Prevention and Non-Surgical Treatment of Caries

Video Transcript

Nathaniel Lawson:
Well, thank you so much, Sarah, for that introduction. Like Sarah told you, my main thing that I do, usually I go around the country talking about dental materials and telling people how to use these materials to make better looking composites and to make nice looking crowns that are going to last in the patients' mouths for a long time. And a couple of years ago, I came to this realization that all of that was just a huge waste of time if I didn't try to figure out why my patients needed to have those fillings and crowns in the first place and if I didn't do anything to prevent them from needing or from getting new caries and then also from destroying the nice fillings and crowns that I just did with recurrent caries. I always say that this topic of caries risk assessment and prevention is maybe not my content expertise, but it's an area I'm super passionate about teaching.

What I want to talk to you about today is kind of a simplified method of going through and finding a caries risk etiology on our patients, and then also a personalized method to give them prevention strategies to prevent them from not, again, not just getting new caries, but also from destroying the restorations that we just did or the work that we just did in our dental practices from recurrent caries. That's kind of the overview, and as I talk to you today, my background is in research, so usually when I talk, I talk a lot about research studies, and I have some research studies and it's trying to be an evidence-based talk, but I want to like have this conversation with y'all through the internet kind of the same way that I'd be talking to a patient, so kind of in the language of patient conversations.

So not some esoteric cariology lecture, but something more like how do we talk to our patients? Because we could have the most philosophical discussion about caries that we want to have, but if we can't communicate it to our patients in a way that they're going to change their behaviors, it was, again, I think kind of just a waste of time.

Anyhow, I teach at the University of Alabama, and since I come from an academic university, I do have to give you this disclosure. I did get an honorarium today from Proctor & Gamble, the parent company of Crest and Oral-B to give this lecture today. This is the first time I'd worked with them in a professional capacity. But normally, we get our research grants from dental materials companies, like the ones that make composites and cements, and so I have research grants with many of them, and then also sometimes I'll speak on behalf of those companies. And the other thing, I guess, that's kind of a disclosure is, like Sarah told you, I'm a member of the American Dental Association Council of Scientific Affairs. We're the 18 of us that kind of review science for the American Dental Association and also do the seal program. So I have reported that I'm giving this lecture to the ADA before I do it.

With that being said, I want to show you this patient. This is a patient of mine that kind of like changed my perspective of dentistry.

Before I started teaching at UAB, I had a couple of jobs. I bounced around a couple of different clinics and never landed a steady job until 2014 when I started teaching at the dental school. And at that point in time, I had never seen a one-year recall on a patient. I would treat patients, but I would maybe see a six month, three call, but I never had a steady job, for longer than a year to see my patients come back at one year.

And when I started seeing patients in one year, it kind of changed my perspective because before that period of time, I was just working on little things like how to make my fillings smoother and make them adapt better to the tooth and maybe make the color look nice and little things like that. And a patient like this came back and this guy came in and I had just done a bunch of class five composite restorations on him. I'd done a crown on him. And within the period of just one year, he had destroyed many of the restorations that I had done with him with recurrent caries everywhere.

And I started freaking out. I started thinking, "Oh my God, I'm a terrible dentist. Like I can't even make my fillings last a year. Was it my ... Did I not use enough phosphoric acid? Did I use the wrong bonding agent? Like what did I do wrong?" And I beat myself up, and I thought, maybe I'm just not good enough to be a dentist, like maybe I should have been a computer engineer. I wonder how much computer engineers make. I always liked computers. And then, finally, I kind of came around to a realization, "Well, hold on, Nate. These things didn't fracture and fall out. They failed by secondary caries. And so, yeah, it's his fault. Like he destroyed his fillings. It's not my fault."

And then I came to another realization. I said, "Well, Nate, you never really talked to him about why he came into your practice with 12 carious lesions that we had to do all this restorative work on him and had a discussion about caries risk analysis and some prevention methods for this particular gentleman." And that's when I made kind of a first epiphany, like, "Okay, I've got to find some kind of way to do a caries risk analysis in my practice, and I also have to talk about prevention strategies with my patients."

But then I had to come to a second realization, which was, "Well, how am I going to do this?" Because carries risks on all patients is not the same.

If we look at these two patients here, the patient on our right is the patient that had come in with all those caries restorations, and he was the patient that had come into me ... I treat patients from, get referred from an HIV clinic, and he came in. He was a gentleman that was taking a bunch of different medications, and he had a dry mouth. He also happened to be a host at Applebee's, and I remember asking him one day, I was like, "Hey, how much soda do you drink?" He's like, "Well, Nate, it's more or less immeasurable because at the beginning of my shift, I go and I get a cup and I fill it up with Coke. Well, Diet Coke." He said, "Nate, it's no problem. It's Diet Coke." We'll talk about that later. "And then I just fill it up throughout the day, keep on refilling it. And so it's kind of immeasurable." Yeah, this guy has got, I think of two big problems. He's got [inaudible] stomach. He doesn't have enough saliva. And then he drinks endless amounts of soda.

The other guy on the left, he has a totally different problem. He's a young guy. He is not very familiar with the toothbrush. You could see like up at the cervical areas of his teeth where he's just collecting all that plaque up there. And additionally, he is a snacker. I found this out by just talking to him. And it's totally different caries etiology between these two different patients. And so I realized, not only do I have to discuss the caries risk factors with my patients and prevention methods, but I have to come up with a framework, a way in my mind to organize patients such as I'm talking about their individual needs for them.

There are tools, right? Like this is the form from the American Dental Association. It's a caries risk assessment form. We've got one at our school. It's not so pretty. And there's much more confusing categories in it. I remember when I was in dental school not filling it out very frequently. This one's not too bad, but if I'm going to be totally honest, it's not something that has been incorporated in our faculty practice, and it is a little bit time

consuming to go through this list. I think it'd be great to incorporate it, maybe something to give the patients in the new patient exam or prior to the new patient exam to fill out for us. We can go over it with them. But I wanted to come up with something that was simple enough so that I could actually use this in a daily practice, like a simplified method of categorizing my patients' carries risk factors.

And so I'm not going to take complete credit for this categorization system. My mentor from research, who's a biomaterials expert but also is interested in this research topic, John Burgess, he gives a nice presentation about grouping patients in the high caries risk, so I borrowed some of his ideas. And if you look through this form, you realize that many of the questions that they're asked can kind of be grouped into specific categories. So like some of the questions that they ask in the caries risk form have to do with the patient's salivary flow. Then you have questions like how many medications are they taking, and does their mouth feel dry and the quality of their saliva. And so that can be its own kind of category, in my mind, the reduced salivary flow patient. And then there's other questions on these forms that commonly have to do with the sugar intake and the dietary habits of our patients. How many sweets do you eat and what kind of beverages do you drink and questions related to diet.

And then there's questions related to the patient's oral hygiene or lack thereof. And they're not always directly like this, not just how much do you brush, but also things like, do you have an oral appliance that makes it more challenging for you to keep your teeth clean? And do you have a physical disability which makes it difficult for you to hold a toothbrush? There's the category of the high caries risk patients based on hygiene.

