tooth decay at an early age that they require treatment under general anesthesia. Each year, Dr. Mendoza has done oral health screenings including surface-specific exams on all the children in the local Head Start program, which a large proportion of the community’s high-risk children of Head Start age attend. This includes children who ever started the Warm Springs Model Project and those who did not. **TABLE 3** shows a comparison of the children screened in 2013 ($n=98$) just prior to the implementation of the SN/FV treatment option with those children screened in 2015–16 ($n=175$). In the latter period, there was a 46.6 percent reduction (66.3 percent – >35.4 percent) in the proportion of children who on exam were determined either to have already had treatment under GA or to be in need of

treatment at the time of the screening exam. There were no other known changes in either population attributes or preventive activities in that period except for the Warm Springs Model Project.

A Serendipitous Finding

An entirely unexpected effect has been what Dr. Mendoza is calling “collateral benefit,” in which mild staining is found in some teeth not directly treated with the SN/FV protocol (**FIGURE**). This effect has been found in the majority of the children in their six-month follow-up exam. The teeth and surfaces showing this collateral benefit had appeared entirely normal prior to treatment of adjacent teeth. Because silver nitrate does not stain normal, healthy enamel,¹⁰ a plausible assumption is that these areas of collateral benefit mild staining represent either very early demineralization that was not clinically recognized or mild qualitative enamel defects. In either case, it is likewise plausible that this will be beneficial in that the silver ions have precipitated into this unhealthy enamel. Data collection and evaluation of this collateral benefit is ongoing and will be reported later in this article.

Telling the Full Story

Despite the many positive outcomes demonstrated by Dr. Mendoza’s Warm Springs Model Project, it is essential that the full story be told about the effect of this project on *all of the children in the community* — not just those who enrolled into and followed the protocol. There

has been an 87.4 percent reduction in restorations and extractions under GA for the children who ever were in the project, including those who received only a single treatment and were lost to follow-up. However, this constitutes a reduction of only about 50 percent for all children in the community, with 40 children requiring treatment under GA in 2016. Despite the ready availability of this safe, effective, feasible and acceptable medical management of caries in young children, it is not uncommon for children to arrive at the dental clinic for the first time who already are symptomatic — usually with one or more teeth with pulpitis or abscesses. These children are, by definition, not candidates for a medical management of caries approach. Also, a small number of children start the protocol but are soon lost to follow-up and return many months later with symptomatic caries. Each of these situations represents a classic *systems failure* — not a failure of the dental clinic, parent or community. In AI/AN communities, it is highly likely that these children will have been seen in either the medical clinic or other public health setting such as the Women, Infants and Children (WIC) program. Many IHS clinics, including Warm Springs, maintain a rate of >90 percent of young children up to date for all of the recommended childhood immunizations, which involves a much more complex schedule than that recommended by the Warm Springs Model Project. This is *prima facie* evidence that a formal medical-dental collaboration could greatly potentiate the community-level effectiveness of this approach.

The other part of the “full story” is that Dr. Mendoza’s treatment strategy has evolved over the duration of this project. This is both appropriate and expected as he was the pioneer in Indian health care to utilize this approach. The principal modifications of his original protocol are:

- Treating children at an older age than expected originally (mean baseline age = 5.9 years). This was usually at the request of a satisfied parent who had a younger child receive this treatment.
- Retreatment of children beyond the initial recommended series of treatments for even the most minor lesions — again, often at the request of the parent.
- Treating with SN/FV the earliest identifiable stage of caries (d1),¹¹ at which time there is only

Each of these situations represents a classic *systems failure* — not a failure of the dental clinic, parent or community.

demineralization and no detectable cavitation although no known published data supports the efficacy of this approach in any population of children — much less in AI/AN children. However, there is every indication this will be a safe approach and, given the exceptionally high proportion of children who without treatment progress to severe disease, seems to be in the best interests of the child.

- Treating with SN/FV what appear to be enamel defects *prior* to the onset of caries. (Same qualifiers as bullet three.)
- Understanding the “art” of using this modality. Dr. Mendoza utilizes an informal, multifaceted decision algorithm to form his

expert opinion on what will be the best option for the child. This includes the age of the child, specific tooth and surface involved, expected level of difficulty for the child keeping on schedule with the recommended protocol and so forth. He is not constrained by a rigid research protocol.

- Gaining experience on enhancing the esthetics of treatment with SN/FV. Considering that Ag⁺ has been used to treat caries in children for decades and given the astonishing number of published reports (850) on using SDF to treat caries in children,¹² it is amazing that at this time there are only anecdotal reports on how to mask the resultant coloration of treated lesions. Dr. Mendoza’s experience has been that a lot of the parents are not very concerned about the coloration and accept his explanation that the dark stain means “the medication is working.” When a few parents have requested a more aesthetic result, he has used a resin primer/bonder material followed by one or more thin layers of a white opaque dental sealant, which has been very acceptable to parents.
- Recognition that even when the active caries has been arrested, if there is a sizeable cavity remaining it will collect food debris and be likely to have recurrent caries unless restored.

Discussion

When possible, primary prevention of disease is nearly always preferred. Caries in young children is hypothetically preventable through a combination of a favorable prenatal environment for tooth development followed by a favorable

postnatal environment of limited exposure to cariogenic bacteria, good hygiene and a noncariogenic diet. It is an unfortunate truism that these “favorable conditions” are unobtainable for many minority and low-income children. Thus, despite the best efforts of parents and concerned health professionals, primary prevention often fails and the child develops caries. This is frequently ascribed to failure of the parents, failure of the providers or failure of the communities themselves. However, the conclusion by a large group of nationally prominent caries researchers and dental public health experts at the 2010 Symposium on Caries in AI/AN Children¹³ was that the principal failure is the vast knowledge gaps that remain in our understanding of this disease. At that time, this included the absence of safe, effective, feasible and acceptable secondary prevention agents. As described above, this has now changed.

In the traditional model of caries management in young children, when primary prevention fails, the invasive surgical restorative approach has been the standard. However, there is a unique feature of caries in the primary dentition that greatly facilitates our approach to secondary prevention to minimize the trauma to the child. Namely, the end organ that sustains the damage from caries — the primary dentition — naturally exfoliates within a few years. This felicitous happenstance completely changes our strategy as compared to treatment of caries in the adult dentition, which needs a remedy that will last for decades. As a result, our fundamental overall goals for young children in high-risk communities who develop caries are simple and straight forward. Until the primary dentition exfoliates:

- Keep the children out of pain from the disease itself and the trauma of invasive treatments.

- Ensure that carious teeth are managed in a way that minimizes the need for extraction thus keeping them in the mouth as guides for the developing adult dentition.

As recently as five years ago, there was no credible data of an efficacious, noninvasive, secondary prevention strategy being used in high-risk populations of children in the U.S. to achieve these two goals. Now there is. Within the Indian health care community, it is called the Warm Springs Model. Note: It is imperative that this approach

Our fundamental overall goals for young children in high-risk communities who develop caries are simple and straight forward.

not be interpreted as simply “slathering the teeth with silver nitrate,” in the unfortunate words of one critic in the past. Rather, at its most fundamental level, it is designed to provide the care that will be in the best interests of the child and requires:

- Providing the parents with all available information and allowing them to be involved in the decision on how to proceed.
- Doing meticulous documentation and data collection of all treatments, procedures and outcomes so that future treatment will be based on clinically relevant data, rather than a combination of clinical impressions and recommendations based on studies that may have little relevance to AI/AN children.

Conclusion

We often see “success stories” in the literature on caries control in young children, with most of them describing primary prevention strategies. However, we do not often see a full explication of the “attributes of success” at the child, family, provider and institutional level. Successful interventions obtained in projects or studies in which there is a high level of infrastructure and stability within the health care system of interest are of minimal generalizability. These are exactly the attributes that are unattainable in a large proportion of small field clinic situations, such as many AI/AN communities or communities served by federally qualified health centers. One of the most attractive and encouraging aspects of Dr. Mendoza’s Warm Springs Model Project is that it does not depend on the above attributes. Based on 3 ½ years of experience, it now appears that the essential components are:

- A local champion (the sine qua non of any new project of any kind).
- A supportive administrator.
- Access to the children at an early age before their caries becomes symptomatic.

One might think that having a “supportive community” would also be essential, but Dr. Mendoza’s experience with the Warm Springs Model Project is that if a safe, effective, nontraumatic alternative is offered, the parents will be supportive and will become advocates and active recruiters for other families.

Last, relying on the dental program alone to handle all the treatments and exams and tracking and recall is a guarantee that a substantial number of the children will “fall through the cracks.” An analysis of the “failures” of Dr. Mendoza’s Warm Springs Model Project clearly indicates it will be much more effective at the community level

if it includes a formal collaboration between the dental program and other programs that routinely provide services to young children, such as the local medical program, Head Start, Early Head Start and WIC. Such a collaboration would greatly enhance early case-finding, tracking and recall and could essentially eliminate very severe tooth decay in young children and thus the need for restorations and extractions under GA. For many AI/AN communities, this would constitute an unimaginably large improvement in the oral health status and quality of life of the children. ■

ACKNOWLEDGMENT

The author acknowledges the truly remarkable work of the architect of the project that is the subject of this report – Dr. Frank Mendoza. In addition to having had a long career working to improve the oral health status of American Indian children, he implemented this highly successful new model of care despite organizational barriers that would have deterred most others. The author also acknowledges and thanks three other career Indian Health Service dentists – Drs. Patrick Blahut, Gary Pannabecker and Mary Beth Johnson – each of whom made a unique contribution to the effort and without whose support the entire project might have failed. Last and most important, the author thanks the members of Confederated Tribe of Warm Springs, without whose trust and support the project would never had been started.

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Radiographic Changes Following Treatment of Dental Caries With Silver Fluoride

Jeremy A. Horst, DDS, PhD; Steven Duffin, DDS, MBA; Sherrie Sanchez; and Michael Bratland, DMD

ABSTRACT Topical silver-fluoride combinations are increasingly used to treat dental carious lesions. Clinical trials showing arrest of dentin lesions have used visual-tactile examination only, assessing the outermost layer with no evaluation of the inner lesion. Similar rates of nongrowth were found retrospectively by radiographic analysis of 18 patients with 93 lesions. Analysis of the 23 treated lesions that grew suggests that carious lesions observed to grow within six months may not be responsive to treatment with silver fluoride only.

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Conflict of Interest Disclosure: None reported.

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An academic recommendation was issued for off-label use of 38% w/v silver diamine fluoride (SDF) to treat and prevent dental carious lesions,¹ and dental organizations such as the American Dental Association and Academy of Pediatric Dentistry have followed. SDF treatment is gaining popularity, as there is no need for local anesthesia, drilling, rubber dams or adjusting the bite, which previously limited caries treatment to operative and prosthetic approaches. Various aqueous silver and fluoride combinations have been employed in research and practice, including different concentrations of SDF, silver fluoride and silver nitrate followed by fluoride varnish; these will collectively be referred to as silver fluoride.

Eleven randomized clinical trials published in English collectively show that SDF works to arrest active dental carious lesions in children²⁻⁶ and older adults^{7,8} while lower concentrations available in other countries work as well, albeit with less potency.^{5,9-12} The outcomes in these studies of “caries arrest” is an accepted standard diagnosis listed as code K02.3 in the World Health Organization’s International Statistical Classification of Diseases and Related Health Problems (ICD-10). A dose-dependent effect has been demonstrated for both SDF concentration and application frequency.^{5,9} At least annual reapplication appears to be imperative for long-term success.^{1,6} Yet some carious lesions continue to grow after SDF treatment.²⁻¹²

Concern has been raised in recent scientific meetings that assessment of caries arrest in clinical trials of SDF may be compromised due to the potential for study examiners to be unblinded by the black staining of lesions (detection bias) and the validity of visual-tactile assessment for carious lesion arrest. The former is a classic concern that universally plagues studies of carious lesion treatment (e.g., composite versus amalgam) and nonetheless remains a potential source of bias. Visual-tactile assessment and caries arrest itself were validated previous to the widespread use of SDF,^{13,14} although a lack of details on visual-tactile technique in SDF trial reports has led some critics to continue questioning the accuracy of caries arrest figures. The chemically induced hardening of the lesion surface by SDF could artificially mimic true caries arrest. The mechanism of caries arrest by SDF is understood to be not only the kill of bacteria in carious lesions immediately upon application and again when reactivated by recurrent bacterial insult,¹⁵ but the chemical hardening of carious tooth structures.¹⁶ Thus it is plausible that a lesion could remain active under the superficial hard layer. Radiographic assessment of caries progression over time may therefore be indicated, as it is not susceptible to either of these weaknesses.

Systematic Literature Review

To determine whether the outcome of caries arrest had been previously assessed using radiographic changes, a literature review was designed to search PubMed using the following search terms: “33040-28-7” or “1Z00ZK3E66” or “silver diamine fluoride” or “silver fluoride” or “silver diamine fluoride” or “diammine silver fluoride” or “ammoniacal silver fluoride” or “ammoniacal silver fluoride” and “radiograph” or “radiographic” or “radiography.” Four papers were

found by the literature search.^{12,17-19} One paper described a protocol for an ongoing clinical trial¹⁸ and another mentioned radiographic examination at a 12-week follow-up examination in the methodology section, but made no report on any results of the radiography.¹⁷

One completed clinical trial used radiographs to identify growth of enamel lesions into dentin. The arrest of active enamel lesions in permanent molars was compared between three applications of 10% SDF in two weeks, low-viscosity glass ionomer cement and brushing

It appears that increases in density of carious dentin is observed (suggestive of remineralization) but not requisite for carious lesion arrest by silver fluoride.

instructions.¹² Activity assessment was adapted from previous work to differentiate lesions that were entirely active from those that were partially or completely arrested.²⁰ Nearly all lesions in the 10% SDF group were arrested within three months; all were determined to be arrested by 12 months and stayed arrested through the 30-month evaluation. None progressed to dentin radiographically. No images were shown in the report.

Another paper reported a study that validated visual determination of continuous blackening across a lesion in the assessment of the dentin carious lesions activity against growth in bitewing radiographs six months after treatment with both 40% silver fluoride and 10% stannous fluoride.¹⁹ A previous clinical trial paper reported that 100 percent of

SDF-treated arrested caries were black but did not assess the prevalence of arrest among completely blackened lesions.²¹ For the 47 patients in the validation study with uninterrupted black lesions, the radiographically measured progression of lesions toward the pulp ranged from 0.83 to -0.59 mm. The mean growth and standard deviation was 0.00 ± 0.23 mm and interquartile range was -0.12 to 0.00 mm. The corresponding figures for patients with nonretained or interrupted black lesions were as follows: range: 0.70 to -0.46 mm, mean: 0.26 ± 0.25 mm and interquartile range: 0.12 to 0.47 mm. The diagnostic accuracy of continuous blackening across a lesion at follow-up compared to the gold standard of radiographic growth was 80 percent in sensitivity and 81 percent in specificity. Indeed, lack of continuous black color to the lesion surface signified 4.6 times greater likelihood of lesion growth. No images were shown in the report. The finding of decreased depth for many dentin lesions documents the increased density of treated lesions. This suggests that silver and/or fluoride incorporated into demineralized dentin perceptibly rebuilds the dentin bulk to increase resistance to the disease process.