And then, finally, there's often on these caries risk assessment forms, some kind of question about fluoride, like, are you … Sometimes I think about the type of patient that just doesn't have access to fluoride. Like maybe they drink just bottled water, or maybe they're in a county that doesn't fluoridate their water. Or sometimes there's people that are actively avoiding fluoride, the fluoride-averse type patients.

I'm going to go through these four types of patients. In my mind, I've categorized, based on this list, to just simplify it so I have something, a framework in my mind, to think about patients in these four different risk categories and then treatments that are specific for these categories. And that's the outline. That's all I'm going to do with you today. I'm going to just take you through these four different types of high caries risk patients: the low salivary flow, the patient that just has too much exposure to sugar, which I subdivide those, and you'll see there's subdivisions. And so I think of the ones that have too much snacking. They're just snackaholics and then the patients that are just destroying their teeth with sodas and juices. And then the problems with the oral hygiene, like I classify into appliances, patients that have physical disabilities that prevent them from brushing well, and then the patients that I just think kind of have unfamiliarity with the toothbrush or low motivation patients. And then at the end, we'll kind of do a little summary talking about the benefits of fluoride.

When I talk about the low salivary flow patient, I kind of categorize these into … I think the majority of our low salivary flow patients are our polypharmacy patients, kind of like the gentleman I showed you at the beginning. They're taking multiple different medications, which cause them to have a reduced salivary output. And then we've got some other patients that have low salivary flow because of destruction or damage to their salivary glands. So often, we think of the head and neck radiation therapy patients, which is a smaller, much, much smaller percentage of our patients, but it's something to consider. I'm going to talk about these two, and there's a slight difference in how we would treat someone that just has pharmacological reduction in salivary flow versus someone that has destruction of their salivary glands.

First of all, how do we know if our patients have a dry mouth? I remember one of the exercises in torture they used to do to us when we were in dental school is we would have to do our new patient presentation to our faculty member. And of course, our patients were all older patients. They give us this long list of medications, and we go look them up

in a book, and we try to find out their side effects and present them to our faculty. And we always knew that they had wanted to ask questions, so what is this? What's the side effect of this drug? We could kind of guess that xerostomia might be right, and we had no other idea. We'd say xerostomia, and half the time, we'd be right because there's so many different drugs that can cause xerostomia, and I'll be honest, I don't, not like I memorize the drugs that cause xerostomia, but if a patient's on many different medications, you can probably guess they are.

But I just think let's just do it a more direct way. Let's just find out if our patient, do they have a dry mouth? And I think the easiest way to do it is just to talk to your patients because they can kind of tell you, oftentimes, if they have a dry mouth. They might not say I have a dry mouth. They can say some of these other things, like their mouth feels sticky or dry. They can talk about their saliva being ropey or thick and stringy saliva. They have problems with their breath, speaking, swallowing, doing these different types of oral functions. They can have grooved tongues, problems with taste, and then sometimes problems with dentures.

So this kind of conversation, sometimes I feel like I have this sixth sense, too, like with my patients where I'm like I sense xerostomia because I can just ... Sometimes when you pull their cheeks off of their teeth, they just kind of stuck to their teeth when they have dry mouth. And another thing is sometimes you'll see, with dry mouth patients, because they don't have saliva to lubricate their teeth, if it's a lady, they'll have the lipstick stuck on their teeth.

And then if you want to be very scientific about it, you can actually quantify the amount of salivary flow that they have to diagnose them with xerostomia. We've done this in clinical trials before where you have them chew on a piece of wax and tell them don't spit for one minute. I'm going to time you. And then you have them spit into a little medicine cup like this. And if they can get a milliliter of saliva in there in one minute, then you know that they're not dry mouths. And the hard thing is, we buy these medicine cups on Amazon and the smallest measurement they have is 2.5 milliliters, so we have to estimate, but oftentimes a dry mouth patient can barely even get a drop into the medicine cup within a minute of trying to get stimulated saliva.

That's how I kind of get an idea, does my patient have xerostomia. Just kind of ask. And then why do we care if our patients have low salivary output? What are the functions of saliva? And this is one of those questions that might sound easy, but there's the things that our patients think about, but there's the thing that we care about as their dentists, their hygienists, as their dental professionals, that we care about is as far as preventing caries. Our patients care about the fact that it lubricates their oral mucosa, and that's what allows them to help them do all those functions like speak and swallow and all that kind of nice stuff, and it helps them with taste. But for us, there's actually two main things that I think about is the person trying to help them, prevent them from getting caries. There's two things I care about.

One, I care about the fact that saliva is a buffer. It contains bicarbonate, so when we have intrinsic acids from bulimia, if they're bulimic, from the acid producing bacteria, or extrinsic acids, kind of like the sodas and the juices, like the drink. There's bicarbonate in our saliva that neutralizes their pH in their mouth. So buffering saliva, I think, is one of the main advantages of saliva, the bicarbonate, and then the other thing is this idea of being a fluoride reservoir or an ion reservoir. Because if we think about what is caries, we'll talk about this more later, but it's just this process of having more demineralization off the tooth and remineralization.

Our teeth are always in this state of mineral hydroxyapetite coming off of our teeth, our enamel, and then it going back on there in the process of remineralization. Demin, remin. And when we get caries, when there's a higher prevalence of demineralization than tooth going back there. So if you've exposed your teeth to acid and you're getting this demineralization and you don't have any saliva on there to hold the mineral that's coming

off, you're not going to be able to do that remineralization process as well because you don't have this reservoir of ions or calcium and fluoride and phosphate and all the ions that you need in your mouth. So it's a buffer of bicarbonates that neutralizes pH, and it's also a reservoir for the ions that we need for the process of remineralization, so it's extremely important to have saliva, not just for things like lubrication and taste.

Okay, so this is the part where I talked about, if I think of my mind, two different etiologies of dry mouth, and there is some importance there because it can affect a little bit how we can treat it. Most of the saliva in our mouth comes from glands, so it can come from our major glands like parotid and submandibular and sublingual, or the minor salivary glands in our mouth. And if your patient has had neck radiation therapy and they've had those glands destroyed so they're no longer functional, they're no longer producing saliva, then they're never going to produce more saliva, so you have to just replace saliva in their mouth. To some extent also with Sjogren's syndrome, which is an autoimmune disease of the salivary glands that has some destruction of the salivary glands. So in any etiology in which the glands are destroyed, the only strategy you have left is to replace saliva.

On the other hand, the more common thing is when we take medications, if we take medications, which just kind of trick our salivary glands into under-producing saliva, then we can just retrick our glands into producing more saliva by stimulating saliva. They're taking a medication to slow down the saliva production. We can give them a mint or something that they can use to stimulate additional saliva so that they can produce more. But if they have a nonfunctional gland, then giving a mint to produce more saliva is just a mean thing to do because they don't have a functional gland to produce more.