Another paper known to the authors, but not found in the literature search, used the same 40% silver fluoride and 10% stannous fluoride protocol above, 30 years prior, to treat carious lesions in children. Outcomes were monitored for 24 months with radiographs.²² Of the 86 lesions that were initially in enamel or the dentinoenamel junction, 19 were observed radiographically to progress into the dentin and three were treated operatively. Of the 113 that were initially within the dentin but >1mm from the pulp, 57 progressed radiographically to within 1 mm from the pulp and 34 were treated operatively. Of the 82 lesions that were initially within > 1mm from the pulp, 59 progressed

radiographically and were treated operatively. Proximal lesions were roughly twice as likely to progress as occlusal lesions of the corresponding baseline depth, which matches the distribution of treatment failure likelihood observed in a recent clinical trial.⁵ No images were shown in the report and no unique features of radiographic changes were noted beyond the decreased lesion depth.

From these reports, it appears that increases in density of carious dentin is observed (suggestive of remineralization) but not requisite for carious lesion arrest by silver fluoride. Blackening of the lesion surface is highly associated with arrest, but also not requisite. No other features of treatment success or failure were noted to be any different than in other situations. The focus instead has been on growth of lesions over time. Determination of lesion growth by radiography requires taking images over time, particularly from the beginning of treatment.

Methods

A retrospective analysis was carried out to investigate the relationship of topical silver fluoride treatment to radiographic changes indicative of carious lesion responses. Patients were seen for routine oral care by one author (JAH) and colleagues in a private practice in Alameda County, California, with >15,000 active patients. Charts were searched digitally in April 2016 according to the inclusion criteria below. Available images through April 2016 were de-identified and encoded with reference to the time corresponding to initial silver fluoride treatments. Nearly all patients had been treated with a regimen of evenly distributing either two or four applications per year, using a protocol matching the UCSF protocol for silver diamine fluoride¹ except with no rinse and therefore no waiting after application.

Inclusion criteria:

- Custom billing code corresponding to silver fluoride treatment (25% silver nitrate and fluoride varnish or 38% silver diamine fluoride) at any visit.
- A radiograph of the treated area prior to silver fluoride treatment (at most one month before).
- At least one radiograph of the treated area any time after silver fluoride treatment.
- At least one carious lesion apparent in the initial radiograph (in enamel or dentin).

Radiographic Measurements

Lesion growth was determined by the treating clinician using radiographs and visual-tactile examination. Visual examination followed the Nyvad criteria focusing on the surface texture of the lesion¹⁴ and did not require any or all of the lesion to be black. If multiple posttreatment radiographs were available for an area, the most recent was used. Lesions clinically determined to have grown were de-identified and measured as follows. Images were imported into Illustrator (Adobe) and the line segment tool was used to draw a line from the middle of the lesion at the dentinoenamel junction to the closest extent of the pulp. The length of the line in pixels was rounded to whole numbers. The line was then shortened along the same vector from the pulp to the deepest extent of the lesion and the whole number length taken again (**FIGURE 1**).

Alternative Silver Fluoride Combinations

The combination of 25% w/v silver nitrate and 5% sodium fluoride varnish (SN+FV) was adopted by the author (JAH) in January 2014 from the earlier suggestion in this *Journal*,²³ until August 2014 when SDF was cleared by the FDA. Saforide

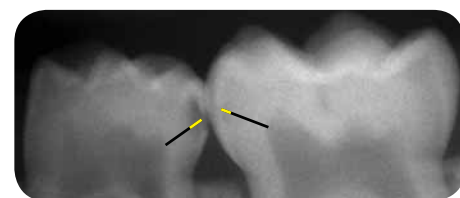


FIGURE 1. Carious lesion depth measurement. To determine lesion depth, a line is drawn from the center of the lesion at the dentinoenamel junction to the nearest definitive reach of the pulp (black line), then a copy of the line is overlain and shortened to the edge of the lesion along the same vector (yellow line). The ratio of the lengths of these lines is taken as the lesion depth.

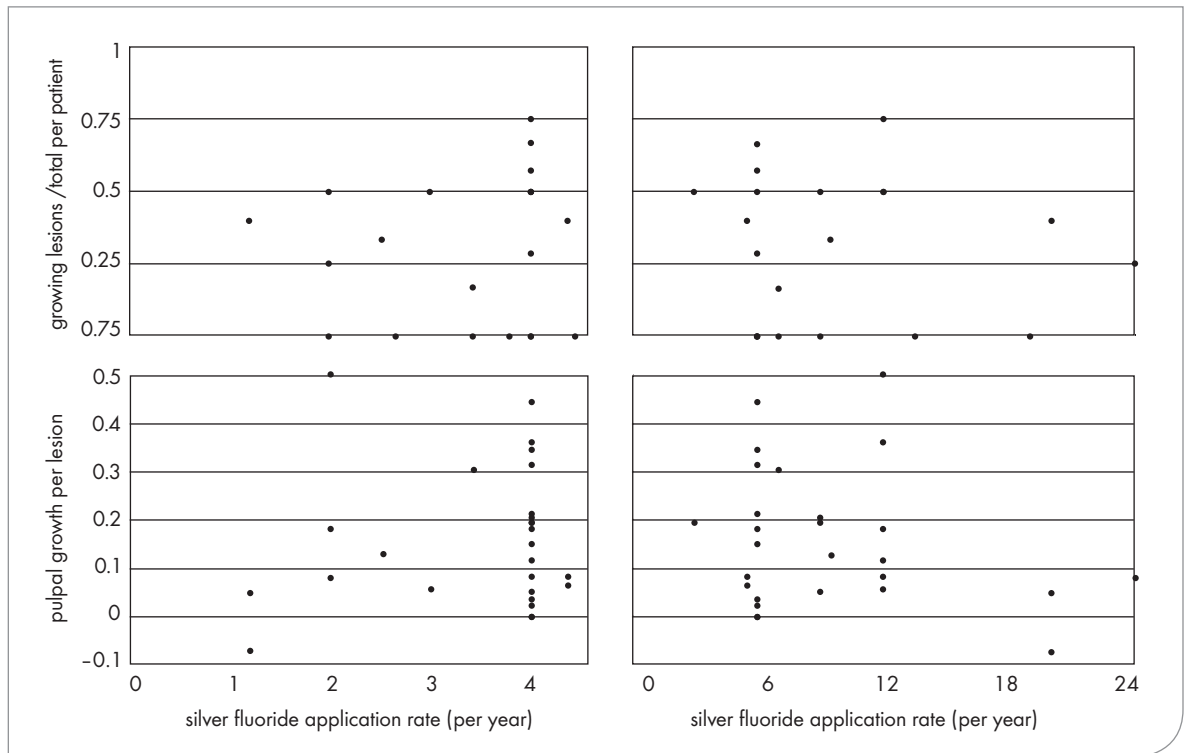
(Toyo Seiyaku Kasei Co. Ltd., Osaka, Japan) was then used until Advantage Arrest (Elevate Oral Care, West Palm Beach, FL.) became available in late April 2015. The rationale is that SDF and SN+FV involve similar approaches to deliver the same chemicals. A similar rationale was taken by the Craig group in the works mentioned above, employing 40% w/v silver fluoride without the ammonia and 10% stannous fluoride as a precipitant and to provide additional metal and fluoride ions. In SDF, the weight per volume ratios are 25% silver, 8% ammonia, 5% fluoride and 62% water. In 25% silver nitrate, there is 16% silver, 9% nitrate and 75% water (Gordon Labs, Upper Darby Pa.; 50% is also available) and in fluoride varnish there is 2.3% fluoride (many products available). Indeed, ex vivo laboratory studies show no differences between SN+FV and SDF in stopping dentin demineralization by pH cycling.²⁴ The two approaches are also being compared directly in an ongoing clinical trial.²⁵ In fact, SDF was developed to incorporate the then recently discovered effects of topical fluoride with the long history of partially successful caries arrest with silver nitrate.²⁶ As noted above, these materials are referred to collectively below as “silver fluoride.”

Results

The custom billing code for the period between January 2014 and April 2016 identified 331 patients. The mean age at first treatment was 4.7 years (standard deviation \pm 2.0, range

FIGURE 2.

The relationship of carious lesion growth to silver fluoride applications. No correlation was observed between the frequency of silver fluoride applications and the proportion of lesions that grew radiographically (top, left) or the extent of pulpal growth for lesions that did grow (bottom, left). No correlation was observed between the radiographic follow-up time and the growth of lesions (panels at right). Radiographs six months after initial treatment was sufficient to observe lesion growth.



1–12). Surprisingly, radiographs were only available < 1 month prior to silver fluoride treatment and at any follow-up thereafter for 18 patients. This low proportion is attributed to a connection between the selection of topical rather than operative treatment and the less-developed coping skills of the child.

The patients received 2.5 ± 1.2 applications of silver fluoride to all lesions (range 1–6) over 9.0 ± 4.6 months (mean \pm standard deviation; range 3–24). The radiographs captured 93 lesions with 4.9 ± 3.1 per patient (range 2–15). The corresponding 93 teeth were distributed in alphabetical order from A to T: 6, 8, 3, 2, 3, 3, 2, 2, 9, 7, 9, 9, 2, 1, 1, 1, 1, 3, 10, 11. Of the 93 radiographically visible lesions, 23 (25 percent) were clinically determined to have grown.

Visible early enamel lesions that were not radiographically apparent were noted in patient records; none of these were observed to grow visually or radiographically. In total, 0.31 ± 0.60 new

lesions grew in these patients during the same time period (range 0–2).

No relationship was observed between the proportion of growing lesions per patient and the amount or frequency of silver fluoride applications they had received (Pearson's $R < 0.1$, **FIGURE 2**, top). No relationship was seen between the amount or frequency of silver fluoride applications and the extent of growth toward the pulp (Pearson's $R < 0.1$, **FIGURE 2**, bottom). Similar responses were observed when using SN + FV or SDF. No lesions that grew following SN + FV treatment were arrested upon the switch to SDF.

Complete concordance was observed between visual-tactile examination of directly accessible lesions and apparent radiographic growth (in any direction). As shown in **FIGURE 2**, bottom, a range of lesion size with respect to the pulp was observed, including one that became smaller. The lesion that did not change size by the applied measure did grow

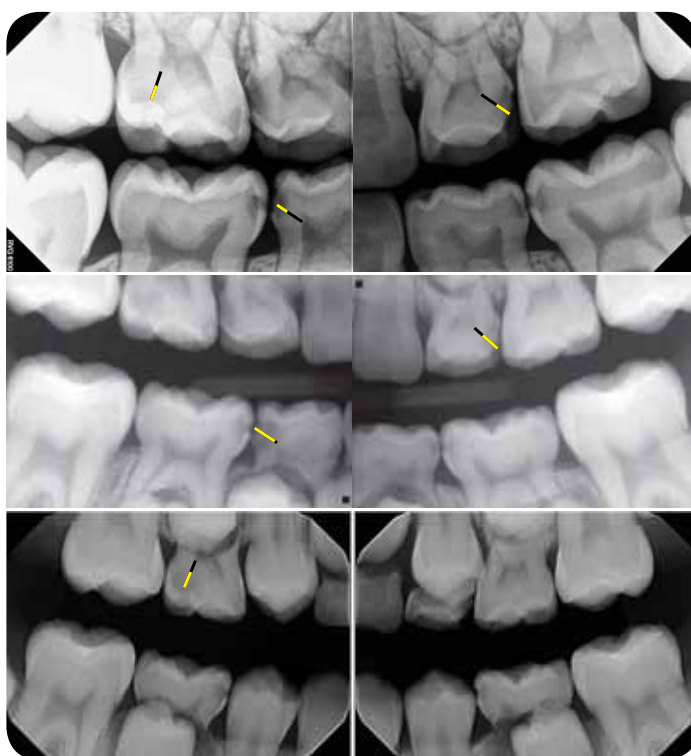
from one-quarter to one-half depth in the enamel. Effects of non-ideal angulation of the radiographs on the measured lesion and pulpal depths cannot be ruled out.

Discussion

The increasing use of topical silver fluoride for management of carious lesions demands a better understanding of how to monitor treatment success and failure. This literature review and the retrospective case series were carried out on radiographic changes following silver fluoride therapy to understand changes at the bottom of lesions, which cannot be observed by visual-tactile examination.

Of the 93 lesions in the case series that were imaged before and 9.0 ± 4.6 months after initiating treatment in 18 patients, 66 (71 percent) did not grow. This falls within the 81 percent (95 percent confidence interval: 68–89 percent) effectiveness of SDF caries arrest in children measured by meta-analysis of eight clinical trials.²⁷ No unique

FIGURE 3. Two-year follow-up of topical silver fluoride treatment. Bitewing radiographs are shown at baseline (top), one year (middle) and two years (bottom) following initiation of silver fluoride treatment. Of the seven primary molars with lesions initially, three grew (A, J, S) and one new lesion appeared (J distal). Lesions that grew were on teeth that would soon exfoliate and thus were not treated operatively. All primary teeth have now exfoliated with no pulpitis and no lesions on permanent teeth. Measurement lines are shown as in FIGURE 1. (Image courtesy of Linh Tsai, DDS)



changes were observed. All lesions that were diagnosed as arrested by visual-tactile examination were confirmed to not grow radiographically. Those that did grow, grew 16 ± 14 percent of the distance from the dentinoenamel junction to the pulp. No comparator group was feasible at this time, as most comparable lesions would otherwise be treated operatively in this clinic. In these patients, 0.31 ± 0.60 new lesions were observed, which appears to be low for caries active patients in this population.

Weaknesses of the Lesion Growth Measurement

As described in the methods section, multiple approaches were used to determine which lesions grew. The method used here to determine the extent of lesion growth for the lesions that grew underestimates actual lesion growth, as secondary or reparative dentin formation would increase the distance from the dentinoenamel junction to the pulp and

thereby decrease the fraction of growth to pulpal distance. However, the measure used may be more relevant, as the distance from the lesion to the pulp represents the clinically relevant risks of deep excavation, pulpitis and necrosis. Nonetheless, some lesions that grew only slightly relative to the pulp grew substantially in circumferential extent such that significant tooth structure was lost.

Identification of early enamel lesions by radiography is not optimal. Yet other means to identify interproximal lesions are not practical. It is plausible that some lesions judged to represent new lesions growth were already present at baseline. No lesions deemed as new grew into the dentin.

Lesion Growth Patterns

Although measurement focused on growth of lesions between the dentinoenamel junction and the pulp, it was clear that the pulp receded in many cases. In some established dentin

lesions that grew, growth occurred circumferential to the pulp rather than directly toward the pulp. These observations support the idea that, at least in some cases, silver fluoride treatment does not damage the functional capacity of the dentinopulpal complex to produce secondary dentin and fight off infection.²⁸

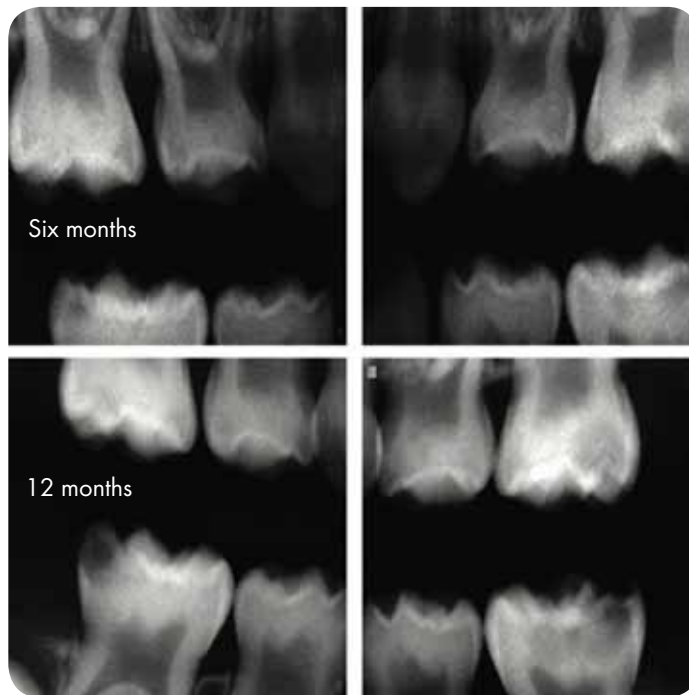
Patterns of growing versus nongrowing lesions within patients may be instructive. In one patient, lesions in three of seven teeth continued to grow despite biannual SDF treatment (FIGURE 3). No pattern is observed in the anatomic distribution of the three growing versus four nongrowing lesions in this patient, as contralateral teeth and/or similar lesions are discordant in regard to growth. The extent of lesion growth in the three teeth was impressive, yet all primary teeth exfoliated naturally without signs or symptoms of infection

Persistent Growth

No lesions were seen to grow after initial treatment and then stop following further applications of silver fluoride. When radiographs were available at multiple time points after treatment, the lesions that had grown between the baseline and first follow-up had grown even more in the subsequent images despite intensified effort to get the material into the lesions during the first follow-up visit.

An example of this persistent growth pattern is shown in FIGURE 4 in an initially 2-year-old child not included in the series due to a lack of baseline radiographs. The lesions were observed to grow by visual-tactile examination between baseline and six-month follow-up despite treatments every three months with SN+FV. At that point SDF became available. Applications lasting three minutes per tooth were then performed with SDF on the same schedule. All lesions had grown substantially at the

FIGURE 4. Growth of lesions at six months. Bitewing radiographs are shown at six (top) and 12 months (bottom) after initiation of silver fluoride treatment. Images were not achievable at baseline for the 2-year, 9-month-old child. Following two quarterly applications of 25% silver nitrate and fluoride varnish, the lesions were clinically determined to have grown at six months. An attempt to continue topical therapy was made with 38% silver diamine fluoride following the same regimen, as it was recently cleared by the FDA. The lesions continued to grow. No new lesions formed.



one-year evaluation (six months after introduction of SDF). No new lesions formed in this child, so there may have been indirect prevention. Thankfully, the child did not experience pain from the lesions and pulp treatment was not necessary. However, intervention by sealing the lesions with the Hall crown technique²⁹ or other operative approaches at the six-month follow-up would have decreased the risk of pain, infection and more invasive treatment.

Two clinical trials that evaluated lesion arrest every six months show a linear increase in the proportion of arrested lesions with continued treatment over time.^{4,5} These studies evaluated arrest, not lesion growth. Indeed, of the 11 clinical trials on caries arrest by SDF, only one clinical trial of 10% SDF used to arrest enamel lesions measured lesion growth (described above).¹² For practical application to clinical dentistry, it may be important to disentangle lesion growth from apparent lesion activity (softness, bacterial load), which is essentially a predictor of future growth. Lesions

that appear to remain active but do not demonstrate growth may not grow substantially toward the pulp and may represent the subset that eventually arrest with continued applications. The subset of lesions that do not appear arrested at the end of the various clinical trials may indeed be those that were growing all along. This needs to be studied further.

Unique Radiographic Changes

No unique radiographic features were observed in this case series besides the one lesion that decreased in apparent size. However, intense remineralization of the superficial lesion has been found elsewhere. **FIGURES 5A–C** show three such lesions. In an older adult, approximately 0.5 mm of the lesion recovered the radiographic density of the surrounding dentin following three treatments with SDF in two weeks. Approximately 0.1 mm of the lesion remained radiolucent. In a child whose composite resin restorations fell out (**FIGURE 5D**), five treatments with SDF over one year resulted in dramatic

increases in radiographic density of the superficial 0.5 mm to an extent similar to that of enamel. The possibility of the radiopacity arising from the remaining bonding agent was refuted by clinical examination of the cavitations by the treating dentist prior and subsequent to initiating SDF treatment.

Do to the radiopacity being similar to enamel and the location being the outermost aspect of a lesion, it is unlikely that apatite variants (e.g., fluoroapatite and hydroxyapatite) provide the additional contrast. Rather, silver reacting with the exposed collagenous dentin matrix is the most likely source. Such a reaction has been observed with both silver nitrate and SDF to gelatin,³⁰ and the hardening of the outer aspect of dentin lesions has been shown to coincide with staining.¹⁶ These observations should be studied further. There is a semantic question as to whether this pattern should be referred to as “remineralization” if the density is from silver, which was not there to be replaced and the final form does not chemically resemble the original mineralized dentin.

Frequency of Applications

Based on the available clinical trial evidence at the end of 2013, a decision was made to apply silver fluoride in a regimen spaced out evenly over time in the clinic evaluated in this case series. Since then, as suggested in this *Journal*,²³ a trial evaluating the benefit of two additional applications within the first two weeks of initiating therapy demonstrated higher caries arrest at six and 12 months. However, annual reapplication in the single application group enhanced the effect observed at 18 months.¹¹ Meanwhile, a second trial has verified the greater effectiveness of application twice versus once per year.^{5,9}



FIGURE 5A.



FIGURE 5B.



FIGURE 5C.



FIGURE 5D.

FIGURE 5. Rare radiographic halos following successful silver fluoride therapy. A halo of increased density is observed in radiographs of patients who were not part of the retrospective analysis. A subgingival carious lesion in an older adult (**5A**) was treated three times with 38% silver diamine fluoride. The result was an approximately 0.5 mm decrease in the apparent size of the lesion circumferentially (**5B**), with a 0.1 mm halo of radiolucency remaining at the original radiographic lesion border (**5C**, inset from **5B**). After five applications of 38% silver diamine fluoride following the loss of composite lesions in a child, radiopacity similar to that of enamel formed on the outer edge of the exposed dentin (**5D**). Again the inner lesion border remained radiolucent. (Images courtesy of Steven Duffin, DDS, MBA, and Michael Bratland, DMD)

Thus, if the situation allows, it appears at this time best to employ multiple applications at the initiation of silver fluoride treatment, as a loading dose, and to continue with maintenance doses over time. It has also been suggested but not formally evaluated that to maximize the absorption of silver and fluoride into the lesion, the area should be covered with a material that decreases dilution by saliva.^{22,23}

Monitoring

All lesions that were assessed to have grown by visual-tactile examination were radiographically seen to grow and vice versa. This supports the use of visual-tactile assessment for monitoring the response of carious lesions to topical silver fluoride

treatment. Many of the patients who benefit from topical therapy as an alternative to operative treatment do not tolerate the invasiveness of radiographs, as evidenced by the 313 of 331 (95 percent) patients for whom silver fluoride therapy was initiated but no baseline radiographs were available. The persistence of growth in every lesion observed to have grown at earlier stages suggests that practical methods to compare the size of lesions over time should be developed. The finding of no correlation between lesion growth to follow-up duration or application rate in this limited analysis suggests that it is appropriate to employ additional strategies when any lesion growth is observed, rather than continuing with the same regimen.

Conclusions

The major conclusions of this limited work are that growth of carious lesions following treatment with silver fluoride can be observed by six months using visual-tactile examination or radiographs and that further lesion growth was not stopped by further applications following the same regimen. Moreover, monitoring at six months appears to catch lesions that will continue growing. Some of these lesions may have arrested with more frequent application, analogous to an antibiotic loading dose. More research is needed. Until more is known about the failure mode of silver fluoride treatment, a pragmatic response to observed growth would be to employ additional strategies with higher success rates, such as the Hall crown technique, as soon as growth is observed rather than persisting with the same approach. Nonetheless, 75 percent of lesions did not progress and very few new lesions appeared after initiation of silver fluoride therapy. Only lesions that were initially apparent in radiographs grew into the dentin. Together, this information adds to the evidence that topical silver fluoride therapy is useful for caries management. ■

ACKNOWLEDGMENTS

This work was supported by NIH NIDCR grant T32-DE007306. The authors declare that no conflicting financial interests have influenced this work.

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Silver Diamine Fluoride Chemical Mechanisms of Action as a Caries Arresting and Preventing Agent

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ABSTRACT The chemical mechanisms of silver diamine fluoride, a caries-arresting and caries-preventing agent, are presented using Raman spectroscopy. Findings included that SDF works as a caries-arresting agent by forming Ag_3PO_4 and as a caries-preventing agent by forming fluorapatite (FAP), that the time needed for SDF to work as a caries-preventive agent is shorter than that needed to work as a caries-arresting agent, and the presence of thiol group (caries) delayed the formation of Ag_3PO_4 and FAP.

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Conflict of Interest
Disclosure: None reported.

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Conflict of Interest
Disclosure: None reported.

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Conflict of Interest
Disclosure: None reported.

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Conflict of Interest
Disclosure: None reported.

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Conflict of Interest
Disclosure: None reported.

Silver diamine fluoride (SDF) is widely used for dental caries management in Japan, Brazil, Germany, Australia and China.¹ SDF efficiently halts the caries process² and exhibits similar known preventive mechanisms of action that other topical fluorides possess in the primary and permanent dentitions³ as well as root caries of the elderly.²⁻⁴ SDF possesses unique advantages and is now gaining popularity in the United States as a caries management approach. The advantages include prevention of pain and infection as well as simplicity of use making the application of this fluoride agent easy for dentists and dental auxiliaries in dental clinics and outreach settings. Other advantages include affordability of the material, minimal

requirement for personnel time and the noninvasive nature of the procedure helping improve availability for people with limited access to dental care.⁵

SDF was approved in 2014 by the U.S. Food and Drug Administration as a device for the treatment of dentinal hypersensitivity but is commonly used “off-label” as a caries-arresting medicament.¹ In 2016, the American Dental Association introduced a new CDT code (D1354) to be used for interim caries-arresting medicaments, including SDF.¹

SDF is a colorless liquid used topically in the medical management of dental caries. It is a complex ion that contains both silver and fluoride. The silver component potentially acts as an antibacterial agent while the fluoride inhibits demineralization and promotes remineralization.^{6,7} In addition, ammonia serves as a stabilizing agent.⁸ The synergistic effects of silver and fluoride ions have been reported to promote better anticaries effects than either silver nitrate or sodium fluoride alone.⁹

Hydroxyapatite (HAp) forms 96 percent of the mass (90 percent volume) of enamel and 70 percent of the mass (50 percent volume) of dentin.¹⁰ The effect of SDF on the mineral content of enamel and dentin has been previously reported in the literature, but the mechanisms of action are not fully understood.⁸ Following the application of SDF on demineralized tooth tissues, lesion depths have been shown to decrease and progression rates slowed down.^{7,13,14} Treated carious surfaces have also shown higher surface microhardness compared to control tooth structures.^{6,7,15–18}

Multiple chemical, mechanical and antibacterial mechanisms of action of SDF as a caries protective agent have been proposed but the exact mode of action is still uncertain.^{8,15} Moreover, proposed

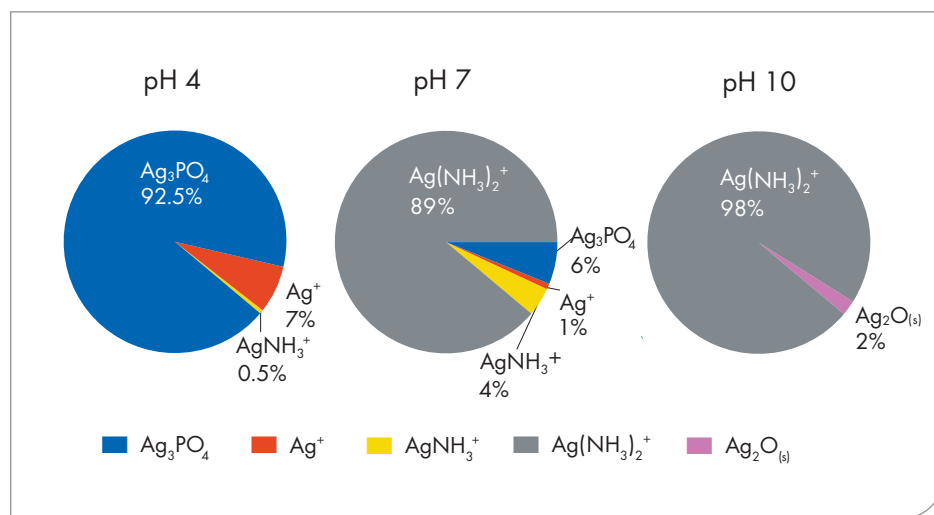


FIGURE 1. Predicted relative abundance of silver products that form from an [SDF]:[HAp] = 1:1 at pH 4, 7 and 10.

mechanisms of action have not been studied in different oral environments (acidic, neutral and basic media) or in the presence of carious lesions compared to sound tooth structure. Preliminary results by Lou et al. (2011) on the reaction of SDF with HAp and protein showed that SDF reacts with the principle components of tooth tissue.¹⁹ However, the solubility of the CaF₂ formed has caused the scientific community to question the effectiveness of SDF as a caries-protective agent.¹⁹

No previous studies have investigated the chemical mechanism of SDF action as a caries-arresting agent as well as a caries-preventing agent in different oral pHs (acidic, neutral and basic). This study aimed to observe the effect of SDF on HAp occurring in vitro at different pH levels using Raman spectroscopy and to describe the reactions and quantify the reaction products with a chemical model. The mineral composition of enamel and dentin has been recently analyzed using Raman spectroscopy.¹¹ This nondestructive detection method results in chemical fingerprints of mineral components of teeth and can be used for their identification and quantification. When combined with an optical microscope and scanning stage, localized spatial information down to ~ 1 μm²

area can be collected, thus providing localized chemical identification.^{11,12} This study also investigated the effects of cariogenic bacteria presence (dental caries conditions) or absence (sound tooth conditions) on the reaction of SDF and HAp and the time required for the reaction. Reaction time differences between SDF and HAp are reported in samples mimicking carious tooth versus sound tooth structures using HAp with and without the thiol group.^{20,21} Finally, this study quantified relative amounts of all reaction products of interest including calcium fluoride (CaF₂), silver phosphate (Ag₃PO₄) and fluorapatite (FAP) and provides clarifications regarding their interactions to promote an understanding of the chemical mechanism of SDF.