Here are the different treatments that I think about for our low salivary flow patient to address all of the reasons, all the things that saliva did for them, which they don't have as much of anymore. We can try to replace them, and then if they have functioning glands that are just being tricked into under-producing saliva, then we can try to stimulate more saliva. I'll go through these one by one.

The first thing is really more for our patients, for the comfort, so we can give them things like Biotene, which is a lubricant that contains things like glycerin, and it just makes their mouth feel more lubricated, and they like that for taste and speech and for function. But I think of that as the main function of something like a Biotene. But there's that other very important function of saliva, which is the fact it's a neutralizer of acid in our mouth, and so we said that the buffer in our saliva is bicarbonate, so we can replace bicarbonate with bicarbonate.

I remember I learned this trick from Dr. Burgess, who I said was my mentor, and he used to talk about having the patients swish with bicarbonate. And I was like, "Well, that sounds nice, but where are they going to … They're going to go to the pharmacy or the online chemical store and buy some bicarbonate?" Didn't think about the fact bicarbonate is what's baking soda, so according to the almighty internet, as far as recipes, the recipe is a cup of water, so not a glass, a cup of water, with a quarter teaspoon of baking soda. And that's the bicarbonate rinse that you can have your patient swish with, and it can help neutralize some of the acids in their mouth.

And the last function of saliva that we talked about is it's a reservoir for the ions that come off their teeth during demineralization, so we should be giving them additional ions in their mouth to kind of favor that process of remineralization because they've got this missing part of their, this missing saliva that's supposed to be doing it for them. So we can give them a mouth rinse, and it's important for that mouth rinse to contain fluoride.

So if you look around at mouth rinses, I didn't realize this until I was looking around for a mouth rinse to prescribe to my patients, many of the mouth rinses don't contain fluoride. Most of them, I would say, probably don't contain fluoride, so you have to make sure that

it contains fluoride, if you're using it for this purpose. And then additionally, if you have dry mouth patients, dry mouth patients are very sensitive to alcohol-containing mouth rinses, so you have to find a mouth rinse that is alcohol-free. Otherwise that's just, again, just mean to our patients. That one that's listed there is an alcohol-free fluoride containing mouth rinse, so I'd look for something like that.

All right, so that works for everybody. You can always replace saliva if they have functioning or non functioning glands, but if they do have functioning glands, you have the additional ability to stimulate more saliva, so you can do this by having them chew or suck on something that will stimulate additional saliva. The thing is you don't want them to be doing that with a Jolly Rancher, though, right? Because if you put a Jolly Rancher in their mouth, then you're introducing sugar, feeding the bacteria in their mouth, and they're perpetuating carries. You just want to stimulate saliva without causing cavities, so that's where things like xylitol-based lozenges and mints and gums have come in, or sugar-free gums and mints.

And we're going to talk more about what xylitol is later, but as you explain to your low salivary flow patient they need to stimulate saliva, but they don't want to cause cavities at the same time, you can tell them then to look for xylitol containing products. I think the first thing you have to do is, sometimes they come back six months later and they're like, "I looked for that xylitol stuff, and I couldn't find it on the internet." And [inaudible 00:22:38], you spell it with an X. It's X-Y, xylitol. Or you can, this is a product, these are on Amazon. I don't know much about this company, but I know that they make xylitol-containing products and you can buy them on Amazon, and they make lozenges and chews and all different kinds of stuff. It's called Spry.

And then finally, we could also do it pharmacologically and prescribe parasympathetic agonists to stimulate additional saliva. It's not something I've been bold enough to do. I don't do this in my practice, but I just put it on there as another option that you can have. That's kind of, those are the treatments I think of for our dry mouth patients, the first three are to just replace saliva. It's the lubrication effects, this acid neutralization, and its ion reservoir. And then if they have functioning salivary glands and you can additionally try to stimulate more of their own saliva with something though that just contains non-fermentable sugar like xylitol.

And one last little point related to the different products. I like to know just like a little bit more about these products than the person at Walgreens helping them select them. So when I talk to them in the office, I'll say you've got options for different types of lubricants in the grocery store. There's ones that are rinses, and there's ones that are gels. The rinses are made to be used during the day because you can't spit them out at night. You can't rinse your mouth at night while you're sleeping. And the gels are nighttime use, but that's not to say you can't use a gel during the day, too. It's just The viscosity is a little different. The consistency is different. There's some patients that like to use gels all the time. They don't like the rinses at all. So I just say it's a kind of patient preference thing, and just give them a little bit of education about the different kinds.

All right, so next we have our too many sugar patients. And I classify these into, like I said, two different kinds. I think of the ones that are getting too much sugar from snacking too frequently, and I think about the ones that are getting too much sugar from too much beverages. And we'll talk about them individually. And again, this conversation about too much sugar is like not something where we're necessarily recommending a product. This is just more about education.

And with our patients to get them to understand what's going on. I like to give my patients just a teeny little bit of not even cariology one-on-one, just cariology for kindergarteners to try to make them understand what's going on with caries, with the process of getting cavity. And I like to give the example that many of us think that our patients know how cavities form. My wife is sitting in the other room. I had the conversation with her, my wife is way, way,

way smarter than me. I have no idea what she's doing with me, but she's a lawyer and she has never had a cavity in her life. She's never had much of a conversation with a dentist until she met me. And I asked her one day, "Hey Rach, how do you think that cavities are formed?"

And she said, "Well, I know it has something to do with Sugar." She's like, "I think the sugar coats the teeth, and then they crystallize and turn it into bacteria. And then those bacteria will just slowly eat the tooth away." And I was like, "Man, Rachel, you're so smart, but that's so wrong. That's totally not how caries are formed." But she's a highly intelligent patient so can you imagine what our normal patients think about the way the cavities are formed? I like to just give them a little bit of education.

This first diagram, the keys diagram, is a really simple concept that we've all taken for granted. And basically the idea is just that what causes cavities is that you eat sugar, the bacteria in your mouth, metabolizes sugar, and produces acid, and the acid dissolves your teeth, and that causes demineralization and the caries process. It's not just the sugar, it's the acid really that causes cavities and to get patients to understand it's not sugar and it's not bacteria, it's acid. Acid is the bad thing in their mouth causing cavities. So that's part one of the lesson.

And then the second thing for them to understand is this concept of the Stephan Curve, and this is an old publication I guess, from 1944, where they had done this thing where they had given patients glucose rinses, or sugar rinses. And then they measure the pH of the plaque on their teeth after they give them this glucose rinse. And what they found was in a period from five to 10 minutes, that it would decrease the pH and make their pH of their bacteria in their mouth more acidic. And it took somewhere between 20 minutes to an hour for the pH to elevate again, because of the bicarbonate buffers in their saliva to elevate the pH back to where it's a safe level because there's this pH, it's a pH of about 5.5, which will start to cause demineralization of enamel.

It's the critical pH for enamel, 5.5 and for dentin and cementum, it's even higher, 6.5, you only have to get down to 6.5 to demineralize a dentin and cementum. The thing that the patients have to understand is this not really about the amount of sugar that they eat, it's about the frequency at which they eat sugar, which is a little bit different maybe than what their physician's telling them. Their physician probably wants them to cut down on the amount of sugar they're eating so they don't get diabetes or something, or they don't become overweight.

But us, as their dental professionals, we want to tell them, it's also about the frequency at which you consume sugar. It's a concept for them to understand. I've got this pretty... I apologize if you guys think this is stupid, but I got this story that sometimes I share about this concept. That's a picture of me in the all red outfit and my mother, and then that's my little brother there sitting next to me or standing next to me. I was always the kind of goody two shoes son and my brother was the more mischievous son. One of our favorite times of the year was Halloween. And we go out together... We did a lot of stuff together. We went out together, we'd go collect candy throughout the neighborhood. And we bring back these humongous bags of candy to our house.

And then me being the goody two shoes, I go straight up to my room. I got these a hundred Ziploc bags and I'd individually packaged all my candy into little Ziploc bags. And then my brother, who's bad as hell did everything he wasn't supposed to do. Would run up into his room and just immediately destroy his candy bag from Halloween. And I always thought, "Well, man, I'm the good one." My responsible habits have allowed me to preserve my candy as long as possible. But honestly from like a caries risk standpoint, every 40 minutes I was replenishing the candy in my mouth feeding the bacteria again. And I never let the pH in my mouth buffer back out to a pH that wouldn't cause cavities, so it was just constantly demineralizing my teeth.

Whereas my brother just got it all knocked out in one 60 minute period. And then the pH of his mouth was buffered out to a neutral pH and it wasn't causing cavities anymore. Yeah, it

was kind of a weird story, but anyhow, this is a point, something like that to explain to my patients that it's the frequency at which they consume sugar, it's not the amount of sugar that they consume.

What are some other strategies though? Because one of the things I always talk about is us in dentistry as dentists or hygienists or dental assistants, as clinical dental professionals we have a little bit different job description than other people. And I think maybe many of us now in quarantine are finding out that our... I have a lot of friends that say they're gaining weight because they're sitting around and they have just access to food all the time because they're at home and they're constantly snacking. I'm sitting at my kitchen table and I've got little snacks on top of our kitchen table I just snack on throughout the day. When we practice dentistry, we can't do that, we've got the PPE on and the masks and the gloves and it's disgusting to go in there and reach and eat candy.

But there's some people that this is what their normal jobs are like. They can constantly snack on food. What are some strategies for people that are just going to snack on food and you tell them to decrease the frequency consumption of snacks, but that just kind of goes against their lifestyle. There's such a thing as non fermentable sugars. That means that there's sugars, that the bacteria in their mouth can't eat, so they can't metabolize them and they can't produce acid. And the fancy word for that is a non-fermentable sugar. These are examples on the screen here of some non-fermentable sugars. These are sugar alcohols, all these ones ending in ols, so xylitol, sorbitol, erythritol, they're all natural sugar alcohols which bacteria can't eat. So they can't metabolize and they can't produce acid, so these types of sugars can't cause cavities.

As long as they're the only sugar that's sweetening a product, sometimes these are added as additional sugars and they also have high fructose or glucose or some other type of sugar inside of them. But as long as this is the only sugar that's sweetening a product, then it can't cause cavities. The one that we always hear about usually though, is we hear about xylitol, that's the big one. And the one I mentioned to you earlier, and that's how you spell it with X, because aside from just being a non-fermentable sugar, there's also some potential other benefits of xylitol that could possibly inhibit the growth and metabolism of S-mutans. And there's been some research studies showing this.

The one thing I do say about this and when I thought about this is there's the Cochrane Reviews, which are kind of the pinnacle of evidence that most of us look at and what the Cochrane Review said was that there was some low quality evidence if you add xylitol to regular fluoride containing toothpaste, that there was a benefit of doing that. But in the application that most people had talked about was providing it as some kind of dietary supplement or just eating xylitol. There's no evidence that it could reduce caries in infants, older children or adults. I have seen some people come in and say that this Cochrane Review doesn't look at studies, which give a high enough dose of xylitol in order to show these effects.

Maybe it's just a dose thing, but that's kind of where I personally had to stand on this. I think xylitol is great. I recommend it for patients because it's something that's a non-fermentable sugar, but I'm not saying that this is necessarily going to in and of itself help prevent caries. It's just better than eating sugar that's fermentable. The neat thing about xylitol compared to the other sugars is that xylitol is something that you can bake with. I've gone to Publix where I grocery shop, and they actually have bags of xylitol. It's not something weird that you can't get at the grocery store. So you can actually bake with xylitol and then like I said, there's many products that are xylitol sweetened so that you can just tell your patient, "If you think that you have to eat your snacks every day, I'm sorry, you don't get to eat the ones with sugar in them, you have to go on the Amazon and buy a little bit more expensive sugars because you have this disease of caries and you're going to have to make some lifestyle changes and buy a little bit more expensive xylitol containing candies."

What about other types of... These types of sugars? The yellow and the pink and the blue, the sucralose and the saccharin and aspartame, I've had patients ask me about if these sugars are bad. Well, these are also non-fermentable sugars. They're what's called non-nutritive sugars because they have no calories and they're non-fermentable, bacteria can eat these types of sugars. Yeah, I mean, I suppose if your patient got a glass of water and mixed Equal inside of it and drank it, it would be a non-cariogenic beverage. Usually people are using these sweetened beverages, which are already acidic, so they're already going to be causing cavities. That's where your patients... We'll talk about that in a second later, but in and of themselves, these are non-nutritive... These are non-fermentable sugars that can't cause cavities.

I think the reason that we, as dental professionals, haven't gotten behind these as much as maybe the sugar alcohols is because there's also the potential of other systemic effects. Are they potentially carcinogens? I think most of those studies were done in rodents, but still I think that we like natural sugar alcohols, like xylitol probably more than these non-nutritive sugar. Yeah, but in and of themselves if the patient asks you, these are non fermentable sugars.

How about this? I like asking these questions because these are the kinds of things that the patients ask you and they're always trying to stump me. At the beginning they used to always be able to stump me and I've gotten more answers now, so I don't get stumped as much. What's the difference between an apple and the gummy bear? Why does the patient have a perception it's okay to eat an apple and we're not supposed to get a gummy bear? Does the apple contain non-fermentable sugars? No, actually an apple does contain fermentable sugars and you can get cavities from eating an apple. The difference between the apple and a gummy bear, there's two that I can think of.

First, is that the apple has other nutritive value aside from just providing sugar. It's got other vitamins and nutrients within the apple, whereas the gummy bear doesn't. I mean, of course it's better to eat the apple than to eat the gummy bear. The other thing has to do with consistency. That's another thing to think about with foods and snacks. Is there consistency? Gummy bears are sticky, they get stuck in the grooves of your teeth or between your teeth so they can sit there longer and feed the bacteria longer, whereas apples aren't sticky. And I actually had the... I got to go on the news this year, around Halloween time and talked to them about which candies are good and which candies are bad for people's children.