Materials and Methods

Sample Preparation

Samples using HAp (Sigma-Aldrich) mimicking healthy teeth treated with an excess of SDF (Elevate Oral Care) were prepared by suspending 2.0 mg (4.0 μmol Ca₅(PO₄)₃(OH)) HAp in 998.3 μL Nanopure water (Thermo Fisher). The samples (HAp and water solution) were liquid in nature to facilitate chemical reaction monitoring using Raman

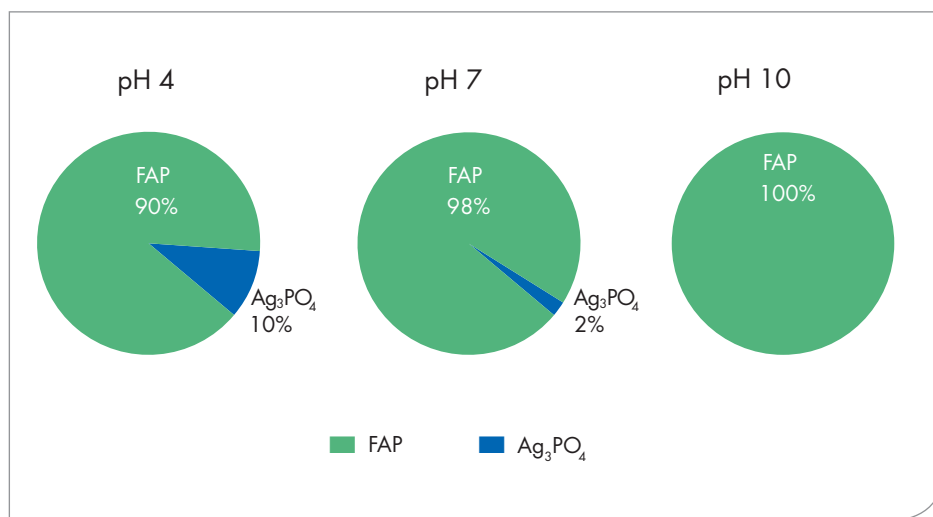


FIGURE 2. Predicted relative abundance of phosphate species that form from an [SDF]:[HAp] = 1:1 at pH 4, 7 and 10.

spectroscopy and to have more control of the chemistry in the samples. After allowing this solution to equilibrate for ~30 minutes, 1.7 μL 38% SDF was added. Alternatively, samples mimicking teeth containing carious lesions that were treated with an excess of SDF were prepared by suspending 2.0 mg (4.0 μmol $\text{Ca}_5(\text{PO}_4)_3(\text{OH})$) HAp in 996.3 μL Nanopure water and adding 2.0 μL of a 1.0 mM butanethiol stock solution (Sigma-Aldrich). Butanethiol was selected as it contains a sulfhydryl group similar to thiolated DNA present from cariogenic bacteria.²¹ After allowing this solution to equilibrate for ~30 minutes, 1.7 μL 38% SDF was added. Samples were briefly vortexed before spectroscopic analysis.

Chemical Equilibrium Diagrams

Chemical equilibrium diagrams were constructed using MEDUSA/HYDRA software²² using the solution composition for speciation prediction at acidic, neutral and basic pHs. Speciation was predicted for SDF ($\text{Ag}(\text{NH}_3)_2\text{F}$) reacting with HAp ($\text{Ca}_5(\text{PO}_4)_3(\text{OH})$). SDF is provided in a 2.36 M (38%) stock solution, so the concentrations entered in MEDUSA were $[\text{Ag}^+] = 2.36$ M, $[\text{NH}_3] = 4.72$ M, and $[\text{F}^-] = 2.36$ M. In addition, when a 1:1 ratio of SDF:HAp

is modeled, the [HAp] is 2.36 M ($\text{Ca}/\text{P} = 1.67$); therefore, concentrations were included as $[\text{Ca}^{2+}] = 11.8$ M and $[\text{PO}_4^{3-}] = 7.10$ M. An ionic strength of 4.720 M was used for all calculations. Relative abundances of products that form are shown for silver products, phosphate and calcium species. Raman spectroscopy and analysis are presented in the supplementary materials section along with supplementary **FIGURE 15**.

Results and Discussion

The Reaction of SDF and HAp as a Function of pH

Chemical reactions such as that between SDF and HAp can be modeled under various experimental conditions using databases in which thermodynamic constants can help predict conditions in which various reactions' products can form. Because the oral environment and tooth surfaces can be at different levels of acidity and basicity, knowing what products can form in these various conditions is relevant. MEDUSA/HYDRA, a program that models complex equilibria, was used in this study to evaluate products that should form between SDF and HAp as a function of pH.

FIGURE 1 shows the predictive relative abundance of silver products that forms from a [SDF]:[HAp] = 1:1 at pH 4, 7 and 10. At an acidic pH (pH 4), the main silver-containing reaction product of SDF and HAp is Ag_3PO_4 . This is consistent with previous reports that suggest that Ag_3PO_4 is an intermediate for SDF.⁸ While 92.5 percent of the silver product that forms is Ag_3PO_4 , a small amount of Ag^+ ions also develops as does 0.5% dissociated SDF. The formation of Ag^+ ions is significant as these ions are reactive and can lead to residual blackening. As pH increases, the Ag_3PO_4 percentage that forms declines, reaching 6 percent of the silver products at pH 7. At higher pH (pH = 10), the silver diamine ion ($\text{Ag}(\text{NH}_3)_2^+$) is the primary silver-containing product of the reaction (98 percent of the silver products). These findings suggest that the desired silver-containing intermediate (silver phosphate) forms preferentially at slightly acidic to neutral pHs.

In addition to silver-containing products, phosphate- and calcium-containing products are also relevant in the mechanistic action of SDF **FIGURE 2** shows the predicted relative abundance of phosphate species that form from an [SDF]:[HAp] = 1:1 at pH 4, 7 and 10. The main phosphate-containing reaction product between SDF and HAp in all reaction conditions when the pH is greater than pH = 3 is FAP ($\text{Ca}_5(\text{PO}_4)_3\text{F}_{(s)}$). Above pH 7, the only phosphate-containing species that forms is FAP. **FIGURE 2** also shows that the formation of Ag_3PO_4 is only evident when the pH of the solution is 7 or less.

FIGURE 3 shows the predicted relative abundance of calcium species that form from an [SDF]:[HAp] = 1:1 at pH 4, 7 and 10. **FIGURE 3** also compares the calcium-containing products that form, which are CaF_2 and FAP. CaF_2 is the primary product that forms in very acidic solutions (pH <

3). In all higher pH solutions, FAP is the primary product formed. FIGURES 2S and 3S provide more detailed information.

These findings indicate that the reaction between SDF and HAp is different at various pHs. The formation of Ag_3PO_4 and CaF_2 is favored in acidic conditions and the formation of FAP is favored in alkaline conditions. The formation of FAP in alkaline media explains the mechanism of SDF as a preventive agent because FAP is more acid resistant than HAp found in enamel.

The Effect of Thiol on the Reaction Between SDF and HAp

In this study, the predicted products that form from the reaction between HAp and SDF are confirmed using Raman spectroscopy. This analytical method provides a noninvasive approach for real-time monitoring of both reactant consumption and product formation in water. Previously, Raman spectroscopy has been used to show a shift in the phosphate vibrational frequency associated with HAp in the presence of SDF.²⁷ In this study, a careful, time-dependent analysis of vibrational frequencies associated with HAp consumption (PO_4^{3-} symmetric stretch, 960 cm^{-1}) and the formation of Ag_3PO_4 (PO_4^{3-} symmetric stretch, 910 cm^{-1}), FAP (PO_4 bend, 562 cm^{-1}) and CaF_2 (Ca-F stretch, 260 cm^{-1}) is demonstrated.

To do this, HAp and SDF are mixed and the reaction is monitored using Raman microscopy. These reactions mimic the action SDF would exhibit on a sound tooth structure. FIGURE 4 shows the time-lapse Raman spectra of HAp + SDF in the (A) absence and (B) presence of carious lesions (i.e., thiol). The bands associate with the consumption of HAp and formation of Ag_3PO_4 , FAP and CaF_2 are highlighted in red, blue, green and orange boxes, respectively. As shown in FIGURE 4, top, the HAp decreases

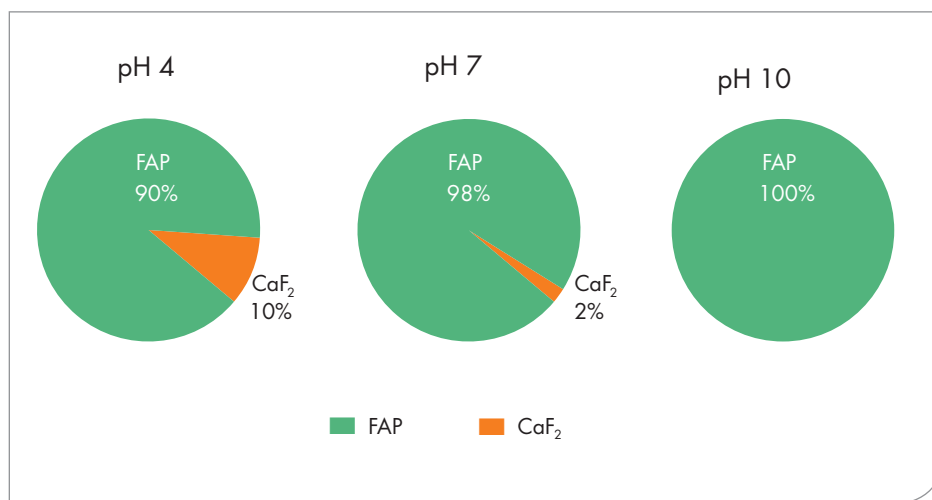


FIGURE 3. Predicted relative abundance of calcium species that form from an $[\text{SDF}]:[\text{HAp}] = 1:1$ at pH 4, 7 and 10.

as this reactant is consumed while the bands associated with Ag_3PO_4 , FAP and CaF_2 increase. Each chemical continues to form until the reaction completes, approximately for 30 minutes. A similar experiment can be performed mimicking a tooth containing a carious lesion as shown in FIGURE 4, bottom. To do this, a similar experiment is carried out except that a trace amount of butanethiol, a molecule used to simulate the thiolated DNA that is found in the presence of cariogenic bacteria, is added. A low concentration of thiol is pre-incubated with HAp prior to the addition of SDF. Once SDF is added, the materials are mixed and time-dependent Raman spectra are collected. Two significant differences are noted versus the sample mimicking sound tooth structure. First, HAp is consumed much slower while Ag_3PO_4 and FAP formation increase in quantity more gradually. These results suggest that the presence of thiol (i.e., in the presence of cariogenic bacteria) decreases the preventive action of SDF during initial application.

To more closely evaluate how long SDF needs to be applied for caries-arresting or caries-preventing mechanisms, time-dependent changes in the consumption of HAp and formation of Ag_3PO_4 and FAP in the absence and presence of carious lesions (i.e., thiol) is shown in FIGURE 5. As shown in FIGURE 5, top, at least 75

percent of HAp is consumed (indicating the formation of FAP) within the first few minutes (less than five minutes) after SDF addition on sound tooth structure. In contrast, the formation of Ag_3PO_4 (FIGURE 5, middle) and FAP (FIGURE 5, bottom) are significantly delayed in the presence of cariogenic bacteria indicating that the SDF:HAp reaction occurs more quickly on sound tooth structure compared to the decayed tooth structure. FIGURES 5 middle and bottom also note differences in the production of Ag_3PO_4 and FAP. For instance, Ag_3PO_4 rapidly forms in the first two to three minutes after SDF addition on sound tooth. This reaction then slows down but continues for several hours. In the presence of carious lesions (thiol), Ag_3PO_4 formation is not observed until 10–15 minutes post-addition of SDF due to the formation of silver sulfide (Ag_2S) at the beginning until all the thiol is consumed. Notably, Ag_2S is dark-brown solid, so significant product formation can be observed visually. This indicates that longer treatment time is needed in the presence of carious lesions than on sound tooth structure if the preventive action of SDF is desired. Based on these results, we hypothesize that the application time of SDF as a preventive agent could be shorter than the application time of SDF as a caries-arresting agent.

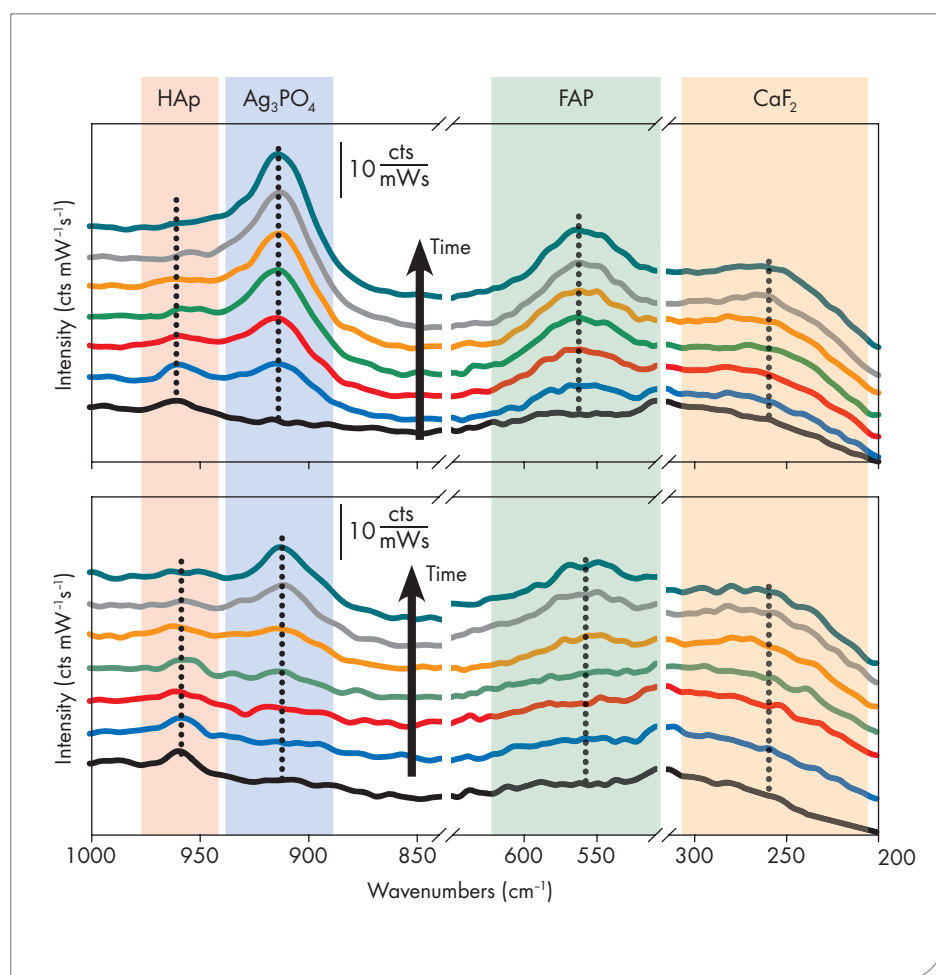


FIGURE 4. Time-lapse Raman spectra of HAp + SDF in the (top) absence and (bottom) presence of carious lesions (i.e., thiol). The bands associate with the consumption of HAp and formation of Ag_3PO_4 , FAP and CaF_2 are highlighted in red, blue, green and orange boxes, respectively.

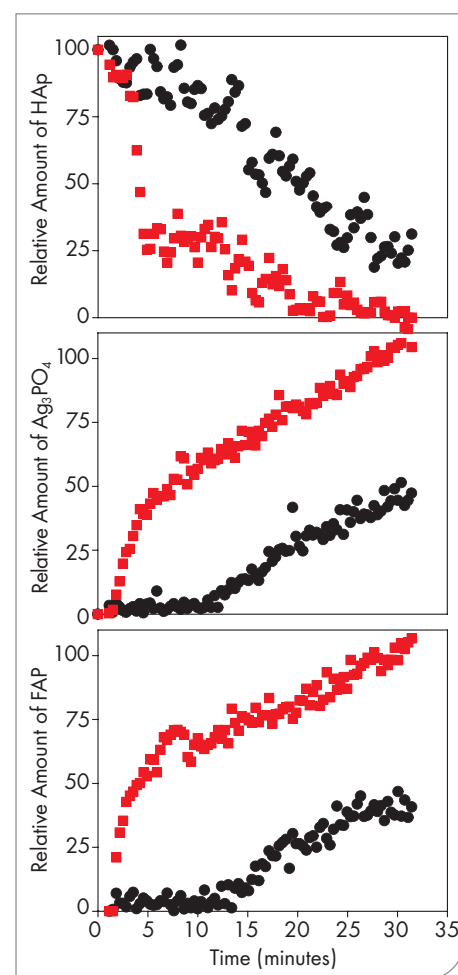


FIGURE 5. Analysis of the amount of (top) consumption of HAp and formation of (middle) Ag_3PO_4 and (bottom) FAP as a function of time in the (red) absence and (black) presence of carious lesions (i.e., thiol). A 1:1 ratio of HAp:SDF was used.

Clinical Implications

SDF is a proven painless, simple and inexpensive caries management agent.²⁸ However, the exact mechanism of action of SDF as a preventive versus arresting medicament is unclear. Previous literature reports suggest that SDF reacts with the HAp in a tooth to release CaF_2 and Ag_3PO_4 , which are responsible for preventing and hardening of dental caries.¹⁵ The literature, however, does not differentiate between the relative abundance of these materials in relation to the mechanism of action of SDF.²⁹

The current study provides additional information to support the reaction of Ag_3PO_4 with cariogenic bacteria.

This study is the first to investigate and differentiate the effect of SDF on HAp as a caries-arresting versus a caries-preventing mechanism using Raman microscopy. Chemical mechanisms consistent with tooth darkening in the absence and presence of carious lesions are provided. The effect of the biological component of dental caries on the proposed chemical reaction was uniquely defended. This comprehensive biological-chemical model allowed us to interpret the

results in a more “real-life” situation close to the in vivo situation. Previous studies either reported the chemical reaction between SDF and HAp or reported on the antimicrobial action of the SDF on bacteria. This report integrated the effect of the bacteria on the chemical reaction. Moreover, this study confirmed the formation of FAP using Raman microscopy. This is significant as previous reports described difficulties related to the confirmation of FAP formation. In previous studies, these limitations were primarily attributed to similarities between the crystal structures of HAp and FAP.¹⁷

Previous literature suggested that CaF_2 , Ag_3PO_4 and FAP are all detected when SDF is applied directly on a tooth surface, but did not compare the relative abundance of these components. This study revealed that Ag_3PO_4 forms in acidic media, while FAP is more abundant in alkaline media. CaF_2 was proposed as either a transient product that is washed away or an intermediate product that leads to the formation of FAP. The instability of CaF_2 was attributed to its cubic crystal structure versus the hexagonal structure of HAp. The crystallographic affinity between the two materials was, as a result, difficult to establish. Furthermore, CaF_2 was thought to be washed away with mastication or washing.³⁰ In contrast, Kani et al. (1970) proposed that the presence of CaF_2 may contribute to the restoration of the imperfect lattice of HAp.³¹ Finally, Ag_3PO_4 was reported to be a stable reaction intermediate that is in agreement with the literature and our study findings.¹⁷

Our study showed an increase of the amount of the FAP (FIGURE 5, bottom). This explains the caries-protective properties of the SDF FAP is a crystalline structure that is more acid resistant than normal tooth structure.³² Yamaga et al. (1972) and Suzuki et al. (1974) reported the formation of calcium fluoride (CaF_2) and silver phosphate (Ag_3PO_4) and suggested that this may be responsible for the prevention of dental caries and hardening of the lesion.^{30,33} These findings were supported by Lou et al. (2011).¹⁹ The published literature, however, reported a decrease in the amount of CaF_2 that formed and was reported to be washed away by water, which caused some confusion as to how the SDF performed its function as a caries-preventive and caries-arresting agent.

In agreement with Chen and Mao (2005), the alkaline properties of SDF match the favorable conditions needed to

synthesize FAP.³⁴ Additionally, the black/brown discoloration can be explained by the formation of silver ions (Ag^+), reduction of Ag_3PO_4 into Ag_2O ,¹⁵ as well as formation of silver sulfide (Ag_2S).³⁵

With regard to the time of reaction completion between SDF and HAp, the results of this study are important for the clinician because it affects the application time of SDF on tooth structure. It was found that the formation of Ag_3PO_4 and FAP are significantly delayed in the presence of cariogenic bacteria. This is of clinical value to the practitioner in that more application time is needed when the SDF is used to arrest decay and should be between two and three minutes.

This study has the limitation of using chemical compounds in solution to predict the chemical reaction that happens between SDF and HAp but not the complete tooth sample. Future research is encouraged to investigate the effect of SDF on sectioned tooth samples in conditions mimicking the oral environment, including the presence of saliva and salivary minerals.

Conclusions

This study presented a model to explain the chemical mechanisms of the action of SDF as a caries-arresting and preventing agent in both enamel and dentin using Raman spectroscopy and equilibrium modeling as follows:

- In acidic pH, SDF works as a caries-arresting agent primarily by forming Ag_3PO_4 .
- In alkaline and neutral conditions, SDF works as a caries-preventive agent by forming FAP.
- The time needed to form FAP is shorter than that needed to form Ag_3PO_4 indicating the time needed for SDF to work as a caries-preventive agent is shorter than that needed to be a caries-arresting

agent. This finding should be taken into consideration when developing protocols for using SDF as a caries-preventive and caries-arresting agent. It should be emphasized that the time of application of SDF to carious tooth structure should be at least two minutes to maximize the anticaries benefits.

- The presence of a thiol group (carious lesions) in the reaction significantly delayed the formation of both Ag_3PO_4 and FAP indicating the thermodynamically preferred formation of Ag_2S . This indicates that the reaction is occurring faster on sound tooth structure compared to decayed tooth structure. ■

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Supplementary Material

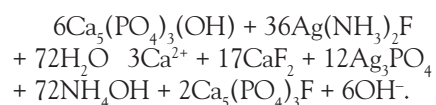
Raman Spectroscopy and Analysis

Raman spectra were collected using a semi-homebuilt Raman microscope using an ExamineR532 (DeltaNu) module mounted on an Olympus IX71 inverted microscope and excitation using a 532 nm wavelength (λ_{ex}) laser. All measurements were performed using an integration time (t_{int}) of 10 seconds and laser power (P) of 8–10 mW. Samples were prepared in glass vials. The laser spot was focused at the bottom of the vial so that precipitate composition (i.e., the reaction products that form at the surface of teeth) could be monitored as a function of time. Spectra were collected every 10 seconds for at least 30 minutes. Spectra were also collected after a 24-hour incubation period so that equilibrated products could be compared to time

dependent results. All reported spectra represent background corrected spectra using a water blank, and intensities were integration time and power adjusted.

Example spectra and vibrational band assignment are shown in **FIGURE S1**. Raman spectra of (A) HAp, (B) SDF and (C) yellow precipitate that forms when a [1:1] of HAp:SDF are mixed. From vibrational band assignments, reaction predictions and color, this product is assigned to a mixture of Ag₃PO₄ (primary product) and FAP (minor product). The vibrational bands for HAp are 960 cm⁻¹ (PO₄³⁻ symmetric stretch), for SDF are 1625 (NH₃ deformation) and 1225 cm⁻¹ (NH₃ bend) and for the precipitate are 1069 (FAP, PO₄ antisymmetric stretch), 910 (Ag₃PO₄, PO₄³⁻ symmetric stretch) and 562 (FAP, PO₄ bend) cm⁻¹.

Intensities are reported in terms of signal counts (cts) divided by power in milliwatts (mW) and time in seconds (s). Raman spectra for HAp and SDF are shown in **FIGURES 1SA** and **1SB**, respectively. Chemical products were assigned based on previously reported vibrational frequencies. The most intense chemical feature for HAp is associated with a PO₄³⁻ symmetric stretch and is centered at 960 cm⁻¹.²³ Other weaker bands are also observed. SDF exhibited bands at 1625 (NH₃ deformation), 1225 (NH₃ bend) and 997 cm⁻¹ (NH₃⁺ rocking).²⁴ Upon mixing, a reaction with HAp can occur via the following process:⁸



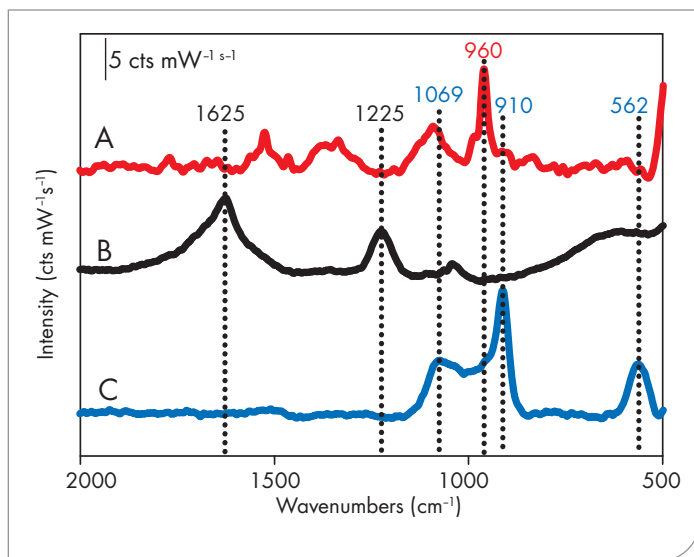


FIGURE 1S. Raman spectra of (A) HAp, (B) SDF and (C) yellow precipitate that forms when a [1:1] of HAp:SDF are mixed. From vibrational band assignments, reaction predictions and color. This product is assigned to a mixture of Ag_3PO_4 (primary product) and FAP (minor product).

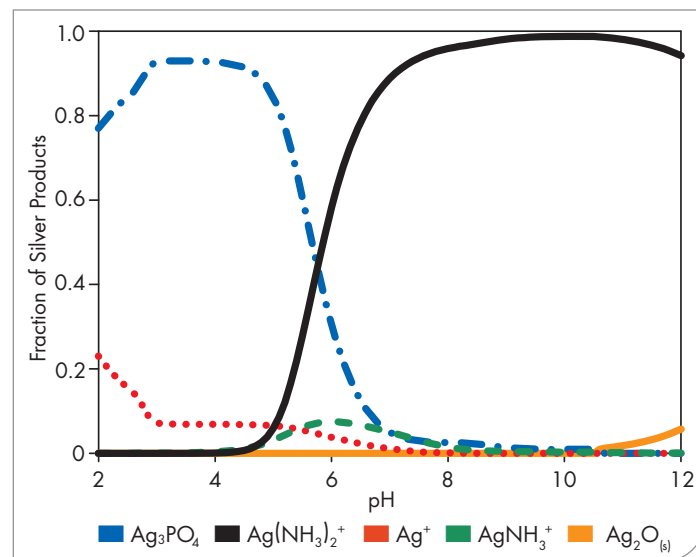


FIGURE 2S. Predicted relative abundance of silver products that form from an [SDF]:[HAp] = 1:1 as a function of pH.

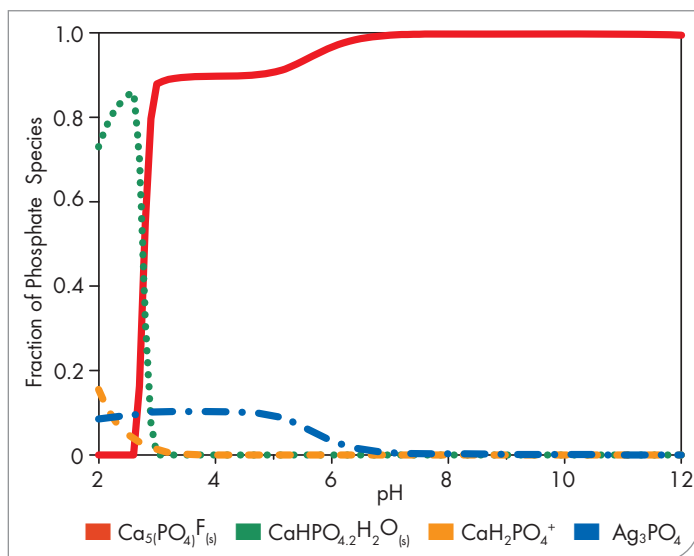


FIGURE 3SA.

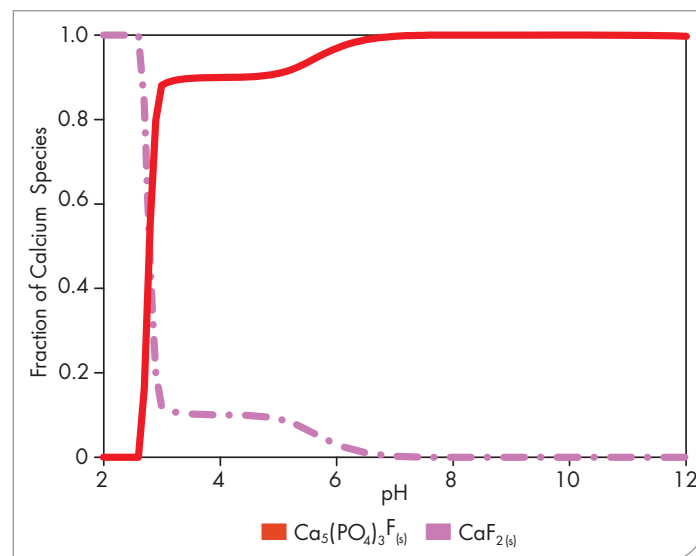


FIGURE 3SB.