We had the discussion about what are some of the bad candies, I thought, "Well, anything that sticks around in your mouth for a long time, like a lollipop or a jolly rancher or something like that is going to be worse than something that you can chew on and get rid of quickly." I always think of a piece of chocolate that's going to dissolve away and it's not going to hang around as long as the sucker or a lollipop or a jolly rancher. The other thing is consistency.

Again, taffy is going to get stuck in your teeth more, or even when we talk about chocolates, I'm thinking about pure chocolate. If we think about Snickers with caramel, that's sticky, it can get stuck in your teeth longer. And then the last thing we talked about in the thing was acidic candies being worse then... Again, at the end of the news conferences I thought, "Well, chocolates, aren't so bad, aren't they? I mean, of course they're cariogenic, but not as bad as maybe some other candies."

How about these? Can these things cause cavities? Can a potato chip? Yeah, potato chips can cause cavities. Potato chips are polysaccharides, starch containing, these can also cause cavities. This is a nice chart, some of the classes I teach to the third year dental students they give presentations about topics related to this. And they presented this chart this year, which I thought was a really nice chart that went through some of the different sugars and showed which ones were fermentable. And we've already been through all of this, that I think we didn't talk about lactose and milk, that's fermentable sugar. That's why you can't set a baby down with milk because it's

got a lactose and fermentable sugar. Maltose and beer, some beer has fermentable sugar, starches have fermentable sugars, but in all those non-nutritive sugars are non-fermentable like Sweet'n Low and NutraSweet and Splenda.

All right. I want to move on to the next topic. What about the frequent snackers? We can try to get them to reduce the frequency of consumption, and we can also get them on non-fermentable sugars. Now I want to talk about this is the real... This is where I feel like a really bad category is our patients that consume massive amounts of sodas or juices or any type of acidic beverage that contains sugar. And this is something I've known about for a while. I like this picture. This is another picture of me as a child doing my very first science experiment.

My aunt was a pediatric dentist and she mailed me all of these pediatric or primary teeth. And they put them in different solutions and I measured the pH of the solutions, and then I documented how quickly the tooth would dissolve over time and I thought it was awesome. It's probably why... Somewhat related to the clothing my parents would make me aware and the fact that things like this is probably why I had no friends, but it was a science project that I had done as a kid. Now I look on the internet and now they're doing something similar like this, but they're doing it with eggshells because they probably don't want kids walking around with the extracted primary teeth.

But anyhow, just the concept that it's not just the sugar, it's also the acidity of the beverages that make them so bad. My very first patient I mentioned that worked at Applebee's. He said, "Oh, Nate, I drink an endless amount of soda, but it's diet soda." And yeah, if you only listened to the first part of the lecture where he found that's got a non-nutritive, non fermentable sugar in it, we'd say, "Oh, okay, he's right."

But no, there's another thing, there's acid. Remember? Acid is the thing that ultimately causes carries and erosion of our tooth. We can't give our patients... We can't soak our teeth in acidic substances. One of the cool things we did in this study here was we put teeth in milk. And I remember talking about this as a fourth grader, whatever it was that milk is the bad thing that we can't put in a patient's mouth because it's got sugar in it, but it's not acidic. If there were no bacteria to metabolize that sugar and produce acid, then milk wouldn't be bad. But in our patient's mouths, there are bacteria and they can metabolize the sugar and then they can produce acid, which can cause caries.

I really like this diagram here, this was published in the Journal of American Dental Association, by the second author there, Dawn Norris, she was a classmate of mine and they published the study when we were in dental school and they published it later, and it just has the pH of a whole bunch of different beverages. As I'm trying to explain this to the patients, I do have to simplify this a little bit because I did test this one on racial again and asked her about pH. She said, "Well, water is one and then it goes up from there." I realized I just can't talk about pH numbers with patients. I explain to patients that water has got a pH of seven and then we've got battery acid, which has a pH of one, which is, do they understand what battery acid is? And I say, "The Coke Cola that you're drinking has got a pH of 2.5, that means it's much closer to battery acid than it is to water."

To try to get them to understand it's kind of like soaking their teeth and battery acid when they're drinking these acidic sodas and juices. Same thing, orange juice has got a pH of 3.9, the pH that we need to dissolve an enamel, remember the critical pH was 5.5. And the pH that we need to dissolve dentin or cementum root structure is 6.5, so these all do that. It was funny, the study found that a root beer was the least acidic beverage. They said, "Because it doesn't contain citric or phosphoric acid, which most of these do." But it still had a pH of 4.5, so it was still acidic enough to dissolve both an enamel and cementum.

This is this next one, though. This was weird. This is what really broke my heart though. I had a really good friend of mine

who's an endodontist in Atlanta and he likes Pamplemousse LaCroix. I am addicted to the natural flavor LaCroix, that's my jam. I love a national flavored LaCroix. And I was having this argument with him about how I was a better person than he was because he drinks Pamplemousse and it's citric flavored, citrus flavored so it's going to be more acidic than my natural flavored LaCroix. I'm not getting cavities, I'm drinking this stuff like five cans a day and I'm not getting erosion from it because it's natural flavored. And he said, "No, Nate is just as acidic is my Pamplemousse."

I didn't believe him so I took the cans to work and I got a pH strip and I dumped the pH strip inside the natural flavor LaCroix and found out it had a pH of 4.5. It was a terrible day for me because I thought... I don't know. I just thought that it was a non-acidic beverage because it's natural flavored. It and many of these carbonated or bubble containing waters are acidic due to the carbonation they put in there. I haven't given up my LaCroix's, I still love my natural LaCroix's, but I'm just... Now I have them in moderation because I understand that they are acidic. It's a PSA for all of you LaCroix people. And I'm sorry if I just ruined anybody's day today.

All right. For again, my patients like me, I'm not going to give up my LaCroix, so what are some strategies that we can talk about for our patients realizing that it's not the sodas are going to go away? These are just some behavioral changes that I recommend is one is to drink your sodas at meal times. And that just kind of limits the frequency of consumption of the sodas. I think there is some truth to that saying, "Drink it through a straw because then it has less contact with your tooth." And then the last thing is the acidity. So you have to remind them it's this acidity thing. When they have their morning cup of coffee and they're done with it, if they're not going to go brush their teeth in the bathroom, at least go over to the drinking fountain like I do, and rinse your mouth out with water to help neutralize the pH in your mouth. Those are some strategies for those patients.

I want to now talk about our patients with challenges with oral hygiene. Again, this can be the patients with the appliances that make it difficult for them to clean their teeth, or you can have hands that either have a physical disability preventing you from touching a toothbrush or I have another little brother that I think... And as he was growing up, he said the toothbrush would burn his hand, that's why he never used it. He just never brushed his teeth. The patients have low motivation or are just unfamiliar with brushing, so we're going to talk about both.

First thing I want to talk about is orthodontics and this is something near and dear to my heart. Here I was when I was in the third year of a dental school, so that was when I was 13, according to Sarah's... No, I mean, that was... It was an adult orthodontist. I remember the pain of being in orthodontics and trying to keep my mouth clean. It's very challenging. And those aren't necessarily a closeup of my teeth. That's disgusting, but they could have been, not that dissimilar. I think the thing when you have patients that have appliances or they have orthodontics it's if you're their a hygienist or if you're their comprehensive care dentists and you're going to be treating them for their maintenance, you need to be discussing with them some of the strategies that they need to do to keep these appliances clean.