FIGURES 3S. Predicted relative abundance of (A) phosphate and (B) calcium species that form from an [SDF]:[HAp] = 1:1 as a function of pH.

After equilibrating a 1:1 molar ratio of HAp:SDF for 24 hours, solid products formed that are consistent with the formation of Ag_3PO_4 (yellow solid), FAP (white solid) and CaF_2 (colorless solid). Raman spectra revealed intense bands associated with FAP at 1069 (PO_4 antisymmetric stretch) and 562 cm^{-1} (PO_4 bend),²⁵ while Ag_3PO_4 exhibited a band at 910 cm^{-1} (PO_4^{3-}

symmetric stretch).²⁶ In addition, a weak vibrational band associated with CaF_2 production was observed at 260 cm^{-1} .¹²

These unique bands were used for monitoring reaction progress as a function of time. These vibrational features were analyzed using Origin Pro 9.1. Vibrational frequencies were determined using second derivative analysis using a 10-point Savitzky-Golay

smoothing approach and a 10 percent threshold. Time-dependent changes in vibrational band areas were calculated using integrated areas and were related to relative concentrations of each product and reactant. The formation of Ag_3PO_4 and FAP was found to be significantly delayed in the presence of trace thiol indicating the thermodynamically preferred product formation of Ag_2S . ■

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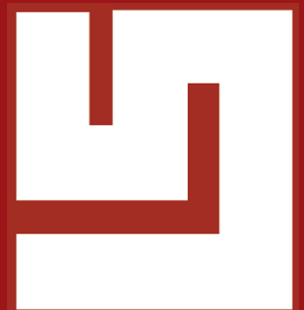
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LA MIRADA - GP established circa 1963 located in a 2 story med prof bldg. Consists of 5 eq ops. Grossed approx. \$408K in 2016. **Property ID #5119.**

LA VERNE— Est. in 1980 w/ 4 eq op in a 1, 250 sq ft. **Grossing approx. \$64K/mo. Net of \$195K. PPO & Cash Only!** **Property ID #5196.**

LOS ANGELES - **Price Adjustment!** GP w/ 40 years of goodwill. In a 10 story medical/dental bldg. Has 4 eq ops with views to the mountains. PPO/Cash/Medical/CAP. Grossed \$670K in 2016. Net of \$166K. **Property ID #5107.**

LOS ANGELES - GP established in 1968 in a 6 story bldg. NO HMO. Has 4 eq ops in a 1,211 sq ft suite. Grossed approx. \$531K in 2016. **Property ID #5163.**

MONTEREY PARK— **COMING SOON!**

MOTEBELLO—Grossed approx. \$1M in 2017, located in a free standing bldg w/ 5 eq ops. Established in 2002. **Property ID #5168**

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PASADENA - **COMING SOON!**

VALENCIA — GP + Spec office with 9 eq ops in a busy single shopping center. **Grossed \$1.6M in 2016.** **Property ID #5171.**

WALNUT PARK - Established in 1968 GP in free standing bldg. **Option to buy bldg.** Grossed \$531K in 2016. Net \$166K. Has 4 eq ops. **Property ID #5176.**

KERN, VENTURA, & SAN LUIS OBISPO COUNTIES

CAMARILLO—GP + Real Estate. Well established practice w/3 eq ops / 1 plmbd not eq. **NET OF \$228K. Property ID #5150.**

GOLETA—COMING SOON!

OXNARD—COMING SOON!

SIMI VALLEY— GP + Bldgs. Well established practice 4 eq ops & 2 plmbd not eq ops. **Net of \$92K.** Extra income generating from rent. **Property ID #5185.**

ORANGE COUNTY

ANAHEIM— Established in 1960's this practice is on a single story bldg w/ 4 eq ops. **Grossed \$735K in 2016. Net \$308K. Property ID #5187.**

BREA— Beautiful well established practice located on a corner location. Has 8 equipped ops and 3 chairs in open bay. **Grossed \$1.5M.** On a busy major street of the city. **Property ID #5190.**

BREA— GP + Bldg. Well established practice w/4 eq ops & 2 plmbd not eq. PPO & Cash Only. **Grossed \$683K in 2016. Property ID #5197.**

COSTA MESA - **COMING SOON!!**

FOUNTAIN VALLEY—GP in busy strip mall. Has approx. 27 years of goodwill. Grossed \$344K in 2016. Net of \$136K. **Property ID #5165.**

IRVINE—LH & EQUIP ONLY! 4 eq ops in 2 story prof. bldg. Easy access freeway. **Property ID #5195.**

LAGUNA HILLS— With over 30 yrs of goodwill this GP is located in a 2 story med bldg. Has 5 eq ops in a 1,600 sq ft suite. Grossed approx. \$304K for 2016. **Property ID #5127.**

TUSTIN— Beautiful GP **NET OF \$159K. Prop. #5199.**

WESTMINSTER— GP established in 1983 in a 2 story building. Has 3 eq ops in 1,300 sq ft suite. Next to residential area on a busy street. **Grossed \$183K in 2016. Net \$61K. Property ID # 5194.**

SAN DIEGO COUNTY

CARLSBAD—Well established GP w/ 3 eq ops and 2 plmbd not eq. near residential are. **Buyer's net of \$121K. Property ID #5191.**

ESCONDIDO—Perio practice w/ 40 yrs of gdwill in a single story bldg. Has 4 eq ops. **Grossed \$683K in 2016. Property ID #5173.**

SAN DIEGO —COMING SOON!

RIVERSIDE & SAN BERNARDINO COUNTIES

BEAUMONT—GP + Real Estate. Modern GP w/ 6 eq ops in 2,400 sq ft office. Could be two suites. **Grossed \$960K in 2016. Property ID #5182.**

CHINO—**Real Estate Only!** This a rare opportunity to purchase a condo located in a single story strip mall. Has been a dental practice for 40 years. **Property ID 5076.**

DESERT HOT SPRINGS— **GP + Real Estate!** Two partners one office. Consists of 4 eq ops / 1 plmbd not eq. Est. in 1986. **Proj. approx. \$802K for 2017. Property ID #5198.**

FONTANA— **GP + Real Estate!!** Premier office with 50 years of goodwill. In a 3,000 sq ft bldg with 8 eq ops. Has the latest technology. Grossed approx. \$2.3M in 2016. Net of \$968K. **Property ID #5140.**

HEMET GP + Condo Suite Has over 40 years of goodwill to officer. Icon in the community. Located in a single story tri-plex condo bldg. Has 4 eq ops. No Denti-cal. **Net of \$143K. Property ID #5152.**

PALM SPRINGS — General practice with 3 equipped ops located in a free standing bldg. Established in 2005. Suite is approx. 1,200. Seller work 5 days/wk. **BUYER'S NET OF \$153K. Property ID #4487.**

RANCHO CUCAMONGA— GP established in 2004 in busy shopping center. Consists of 3 eq ops in a 1,200 sq ft suite. **Grossed \$747K in 2016. Net \$251K. Property ID #5169.**

RIVERSIDE—GP + Real Estate!! Established in 1975 in free standing historic bldg. Has 4 eq ops in a 2,000 sq ft office. Projecting approx. \$284K for 2016. **Property ID #5146.**

TEMECULA—Modern designed practice w/ 3 eq ops. Projecting approx. \$1.2M. **Net of \$444K. Property ID #5155.**

UPLAND—Pediatric dental practice located in a medical bldg with 40 years of goodwill. Consists of 4 chairs in open with Alpha Dent software. **Grossed \$271K in 2016. Property ID #5188.**

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What do Anthem, Yahoo, LinkedIn and JP Morgan Chase have in common? If you guessed that they were all victims of some of the world's largest data breaches, you'd be correct. From insurance carriers to retailers, financial institutions to the U.S. military, all organizations that have an online presence are subject to cyber-related risks and the reputational damage and loss of consumer trust that follow.

Unfortunately, not all businesses can recoup what they lose from cyberattacks. Major corporations can usually recover any losses as they have the financing, in-house skills and manpower to address the problem and recover lost data. But small businesses aren't always as equipped to respond.

The health care industry is especially vulnerable to cyberattacks as hackers know they can access both patients' protected health information (PHI) and financial records. Even if your practice does not own a website or make financial transactions online, you can still be at risk simply by using the internet and working in a digitally connected office.

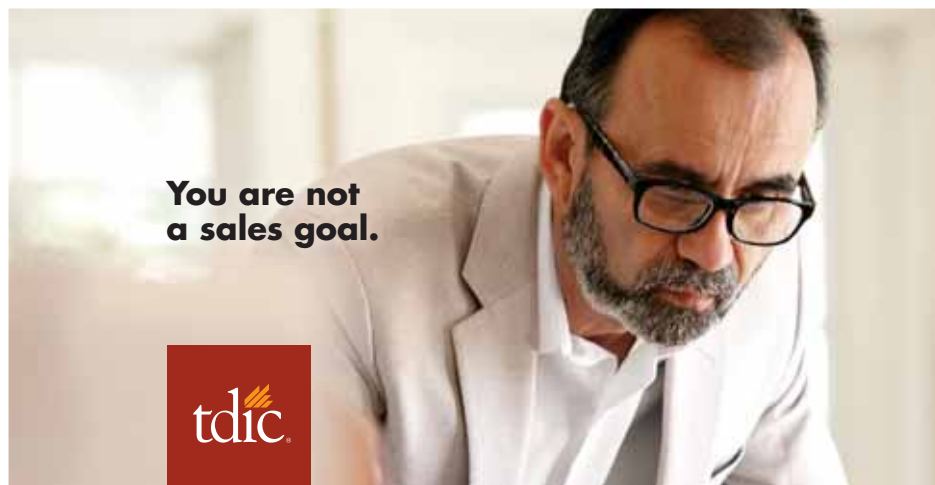
The most common cyberthreats businesses currently face are data breaches, malware and ransomware.

Ransomware cases are increasing and are estimated to have caused \$5 billion in damages in 2017 alone, according to industry researcher Cybersecurity Ventures. A ransomware scenario occurs when hackers infiltrate a system and block access and then demand a ransom be paid in order to lift the restriction. Hackers will generally ask for the ransom to be paid via Bitcoin or other untraceable digital currency, making funds unrecoverable once distributed.

In a case reported to The Dentists Insurance Company's Risk Management Advice Line, a practice's software was encrypted by ransomware. Although the dentist paid the ransom demand, he did not receive the encryption key to regain access. Even an outside computer repair technician could not help recover the data still on the practice's server. Ultimately the dentist had to escalate the matter to the police and sustained a significant recovery expense.

Even if the hackers did reestablish access once the ransom was paid, there was no guarantee that the recovered data would be "clean" or intact. Once a system is compromised, there is no assurance that it won't get hacked again.

Another threat to business owners is malware, short for "malicious software," which can infect computers through intrusive emails, web links and pop-up alerts. The malicious software can be downloaded without one's knowledge and capture private information.



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A dentist called the TDIC Risk Management Advice Line after discovering her email account was hacked. An email containing an encrypted PDF file was sent to 122 of her patients. The email instructed the recipient to download a program to access the PDF. The dentist was concerned that her patients would not realize it was a fraudulent email and would download the program and inadvertently infect their own personal computers. She was advised to notify her patients of the fraudulent email and establish a new email account as soon as possible to minimize any damages.

While cybercriminals are becoming more aggressive and infecting more computer systems, simple human error and misplaced trust are still leading factors in many data breaches. Thankfully, there are steps you can take to help protect yourself and your practice from cyber risks.

Strengthen Passwords

Make sure each employee has a unique password that contains a combination of lowercase and uppercase letters, numbers and special characters to deter potential hackers from gaining access.

Back Up Your Data

You can back up your files and data on a network-attached storage device, portable hard drive, USB flash drive or online through sites like Google Drive, Dropbox and Mozy. It's a good idea to back up files daily, which will make recovering data easier in the case of cyberattacks or computer system damage.

Use Safety Features

Install antivirus and antimalware software for all of your devices and update when available. Use an encrypted virtual private network (VPN) when connecting to an unfamiliar Wi-Fi network to ensure a secure connection. These measures will help prevent your data from being compromised.

Initiate Cybersafety Protocols

Educate your staff on the latest cyber threats and include your practice's cybersecurity policies and training protocols in your employee manual. Employ a multiuser system for the release of sensitive information. For example, make it a policy that two employees must sign off before providing anyone with secure information, such as passwords or file access, to prevent falling victim to a cyberscam and jeopardizing your computer system.

Preventing cyberattacks is the first step in protecting your practice. The second is to be prepared. TDIC offers comprehensive Cyber Suite Liability protection to help you respond to a full range of cyber incidents and cyber-related litigation. To learn more, visit tdicinsurance.com/cyber. ■

TDIC's Risk Management Advice Line at 800.733.0633 is staffed with trained analysts who can provide guidance on cybersecurity and other questions related to a dental practice.

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4101 SAN FRANCISCO GP

Vibrant downtown location in historic high-rise bldg. Retiring doctor offering 30+ years of goodwill. 4.5 days of hygiene, 1,500+ active patients, 20-25 new patients/mo. Gorgeous, spacious facility in approx. 2,500 sq. ft. 2017 annualized GR \$885K. Adjusted net income \$295K+ Seller will assist for smooth transition. Asking \$599K

4207 MID PENINSULA GP

Seller offering 40+ year practice with an emphasis on Restorative and Diagnostic care. \$520K+ average Gross Receipts with 4 doctor days/week. 1,000 square foot office with 3 fully-equipped ops, built-out in 2001. Prime location in a high-traffic shopping center with ample parking and nearby amenities in a waterfront area. Current lease has two 5 year options to extend. Primary drawing area includes Foster City, San Mateo, Redwood City. Asking \$385K.

4178 SONOMA COUNTY PERIO

Seller retiring from 21 year practice with trained, seasoned staff and great location. Exceptional 2,100 sq. ft. ample office with 6 fully equipped ops. Majority of equipment purchased in 2002. 4 doctor-days & 3 hygiene days per week. Average gross receipts \$1M+. Asking \$677K.

4198 NORTH BAY PERIO

Established Periodontic practice with loyal referral sources in 1,564 square foot office with 5 fully-equipped operatories conveniently located close to Petaluma Valley Hospital. Average Gross Receipts \$480K. Seller is offering the condominiumized office for sale or lease to the buyer of the practice. Asking price for practice \$284K.

4191 SONOMA COUNTY ENDO

Seller retiring from 38 year endodontic practice located in attractive ground floor office (remodeled in 2011) with updated modern equipment and cabinetry. Close to several regular referral sources. Doctor sees an average of 7-8 patients per day. 5 year average Gross Receipts \$700K+. Asking \$447K.

4202 SANTA CRUZ COUNTY GP

Retiring seller offering 40+ years of goodwill with emphasis on restorative care. Located on major thoroughfare within walking distance to the ocean. 1,600 square foot office with 4 fully equipped operatories. Average annual gross receipts approx. \$500K with adj net of \$170K+. Owner/doctor works on average 3 days per week with average of 5 hygiene days/week. Asking \$300K.