The major one that I always think about is orthodontics. And of course we always think about using some type of floss threader to get underneath the wire to floss contacts. But there's another thing to think about too, which is getting underneath the wire, next to the bracket because how many times have we seen kids come and get their ortho taken off and then they have those white spot lesions that just trace the borders of their brackets? And of course there's the plaque that sits on top of the teeth, but there's also a plaque that sits right next to those brackets that the toothbrush bristles just can't get to.

Have to explain to them about that, and of course we also have to explain how they're going to get their floss through the contacts so that they can continue to floss their teeth. This stuff isn't rocket science, it's not nothing really complicated, it's just something to be cognizant to think, "Okay, yeah. If I have a patient

orthodontist, I have to remember to tell them this," because I don't know if I was told this and how much I was thinking about this when I was in my adult orthodontics.

Of course they get under the wire there's floss threaders and there's Super Floss, that helps them get through the wire and underneath so they can get through flosser contacts. But then there's... The thing I think that gets missed often is about getting up next to the bracket. They've got the silicone ones and the bristle brush ones, they can get up right next to the brackets and they can kind of scrub next to the brackets and try to take some of that plaque off. And then the last thing I think about these... I think of kind of all of my orthodontic patients, I don't see too many adolescent patients now, but I had a couple and I used to treat a lot of kids is that they're all high cares just patients in orthodontics, teenagers are notoriously bad at hygiene and then also orthodontics just make it so difficult to clean. I think about putting these patients, additionally, on some type of high fluoride mouth rinse or some type of high fluoride gel.

And this is a little something that... Sometimes I say that there's no such thing as a single piece of Super Floss Because when you go in the drawer and you try to get a piece of Super Floss and you get... I call it like Medusa's head, every piece of Super Floss out of the bag. This is a product... I think actually Gum makes the other product over there and I've got some in... I'm still left with my stupid lingual retainer, [inaudible] Lingual Retainers that I have to floss underneath. This is a product that 's got the hard piece and the soft piece, and it's super flush on the spool. I don't know that Oral B makes something like this, so guys get on... If anybody from Oral B's listening, this would be a... I'd love to see something like this.

Next is talking about the patients that have physical disabilities, preventing them from holding their toothbrush. I think of my grandmother with rheumatoid arthritis and her challenges holding a toothbrush.

We have a little toothbrush handle. You can do things to modify the toothbrush handle to make it easier for them to hold the toothbrush. The one that I had always heard of was this modification of a tennis ball, and you just cut a little hole in the tennis ball and you shove the toothbrush through it.

This is a lecture that I started off giving to our dental students, and then I started going around the state of Alabama, and then started doing this lecture a little bit more. I learned that dentists think a little bit about hygiene, but of course hygienists, so much more insight I've gained from talking to so many hygienists and getting all these cool ideas from giving this lecture. Things like using a bicycle grip to put the toothbrush inside of, or if you're in a nursing home and you don't have access to a tennis ball or bicycle grip, you can just take a washcloth and wrap it around the toothbrush handle with some rubber bands, and that's an easy way to make it more grippable for the patient. Also, certain people talk about things like getting the impression putty and making a customized toothbrush for your patient. I just keep on thinking, man, that's a very expensive toothbrush though that you just made because that impression material putty is not cheap.

All right. We talked about appliances. We talked about patients that have physical disabilities preventing them from holding a toothbrush. Now, I want to talk a little bit about the patient that has low motivation or isn't brushing their teeth well. One of the things I think is interesting about this is that oftentimes, I think we've all seen this kind of thing where a patient comes in. At the very beginning, I showed you a patient that had plaque all across the cervical edges of his teeth. Patient comes in like that and you say, "I think you need to brush your teeth more", and the patient says, "Doc though, I brush my teeth twice a day. No, three times. Pretty sure, I brush my teeth three times a day. It's like, I don't know what's going on." Many times I think to myself, well, this person's just a liar. They're just bold faces lying to me.

I had another realization the other day. I don't know, maybe a year or two ago I was brushing my teeth and I stopped and I looked in the mirror and post orthodontics, I have all this [gingival] recession. I was looking at

my mandibular canine, the cervical area, and I realized that I had been constantly leaving plaque right around the gum lines from my mandibular canines. I thought to myself, you know what? This guy is probably lying if he told you he wasn't brushing. That's a lot of plaque, but sometimes when you see plaque in a patient's mouth, they're not necessarily lying to you. Sometimes they think they just don't have great brushing habits and they don't know how to brush their teeth and where to brush their teeth and that all the plaque lives down at the cervical areas of their teeth.

These little plaque disclosing tablets, I think, are great to be used selectively. I have realized that if you give these to patients and you can't get all the purple stuff or pink stuff off before they leave, they don't like you because they came to the dentist to have their teeth cleaned, not to have little bits of purple or pink left in there, but it's an effective communication tool for the patient that you need to explain maybe how they need to be brushing better, either to kind of prove to them that they've got plaque there or to show them where the plaque is they need to clean off better.

Another thing to get people motivated is talking about toothbrushes with them. There's some things that are contentious in dentistry, but I think that the topic that an electric toothbrush is more effective than a manual toothbrush at removing plaque and reducing gingivitis is not contentious because the Cochrane reviews, they're very safe. They don't make any recommendations unless the evidence is very, very clear. In the Cochrane review about manual toothbrushes versus electric toothbrushes say that both in short and medium term studies, there's a clear benefit in reduction of plaque and lowering gingivitis with the use of an electric toothbrush. I think that that's a great thing to recommend to your patients with and maybe any of your patients, but then also particularly patients that have difficulties with keeping their teeth clean or any patient that asks you if they're interested or that's interest in electric toothbrush, I always tell them, yeah, there's definitely evidence that it's more effective than manuals.

The other thing that has been, I think, a contentious topic is there's the two camps of people. I mean, there's of course the companies, but then there's also the followers of the companies. If somebody brushes their teeth with Sonic Care, they're almost religious about it. Same thing with the Oral-B rotating oscillating, toothbrushes. They're very stuck in their camps and you will kind of wonder, is there any science? Have they done research to show that one of these is better than the other? Oral-B rotating oscillating is better than the Phillips Sonic vibration toothbrushes.

My background in composites and in ceramics. We do all the testing and that, and I hadn't been too familiar with the research related to toothbrushes, and then actually as I'm getting ready for this lecture, the April issue of The Journal of American Dental Association just came out and they've behold there's this systematic review of meta analysis of randomized control trials comparing oscillating, rotating, toothbrushes, and other power toothbrushes. They call it other power toothbrushes in the title, but all throughout the manuscript, they talk about Sonic vibration toothbrushes.

This isn't just a clinical study. I mean, this isn't just a lab study. It's not just a clinical study, this is a systematic review and meta analysis. That means they've compiled all the relevant clinical trials on this topic. How wrong I was. They've done multiple studies comparing the effectiveness of removing plaque and reducing gingivitis of different types of electric toothbrushes. I'm going to go through the study with you, and I'm just going to show you a couple of graphs out of the study. There's six graphs, I think, in the study, and I'm going to show you, I think, four of them because two of them kind of repeat themselves.

This graph here, I love these types of graphs. They're called forest plots, and they make a lot of the data. It summarizes one, two, three, four, five, six, seven, eight clinical trials in one small little graph. There's a big vertical line running through the middle of the screen. All the little dots on the left of the side of the screen meant that in that clinical trial that was done, you

saw a benefit of using a rotating oscillating toothbrush head as far as removing plaque. They looked at the plaque index after some of them had brushed their teeth with these different toothbrushes. And so what you see is there's more dots over on the left hand side, meaning more of the studies found that there was more plaque being removed with rotating oscillating versus a Sonic vibration toothbrushes. Additionally, if you read through the study, they found that there was actually a significant benefit, a statistically significant benefit, of using a rotating oscillating toothbrush versus using a Sonic vibration toothbrush when it has to do with plaque removal.

The next thing that they looked at in the study was they looked at gingival inflammation. They had a gingival information score that they would record on patients when they used either type of toothbrush. Again, the dots on the left hand side of the line for the majority of the time here, but they're not as far. And so they couldn't make a statistical claim that there was a greater reduction in gingival inflammation with rotating oscillating based on the studies, but they also looked at gingival bleeding. They looked at it based on an index and the number of gingival bleeding sites, which is an indication of gingivitis based on using rotating oscillating and Sonic vibration toothbrushes. With index, they found no difference, but with the number of bleeding sites, they showed a lower number of bleeding sites with rotating oscillating.

What I took from all this reading was that there actually is a large amount of research that's been done, the clinical trials, randomized clinical trials, comparing rotating oscillating versus Sonic vibrating toothbrushes. None of the factors that they looked at were there more studies that showed Sonic vibration better than rotating oscillating, but for two of the categories looked at, which was plaque removal and gingival bleeding sites, there was an advantage of rotating oscillating. For me, talk to my patients and when they come to ask me and they expect me to have some kind of evidence to back up what I say, I feel like it's an obligation to say, yeah, there actually is data out there showing benefits of using rotating oscillating toothbrush versus a Sonic vibration toothbrush. To my own little personal satisfaction, I used to have both when I was in dental school. I always felt like the Sonic toothbrush tickled the back of my tongue and it felt weird.

Anyhow, this is another thing. The patients with low motivation, we talked about toothbrushing. What about flossing? I have to admit this to all of you out there. Wow. There's a lot of people out there, that I am not a great flosser. I've never been a great flosser. My hygienist over the past, maybe about four years ago, finally got me started into flossing. This is what she used to help me do. I don't know what their official names are, but I call it floss on a stick, and it's just a toothbrush handle that's got floss on the end of it, and that got me started flossing. Now, I've moved on to regular floss. I tried floss pics. They didn't work, but this was a great way to get me started into flossing so that when I floss my gums, they didn't bleed as much, just so embarrassing to admit.

The funny thing about this story is even more embarrassing to admit is when I first got this floss on a stick, I didn't realize that that little string was replaceable. I couldn't figure out how to take the little string off there. I, for probably three to six months, just used one single piece of floss. That'd be like flossing your teeth with a piece of string, setting next to your sink and doing that every day for six months. It's so disgusting. Just to let you know, PSA again, you can cut that little piece of floss and it comes apart and you can replace that.

All right. Now, we're going into our last category. I'm going to try to end in the next 15 minutes, so we have some time for some questions and I just want to talk about fluoride. When I talk about fluoride, I'm thinking about patients again, who maybe just don't have exposure to fluoride because maybe they live in a County that doesn't have fluoride, or I have the Whole Foods bag there. I talk about the fluoride averse patients. There's some patients that actively are seeking to avoid fluoride. I just want to give you a little bit of information about fluoride because I remember before I came back into

academics, when I used to practice, I used to just tell patients it was vitamins for the teeth. If I'm going to be totally honest, I don't know how much more I knew about fluoride.

This slide here, I remember making the slide and spent two hours making the slide. I showed it to one of my friends who was in dental school and I said, "Isn't this slide cool?" She said, "Oh yeah, no, awesome." I was like, "You know what that slide's supposed to be, right?" He said, "Yeah, it's the periodic table." I was like, "No, haven't you ever seen Breaking Bad? It's supposed to be Breaking Bad."

Anyhow, I know you can't see my cursor, but do you know what that F inside of the blocks is right up there? That's not actually the sign for fluoride. That's the element fluorine. Fluorine is the element. Fluoride is an anion of fluorine. I had a patient come into me. I was a chemistry professor at UAB. He said, "Man, we really got to get this fluorine stuff out of the drinking water because fluorine is this nasty, dangerous gas." I was thinking to myself, you're a chemistry professor. Fluorine is F2. It's the gas. Fluoride is this anion of fluorine.

The fluoride we use in dentistry, it comes in different types. There's sodium fluoride, and that's probably the most, currently the most, prevalent type of fluoride that we have in dentistry. It's in mouth rinses and toothpastes and lots of different varnishes and things like that. There's Stannous fluoride. Up until the point when I was getting ready to give this lecture, my knowledge of Stannous fluoride was actually relatively minimal. When I presented this slide, I just basically say, Stannous fluoride contains tin and tin is an antimicrobial agent, and I never really understood beyond that, why it was actually an antimicrobial agent and really much of the differences between sodium and Stannous fluoride. I'm going to share some of those differences with you in just a minute here. The other common type of fluoride would be acidulated phosphate fluoride. Those were like the foam gels that I remember I used to get when I was a kid. It's just a different type of fluoride.

What's the difference between Stannous and sodium fluoride because there actually is a difference. ProHealth is a brand that has Stannous fluoride. I would say currently, most other toothpastes are sodium fluoride containing, but things are starting to change. There's starting to be more Stannous fluoride containing toothpaste out there.

The interesting thing about Stannous fluoride, it's got different mechanisms of action. The little stuff in the bottom, which I know is really small and you can't read, was data that I took off of the American Dental Association seal website. If you ever look at your toothpaste and it's got that little box on there that says ADA seal, you don't just get to put that on there. That's something that a company has to apply for it, and they have to do certain types of testing independently, which they submit to the American Dental Association seal program, and then us as members of the council and [inaudible] review that documentation and decide if it's adequate, and then you can get a seal for your product and you get to make the claims, but only the claims for which you've submitted documentation that you've done clinical research or laboratory research testing to prove.

You can only make specific claims for the ingredients that are within your product. The interesting thing is that Stannous fluoride is the only type of fluoride that can actually make several types of claims. Both Stannous and sodium fluoride can make the claims that they can prevent cavities. They could do the clinical trials or [inaudible] trials showing that they can help reduce caries, but Stannous fluoride can also additionally prevent gingivitis, And we'll talk about that mechanism in a second. It's the only active ingredient right now that can get the claim for acid erosion prevention, which I think is a pretty important thing now with how much acidic beverages and things our patients are exposed to and sensitivity. Usually sensitivity, people get from potassium nitrate if they're in their toothpaste, but Stannous fluoride can also include dentinal tubules, so it can also get the claim for Stannous fluoride.