4161 CONTRA COSTA COUNTY ENDO

Seller retiring from well-established practice in desirable neighborhood. Located in professional center with several loyal referral sources. 1,445 square foot office with 3 operatories and current lease with two 5 year options to extend. 2016 gross receipts \$388K+. Asking \$248K.

4196 PACIFIC HEIGHTS SOLO GROUP

Enjoy the benefits of a well established successful group while maintaining your individual general practice in a modern fully-equipped and continuously upgraded office with well trained, seasoned and dedicated personnel. Approximately 1,400 active patients with an average of 10 new patients per month. Average gross receipts \$689K+ with an equivalent of 3 doctor days per week. Asking \$423K.

4133 NAPA GP

Napa County GP in newly furnished, fully equipped 2 operator facility with option for third op. & digital x-ray. 4 doctor day/week with 3 hygiene days. Average annual Gross Receipts \$420K+. Seller willing to help for a smooth transition. Asking \$295K.

4220 SAN MATEO GP

GP offering 33+ yrs of goodwill. Desirable location on well traveled thoroughfare within walking distance of downtown. 3 ops in approx 900 sq. ft. Loyal patient base with 1,200+ active patients. Office accepts Delta PPO. 2017-2016 average GR \$452K with average adj. net of \$170K. Most services other than crown & bridge are referred out. 4 hygiene days a week. Owner will help for a smooth transition. Asking \$289K.

4119 SANTA CRUZ FACILITY

Great dental facility close to several amenities and minutes to HWY 1, and HWY 17. Clean, ADA accessible professional building built in 1982, with plenty of parking, great street visibility and charming facade. Turnkey dental office in 1,200 square foot facility with 3 fully-equipped ops. Includes reception, private office, staff lounge, lab area, sterilization area and common area with additional attic space. Asking \$95K. sale.

UPCOMING: *Endodontic practices on the Peninsula & San Jose, General practices in Fremont, San Jose, Alameda County, Humboldt County & Solano County*



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Laws Governing Dental Marketing and Advertising

CDA Practice Support

State and federal laws on dental practice marketing and advertising focus on consumer protection and information privacy. Federal and state laws have antikickback rules and both the Dental Board of California and the Federal Trade Commission (FTC) enforce “truth in advertising” rules. The Dental Practice Act sets rules on the naming of a dental practice, how to advertise fees and discounts and more. A dentist should not overlook local regulations, such as a sign ordinance. Dental benefit plan handbooks and contracts may set limitations to marketing a dental practice’s affiliation with a plan.

This article looks at the laws that impact the marketing and advertising concerns of many dentists. These concerns include but are not limited to:

- Patient referral programs.
- Truth in advertising.
- Social couponing.
- Use of patient information.
- Websites/email/telemarketing.

Patient Referral Programs

Dental practices like to seek new and different ways to have their current patients refer new patients to their respective practices. Unfortunately, many of the referral programs include some type of reward, or “kickback,” to the individual making the referral and that is a violation of the Dental Practice Act. The law, Business & Professions Code section 650, states in part, “the offer, delivery, receipt or acceptance by any person licensed under this division or the Chiropractic Initiative Act of any rebate, refund, commission, preference, patronage dividend, discount or other consideration, whether in the form of money or otherwise, as compensation or inducement for referring patients, clients or customers to any person, irrespective of any membership, proprietary interest or co-ownership in or with any person to whom these patients, clients or customers are referred is unlawful.”

The law does allow a dentist to hire an individual to solicit patients as long as the individual’s compensation reflects the time and value of the work performed and compensation is not on a per patient or per procedure basis.

Truth in Advertising

As consumers, patients should not be misled by advertising.

Discount advertising (including coupons), for example, must include the following information:

- List the dollar amount of the nondiscounted fee for the service.
- List either the dollar amount of the discount fee or the percentage of the discount for the specific service.

- Inform the public of the length of time the discount will be honored.
- List verifiable fees.
- Identify specific groups who qualify for the discount or any other terms, conditions or restrictions for qualifying for the discount. For example, a discount for cash-paying patients may be advertised.

Any *fee advertisement* should be exact and not use phrases such as “as low as,” “and up,” “lowest prices” or words or phrases of similar import. Any advertisement that refers to services, or costs for services, and uses words of comparison must be based on verifiable data substantiating the comparison. Fee advertising should not be fraudulent or



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misleading and the fee for each product or service shall be clearly identifiable. The fee advertised for products should include charges for any related professional services, including dispensing and fitting services, unless the advertisement specifically and clearly indicates otherwise. Fee advertising for a dental service must fully disclose all services customarily included as part of the advertised service, including but not limited to necessary diagnosis, radiographs, restorative treatment, drugs, local anesthesia or analgesia, materials, laboratory fees and postoperative care. The advertisement must also disclose any additional services not part of the procedure but for which the patient will be charged, together with the fees for such services.

Many dental practices advertise free teeth whitening for new patients. A proper advertisement should include a note that a new patient exam and radiographs are necessary before the whitening, list the fees for those procedures and state that whitening may be contraindicated for some patients.

Endorsements are a key element in a dental practice's marketing program. Some practices have taken to using social media contests to solicit patients for endorsements. Patients are offered entry into a prize drawing, a gift or discount on a service in return for posting a review. In such cases, the patients and the dental practice must note in the review and social media site that patients receive something in return for posting reviews. This subject is discussed by the Federal Trade Commission in its Endorsement Guide.¹ Consumers must be able to decide whether an endorsement was influenced by the consideration provided to the endorser.

A similar notice to consumers must be provided when a dentist compensates or gives anything of value to a representative of the press, radio, television or other communication medium in anticipation of or in return for professional publicity.

The **use of images** in advertising must not create false or unjustified expectations of results. If a model is used in an image, this fact must be clearly noted. Before-and-after images should be comparable in presentation and contain a statement that the same results may not occur for all patients.

A dentist is *prohibited* from advertising professional superiority or that any dental service or procedure is performed painlessly.

Social Couponing

Recent changes to state law have established conditions for appropriate advertising using social couponing sites such as Groupon and Living Social. If a dentist offers or sells services through a third-party website, the third party does not itself recommend, endorse or otherwise select the dentist and the fee paid by the dentist to the third party is commensurate with the service provided, this type of marketing may not be considered "referral of patients" that is prohibited in Business & Professions Code section 650. Other conditions apply:

- The dentist must disclose in the advertisement that a consultation is required and that the purchaser will receive a refund if not eligible to receive the advertised service.
- Any discount price advertising must include the regular, nondiscounted price for that service.
- The law does apply to the provision of "basic health care services" or "essential health benefits," which include medically necessary dental anesthesia and pediatric oral care.
- The purchaser is entitled to a refund of the full purchase price (as determined in the agreement between the dentist and third party) if the purchaser elects not to receive the service for any reason and requests a refund or if the dentist determines, after consultation with

the purchaser, that the service is not appropriate for the purchaser.

- The third party must be able to demonstrate that the dentist consented in writing to the above requirements.
- The third party must make available to prospective dentist-advertisers all advertisements on its website by other dentists located in the same geographic region.

Use of Patient Information

State and federal law overlap in the regulation of a dental practice's use of patient information for marketing purposes. The federal HIPAA Privacy Rule and the state Confidentiality of Medical Information Act (CMIA) require a dental practice to obtain a patient's authorization prior to using patient health information to communicate about a product or service that encourages a recipient of the communication to purchase or use the product or service or to give to another entity to market its product or service. A dental practice should utilize an authorization form that meets both HIPAA and CMIA requirements to gain consent to use a patient's images and testimonial. A valid authorization form must have certain core elements (e.g., description of intended use of information, expiration date) and three required statements. Sample authorization forms are available on the CDA Practice Support website.

Patient authorization is not required for the following types of communications for which the practice is not financially remunerated by a third party:

- Making a patient aware of a health-related product or service (or payment for such product or service) that is included in the patient's dental benefit plan.
- Providing patient treatment.

CONTINUES ON 130



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6137 SOUTH SACRAMENTO AREA Growing practice topped \$1.25 Million in collections in 2017. 4-ops. Great location at main intersection in its community.

6136 SAN RAMON Great foundation here. Collections for 2017 totaled \$575,000. And this was on work schedule averaging 2.5-days a week. 3-ops. Seller can work back 1-day a week to assist in transition.

6135 SONOMA COUNTY'S ROHNERT PARK 2017 collected \$1,050,000 reflecting nice growth over 2016 which collected \$940,000. Profits exceeded \$500,000 for the second year in a row. 6-days of hygiene. There shall be no change in fees for the Successor. New homes being built nearby.

6133 SAN RAMON'S BISHOP RANCH Beautiful 4-op, computerized and digital office. Located in the Bishop Ranch Medical Center. Bring Business Plan. Great addition to existing network. Full Price \$115,000

6132 NORTH FREMONT AREA \$420,000+ invested here. Very high-end for great patient experience. 3-ops equipped with 4th op available, Panorex, completely networked and digital. \$600,000+ in revenues.

6131 SAN RAFAEL Part-time practice. 2016 collected \$243,000. Profits totaled \$146,000. 2017 trending \$265,000. No Delta Premier hit here! 3-ops. Owner lives out of area.

6129 FOSTER CITY / SAN MATEO Wish to infuse your practice with quality patients? Very high-end practice collected \$500,000+ in 2017 on part-time schedule. Seller and Hygienist shall relocate into Buyer's practice to transition patients. Full Price \$100,000.

6128 LOS GATOS AREA Capitation & PPO. 3-Adec equipped ops, Pano, Digital charting. Collects \$420,000+ year. Available Profits of \$190,000 in 2016. Full Price \$225,000.

6127 SAN RAFAEL'S NORTHGATE Collected \$210,000 in 2016 on part-time schedule. Available Profits of \$106,000.

6125 OAKLAND AREA Collections average \$735,000 per year. High income zip code with young employed Millennials next door. 10+ new patients per month. Digital and paperless.

6124 SAN RAMON 100% Out-of-Network. 5-Ops. 6-days of Hygiene. \$700,000 per year performer.

6122 SANTA CLARA - STARBUCKS "LIKE" LOCATION! Best exposure in beautiful strip center. Office just remodeled. 5-Ops. 2017 trending \$1+ Million in Collections on 4-days. Perfect platform to operate 6-days a week. Wants to do \$1.5-to-\$2 Million.

6121 NAPA VALLEY FAMILY PRACTICE Highly respected community asset. Collections 3 years have averaged \$1.28 Million per year. Beautiful facility. Condo optional purchase.

6118 SAN FRANCISCO'S EAST BAY Forty percent partnership in well positioned and branded practice. 2016 collected \$2.53 Million. 2017 trending \$3.2+ Million in collections. Full complement of specialties. 6-month Trial Association wherein interested Candidate shall see ability to make \$350,000+ per year.

ENDODONTIC PRACTICE Central California Beach City. Established 20+ years. Grosses \$1,200,000 & Nets \$800,000.

ANAHEIM Korean clientele. Part-time grossing \$200,000+. 3-Ops, some ortho. Rent \$2,300. Close to Harbor Freeway exit. Full Price \$110,000.

ANTELOPE VALLEY / SANTA CLARITA VALLEY Two separate Million Dollar Opportunities. Absentee Owners.

BELLFLOWER Female owned Hispanic practice. Part-time. Low overhead opportunity.

DIAMOND BAR Absentee Owned. Grosses \$500,000. Gorgeous high identity shopping center. State-of-art facility. Million Dollar potential. 5-Ops. Chinese / Korean / Hispanic.

EAST LOS ANGELES Part time senior female grossing \$20-to-\$35,000/month. Established many years, Low overhead. Full time will do \$600,000.

INLAND EMPIRE Long time Union Patient Practice. Part-time Seller works 3 days. Grossing \$650,000. Patients are available to go to 6-days. Great union benefits.

INLAND EMPIRE Shopping center. Great Lease. 3-ops in 1,650 sq.ft. Absentee Owner. Grosses \$30,000/month. Working Seller used to do \$50,000/month. 20-to-30 new patients/month. Full Price \$285,000.

INTERSTATE 405 & ARTESIA Established many years. 2-ops. Full Price \$150,000.

IRVINE LOCATION 6-ops. Beautiful state-of-the-art office. Full Price \$150,000.

IRVINE Professional Building. Chinese clientele. Grosses \$500,000-to-600,000. 6-ops in 2,000 sq.ft. Rent only \$5,000/mth. Owner here 2 days per week.

IRVINE Lady DDS Grossing \$1,2 Million. Professional Building. 5-Ops. Only Dentist in building. Full Price \$885,000

LA PUENTE Established 20-years. Small shopping center. 3-Ops. Full Price \$150,000

LAKE ELSINORE Great second location for DDS working part-time. 6-Ops. Rent \$2,700. Grossing \$500,000-to-\$600,000. Some HMO.

NEVADA DENTURE PRACTICE Add Implants. Will do \$2 Million. 4,000 sq.ft. rents for \$4,000. Full Price \$850,000.

NEWPORT BEACH'S FASHION ISLAND Grossing \$400,000-to-\$500,000. Great foundation to build upon.

ORANGE COUNTY BEACH CITY Location, location! Previous Gross One Million. Facility only. 6-ops with computerized monitors, TV's and Dentrux. Full Price \$150,000.

ORANGE COUNTY BEACH HMO Absentee owned. Grosses \$1.6 Million. High identity shopping center. 10-Ops. Full Price \$1.3 Million.

PEDO Chinese / Hispanic. Grosses \$450,000. 4-Ops, low rent. Digitized office. Lots of options to grow to Million Dollar practice.

REDLANDS Great Location. Rent \$1,100/month. 3-ops. Nice patient base. Full Price \$150,000.

WEST LOS ANGELES High Identity Location. 3-Ops. Room to grow. Free parking. Grossing \$450,000. Full Price \$500,000.

CONTINUED FROM 128

- Coordinating care with other providers, such as nursing homes.
- Providing inexpensive items with the practice name and contact information.
- Face-to-face communication.

If a dental practice receives some type of payment from a third party for making any marketing, treatment or health care operations communication, HIPAA requires the covered entity to obtain authorization from patients prior to making that communication. Although financial payment to a dental practice for marketing a product or service is not common, be aware that California law places further requirements on this practice.

Websites, Email and Telemarketing

Be aware of federal and state laws that govern these marketing tools. For example, a website that collects personal information on California residents must comply with the state's Online Privacy Protection Act. Unsolicited commercial email may not be sent to California email addresses or from California email addresses. Both the Federal Communications Commission and the Federal Trade Commission regulate telemarketing. The FCC enforces the Do Not Call Registry rules and the FTC enforces the Telemarketing Sales Rules. Even if a dental practice does not

use telemarketing and instead uses direct mail or general media (radio, print or internet) advertisements, how a dental practice responds to the calls resulting from those ads can be subject to the rule. Refer to the FTC website for more information.

Additional information on marketing and advertising rules is in the article, "Dental Practice Marketing & Advertising 101" on the CDA Practice Support website. ■

REFERENCE

1. www.ftc.gov/tips-advice/business-center/guidance/ftc-endorsement-guides-what-people-are-asking#contests.

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BAY AREA

AC-566 SAN FRANCISCO: Spectacular views of Washington Square. 3 ops +2 add'l, 1400sf **\$170k**

AC-624 SAN FRANCISCO: Wonderful patients, solid income in great stand-alone bldg **\$475k**

AC-649 SAN FRANCISCO Facility: Richmond District, 3 ops+1 add'l, Equipment less than 5yrs old **\$120k**

AC-782 SAN FRANCISCO: Well maintained, multi-level Professional Medical Complex. 1450 sf w/ 5 ops **\$250k**

AN-513 REDWOOD CITY: Practice of your dreams! 900sf w/ 4 ops + 2 add'l **\$350k**

AN-686 SAN FRANCISCO: Office designed w/ patient flow & maximum office efficiency. 1000sf w/ 4 ops **\$825k**

AN-752 SAN FRANCISCO Facility: 3 months Free Rent! Opportunities like this one are few and far between! 1007sf w/ 4ops. **\$115k**

BC-710 WALNUT CREEK: Desirable location in stand-alone, single-story bldg. 1313sf w/ 3 ops **\$150k**

BC-741 DANVILLE (FACILITY): Move in Ready facility to build the practice of your dreams! ~ 1600sf w/ 3 fully equipped ops **\$195k**

BC-758 PLEASANT HILL (FACILITY): Gorgeous décor & remarkable location! 768 sf w/ 2 ops **\$35k**

BC-780 RICHMOND: Contemporary design, warm environment, large windows. 1300 sf w/ 3 ops **\$675k**

BC-789 OAKLAND (Facility): Perfect layout for Pedo or Ortho. 2800 sf w/ 6 fully equipped ops. Plumber for 2 add'l **\$250k**

BC-793 BERKELEY: 2-story Prof Bldg. 1382 sf w/ 4 ops & professionally designed for flow **\$475k**

BG-724 RICHMOND: Spacious office w/ enormous growth potential! 2000sf w/ 4 ops **Practice \$138k / Real Estate \$700k**

BG-731 LAFAYETTE: Well-educated, health conscious patient base. 1,000 sf w/ 3 ops 35+ years goodwill **\$229k**

BG-762 EAST BAY: Stellar, high Quality practice consistently generates ~ \$3M annually. 3000 sf w/ 6 ops **\$1.99M**

BG-734 ANTIOCH: The perfect place to work, live and play! Located in desirable professional neighborhood. 1,323 sf w/ 4 ops. **\$315k**

BG-765 FREMONT: This quality practice is the true definition of a "Family Practice". 1000sf w/ 2 ops. **\$295k**

BAY AREA CONTINUED

BN-777 OAKLAND: Providing a full spectrum of quality dentistry to a wide range of patients. 1,297sf w/ 3 ops. **\$295k**

CC-661 SAN RAFAEL: Starter practice in beautiful location w/ like-new equipment. 3 ops, 900sf **\$190k**

CG-616 NAPA: State-of-the-Art practice. Seller moving out of state! **\$425k**

DC-738 WATSONVILLE: 6ops in beautiful remodeled 2,600sf office, visibly located in attractive shopping complex **\$480k**

DC-786 LIVERMORE Facility: Move In ready & recently updated! 2380 sf w/ 3 fully equipped ops. Plumbed for 3 add'l **\$190k**

DG-635 CASTRO VALLEY: Excellent location & stellar reputation! Solo Group Practice **\$650k**

DG-756 LOS GATOS: Rare & Remarkable Opportunity in affluent community! 920 sf w/ 3 ops **\$275k**

DN-693 SAN JOSE Facility: Attractive & spacious! Faces one of the city's major thoroughfares. 1080sf w/4 ops **\$95k**

DN-713 CASTRO VALLEY Lease: Well maintained, attractive, "Move-In Ready" dental office. 1500sf w/ 5ops **Call for details!**

DG-723 SAN JOSE: The practice exceeds \$1.2mil in collections annually! 1,450 sf w/ 5ops. **\$850k**

DN-771 SOQUEL Facility: The perfect place to sink down roots, raise a family & build an empire! 1100sf w/2 ops + 1 add'l. **\$50k**

DN-774 FREMONT: This opportunity has it all and awaits your talent and skill! 1,150sf w/3 ops + 1 add'l **\$150k**

DG-785 SANTA CRUZ: Known for its amusement park & beach boardwalk, this community has much to offer! 1000sf w/ 4 ops. **\$245k** **DG-790 SAN JOSE:** Two Practices being offer at one great price! Priced to sell at **\$1.4M**. **Call today for more details!**

NORTHERN CALIFORNIA

EC-729 GREATER SACRAMENTO AREA: Seller retiring! FFS Practice and Real Estate Available!

EG-722 ROSEVILLE: On track to collect \$1.5M in 2017 with increased profit compared to last year! Price Reduced even though collections are increasing! 1919sf w/ 4 ops **\$1.05M**

EN-628 ORANGEVALE: Great place to work, play & live. HMO 1310sf w/ 4 ops + 1 add'l **\$375k**

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Jon B. Noble, MBA



Mona Chang, DDS



John M. Cahill, MBA



Edmond P. Cahill, JD

NORTHERN CALIFORNIA CONTINUED

EN-664 SACRAMENTO Facility: Great corner location, excellent visibility & easy access! 2300sf w/ 4 ops. **Now Only: \$30k**

EN-702 SACRAMENTO: Long-established practice w/ emphasis on preventative dentistry! 1600sf w 4 ops + 1add'l. **\$450k Real Estate \$325k**

EN-708 SACRAMENTO: Family-oriented practice with appreciative & loyal patient base. 1600sf w 4 ops + 1add'l. **\$150k**

EN-747 CITRUS HEIGHTS Facility: Be the only dental office in this attractive, popular Retail Shopping Center! 2200sf w/5 ops + 6 add'l. **\$100k**

EN-749 LINCOLN: Come sink your roots down and enjoy a fantastic lifestyle which can't be beat! 1877sf w/4 ops + 1 add'l. **\$320k**

EN-755 FOLSOM: A perfect location, envied by all! Enjoy an amazing quality lifestyle in this thriving city. 1200sf w/ 4 ops. **\$175k**

EN-768 WEST SACRAMENTO: family-oriented practice, equipped with updated technology! 1612sf w/4 ops. **\$275k**

EG-788 ROSEVILLE: Do not pass up on this remarkable opportunity! 2700sf w/ 6 ops. **\$300k**

FC-650 FORT BRAGG: Family-oriented practice. 5 ops in 2000sf, 6 npts/ mo **\$350k for the Practice & \$400k for the Real Estate**

FN-754 SOUTHERN HUMBOLDT: If you love the lure of sea air, a relaxed lifestyle & charm of coastal living, then look no further! 1500sf w/ 3 ops + 1 add'l. **Now \$150k!**

GC-472 ORLAND: Live & practice in charming small town community. 1000sf w/ 2 ops. Seller Retiring **\$160k**

GG-454 PARADISE: 2550sf w/ 9 ops. 40 yrs goodwill! Amazing Opportunity! **\$450k**

GN-667 OROVILLE: **Great place to work & play!** Constant growth attracting an influx of residents! 1000sf w/ 3 ops **\$195k**

GN-668 BUTTE COUNTY: Remodeled in 2010! Well-maintained, long-established professional complex. 1200sf w/ 2 ops **\$95k**

GN-717 YUBA CITY: Seller Retiring. All reasonable offers considered. **Building available for purchase!** 2400sf w/ 5 ops **\$475k**

GN-746 YUBA CITY: State-of-the-Art Equipped! **Includes the latest technology in CBCT Imaging.** Real Estate also available! 1600sf w/ 3 ops +1 add'l. **Practice \$480k/ Real Estate TBD.**

GG-769 REDDING AREA: Offering a full spectrum of general dentistry and total care! 2700sf w/ 6ops. **Practice \$390k, Real Estate \$540k**

HG-732 GRASS VALLEY: Seller retiring. Well established practice. 1250sf w/ 3 ops. Real Estate also available. **\$215k**

HN-280 NORTHEAST CA: Only Practice in Town! 900sf w/ 2 ops **\$60k**

HN-618 SIERRA FOOTHILLS: Seller Retiring! Huge opportunity for growth by increasing office hours! 750sf w/ 2 ops **\$95k**

HN-740 SHASTA CO: Warm, caring atmosphere that is magnified by the exceptional, long-term staff. 2400+sf w/ 5 ops + 1 add'l **\$475k**

HN-773 SUTTER CREEK: Located in an area known for beautiful scenery, excellent wine and rich history! 1536sf w/4 ops + 1 add'l **\$195k**

HN-794 GOLD COUNTRY/CALAVERAS CO: The perfect place to raise a family and practice dentistry. 2300sf w/2 ops + 3 add'l **\$100k**

CENTRAL VALLEY

IC-468 SAN JOAQUIN VALLEY: High-end restorative practice! 6 ops in 2500+sf office. Call for Details! **\$425k**

IG-687 TURLOCK: Established quality practice - remarkable opportunity! 2000sf w/ 5 ops **\$298k**

IN-764 STOCKTON: Well-established, fully computerized, paperless, digitalized practice just waiting for your talent & skill! 5,000sf w/10 ops **\$267.5k**

IN-776 STOCKTON: Step right in and you won't miss a beat in this long-established, quality practice! 1046sf w/2 ops add'l. **\$25k**

JG-753 VISALIA: **Pedo/GP Practice AND Real Estate Available!** Stellar reputation, 30 pts w/ 15 hyg pts daily! Spacious 2600 sf office! **Call for Details!**

JG-778 FRESNO: What a steal. Consistent collections over \$600k with cash flow over \$300k!! 1452 sf w/ 4 ops **\$328k**

JH-770 MERCED AREA: Stellar family-oriented practice with a loyal, stable patient base! 1250sf w/ 4 ops. **\$410k**

SOUTHERN CALIFORNIA

KC-678 LOMPOC & SANTA MARIA: Live & practice along the central coast. Plenty of room for growth, Call for Details! **\$240k**

SPECIALTY PRACTICES

AC-748 SAN FRANCISCO Perio: Practice in this prestigious building in desirable central location. 3 ops, 980sf **\$800k**

AC-759 SAN FRANCISCO Endo: Union Square. 1190 sf w/3 ops (plumbed for 1 add'l) **\$495k**

BC-784 CENTRAL CONTRA COSTA CO Perio: Seasoned Staff. Office runs like well-oiled machine! 3 ops **\$450k**

BC-783 EAST BAY Ortho: Thriving practice & long-term stable staff and patients! 2392 sf w/ 7 chairs/bays **\$915k**

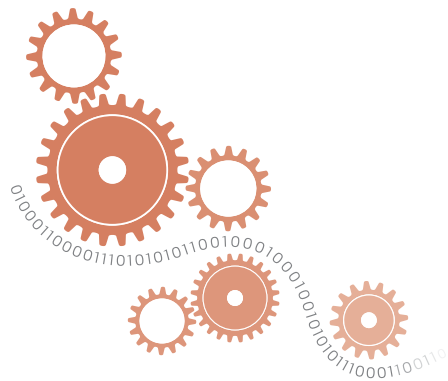
IC-543 CENTRAL VALLEY Ortho: 1650sf w/ 5 chairs in open bay & plumbed for 2 add'l. Strong referrals and PT base **\$125k**

HG-763 GRASS VALLEY Ortho: Avg 30+ pts per day. Newer retail Shopping Center **\$210k**

JG-757 VISALIA Perio: Keep implants in house and imagine the growth possibilities! 9 hygiene days per week! Rare Gem! 2,000 sf w/ 5 ops **\$395k**

KG-779 SAN CLEMENTE Ortho: Huge growth potential by expanding relaxed work week! 2896 sf w/ 6 open bay chairs **\$325k**

"ASK THE BROKER" CAN NOW BE FOUND AT WWW.WESTERNPRACTICESALES.COM



A look into the latest dental and general technology on the market

Samsung SmartThings Multipurpose Sensor and Samsung SmartThings Water Leak Sensor (\$31.99 each)

The Samsung SmartThings Multipurpose Sensor and Water Leak Sensor are two devices that provide users with helpful information that can lead to customizable options to automate the home based on their preferences.

Samsung SmartThings “Things” such as the Multipurpose Sensor and Water Leak Sensor require both the SmartThings hub and a free signup of a SmartThings account through the SmartThings app, available for iOS and Android. Users simply tap + to add a Thing on the app, which places the hub in discovery mode to search for devices. The Multipurpose Sensor is a device with a companion magnet that can be installed on doors and windows and monitors temperature and orientation. The Water Leak Sensor is a device that can be placed anywhere to detect the presence of water and monitor temperature. Both come pre-installed with batteries and a pull tab to activate them. Once the pull tab has been removed, detected Things will appear in the app as they are discovered by the hub. Users can name their Things and add them to their account. Things and their status will then appear in their “My Home” list. The Multipurpose Sensor reports to the app the temperature and whether something is open or closed. The Water Leak Sensor reports the temperature and whether its location is wet or dry. With this information, users can create custom conditional actions directly through the SmartThings app or through third-party partner automation services such as IFTTT (if this then that). For example, users can create an automation action that is based on the statement, “If the kitchen sink is wet, then send a text notification to this phone number.” Many other actions can be created or conditions monitored based on any number of Things that are connected to the hub.

With an increasing number of affordable internet-enabled devices available in the marketplace, the possibilities of home automation are endless. Users have many options to choose from when designing their home setup. Samsung SmartThings “Things” are easy to install and among many in the vast array of internet devices that work together to create a more customized lifestyle and workflow for individuals.

– Hubert Chan, DDS

Large Screens Becoming Preferred Option on Smartphones

The smartphone industry is expected to see steady growth over the next few years, according to a study by IDC. The report states that large displays on smartphones will become more popular and that around 40 percent of the smartphones sold in 2017 had large screens. It is anticipated that number will continue to increase. In comparison, in 2012, large screens, or phablets, only accounted for around 1 percent of smartphone sales. As the preference for larger screens increases, it is becoming apparent that most consumers are willing to pay more for the high-end smartphones, which are averaging around \$850.

– Blake Ellington, Tech Trends editor

Social Media Groups Have Positive Impact on Patient Engagement

Social media groups may be a way to increase patient engagement, particularly when it comes to liver transplant patients. A new study published in the journal *Surgery* utilized a Facebook group as a virtual forum for families, caregivers, health care providers and liver transplant patients to participate in. In the forum, a total of 350 people left posts, comments and reactions to a variety of content, including supportive and inspirational content. A survey was conducted after participation in the forum and 97 percent of those who responded said they participated in the study because it provided support from other patients, and 75 percent of those who participated checked the Facebook page a minimum of once a day. For more information, visit surjournal.com.

– Blake Ellington, Tech Trends editor

Would you like to write about technology?

Dentists interested in contributing to this section should contact Andrea LaMattina, CDE, at andrea.lamattina@cda.org.

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