If you look at this box over here, because it's got the ADA seal on it, all of those claims that it makes on that box all have passed the ADA seal. Every toothpaste have to get past the

FDA. They regulate just making sure it's safe, but it's an additional testing that they have to do in order to get the ADA seal and make those claims. When something contains only sodium fluoride, all it can make is the anti carries claim. There is a difference between the different types of fluorides, and that's not something that I had realized. I don't think many of our patients realize that, and it's not something that I had talked with them as much as maybe as I think I could.

I do want to talk just a little bit about what that gingivitis claim because it was something I never completely understood until I took a little bit deeper dive into this. The way that the anti gingivitis claim works is that gingivitis comes from, we have plaque in the sub gingival aspects of our tooth that can contain gram negative anaerobic bacteria. These bacteria have this little toxin on their cell wall called LPS. I remember the periodontist always used to talk about LPS, and I never knew what they're talking about. Just a little toxin that lives on the cell wall of gram negative anaerobic bacteria living kind of in sub gingival plaque.

What that LPS toxin can do is it can throw a series of mechanisms. It can recruit inflammatory cytokines and cause inflammation of our gums, and most gingivitis just inflammation of guns. That's why that's a bad thing about this LPS toxin and Stannous fluoride is fluoride that contains 10 SN, so SN is 10, and it contains fluoride. The 10 combined with that LPS toxin, and that's what the little picture showing a cell that's got some tin binding with the LPS toxin and inactivate that essentially LS toxin and prevent the process of inflammation from occurring. That's why Stannous fluoride has this additional benefit of not just being a fluoride. It also contains this tin and this tin helps reduce LPS, reduce inflammation and therefore reduce gingivitis, So that was pretty cool. It's something that I didn't know that much about, and I didn't understand the mechanism until I understood it. Now, I'm passing that on to all of you.

With that being said, I want to talk a little bit about fluoride and the effects of fluoride on our hard tissue now back to the tooth. How does fluoride work? Again, I used to talk about fluoride and just say that fluoride was vitamins for your teeth, but it actually has a true mechanism of action beyond that. Fluoride can work systemically, so the whole body or topically, when it's in contact with your tooth. The systemic mechanisms of action of fluoride would be pre-eruptive, before your teeth have erupted into your mouth while they're still forming and then post-eruptive, and really more pre-eruptive, meaning that when you ingest fluoride before your teeth have erupted, then you can incorporate some fluoride into those teeth before they erupt, where when it's post-eruptive, so us as adults that have formed teeth, the only thing that fluoride is going to be doing for us systemically is we're going to drink some of it. It can get it back into our blood, maybe make it into our saliva and then work topically. The main mechanism of fluoride is really topical, and it's got these three mechanisms and we'll talk about how it works topically.

How fluoride works topically? When your teeth are exposed to fluoride, what is it doing? The first thing that I talk about is an increase of remineralization of your tooth. If you think about what's going on in our tooth, they're constantly going through this process of remineralization and demineralization. Enamel is composed of 95 to 99% mineral hydroxyapatite. Throughout the days, you're exposed to different types of assets. Some of that mineral comes off of the surface of your enamel, and then once the pH neutralizes again, the hydroxyapatite can come back onto the surface of your enamel.

One of the things that you can do by putting fluoride in your mouth, introducing fluoride, is it just changes the chemical gradient, such that now in your saliva there's just more ions hanging out in that solution, so that when things come off of your tooth because I said, oh, hey, let's get off of this tooth. Let's go into the saliva. They go into saliva, there's all this fluoride now and all this other ions. They say, well, hey, there's too much of a party here in the saliva with all these other ions on there in this fluoride stuff. Let's go back on the tooth because there's just a chemical gradient

driving them to go back onto the tooth. It's just a chemical gradient that's saying there's too much ion concentration in saliva. Let's go back and hang out on the tooth. It's just an increase in the remineralization process, that's the first mechanism I think of.

The second mechanism I think of is that when the mineral goes back onto the tooth, now it's not just the hydroxyapatite anymore. It's not just the calcium and phosphate and hydroxyl group that originally was. One of those ions, the hydroxyl group, gets replaced with fluoride. What goes back onto your tooth isn't hydroxyapatite. What goes back on there now is fluorapatite. Fluorapatite is different from hydroxyapatite in that it's less acid soluble. You're replacing your hydroxyapatite with the mineral content that is less acid soluble, so that's why we say we strengthen our teeth with fluoride because you're putting fluorapatite onto the surface of your tooth.

The third mechanism, I don't talk about too much because you really need a high concentration of this, is it can inhibit this enzyme in bacteria called amylase, but I really think about the first two. It just creates this chemical gradient so that there's too much ions in saliva so that when things come off of your tooth, they just want to go back there. The other thing is when they go back on there, they're going to be fluorapatite, which is more acid resistant than a hydroxyapatite was.

Again, how does fluoride work systemically? Well, the only way that it really works systemically is you drink water, some of that water can get absorbed into your system and it can either come back if you're a kid like this that has forming teeth, it can come back through the blood supply and go to the forming teeth so that when they erupt, they erupt with some fluoride in there. But us as adults, all that it can really do is it can come back through our saliva and just put a little bit of more fluoride in our saliva and work in the topical mechanism of action. Really, the topical mechanism action is more important for fluoride than systemic mechanism of action.

They've done some studies to show this. Basically, they've done studies showing that if you drink fluoride containing water, you're just getting a small amount of fluoride in your plasma and just transiently elevated, so it's not like you're getting a lot of fluoride that's going to be able to make it back into your saliva.

I'm running a little low on time, but there's a study, which I think is a really kind of a funny study, which is also a very disgusting study where they took advantage of the fact that sharks are born naturally with fluorapatite on their enamel. They don't have hydroxyapatite. The study was trying to show that if you take natural teeth and expose them to fluoride, they're actually more resistant to carries than teeth that are composed of fluorapatite, like shark teeth, basically showing that it's more important to expose teeth once they've erupted to fluoride, then to have them erupt with fluorapatite in them. And so they did the study by making this really disgusting denture for these old people to wear that had shark teeth and that had natural teeth and they showed that if they exposed the natural teeth to external fluoride, that they were more resistant to getting cavities than the shark teeth. I just think how disgusting it is to wear a denture with other people's natural teeth in them?

If we talk about the topical mechanism of action being more important than the systemic mechanism action of fluoride, then what's up with fluoride in the drinking water? Let me just kind of run through this history of fluoride in the drinking water for you really quickly to explain what happens and what's up with it.

The story as it goes is there is this doctor, Dr. McKay, that went to Colorado and noticed that there are these people in Colorado that had this thing called Colorado Brown spot, which was their teeth were brown. They're trying to figure out what was going on, what was causing their teeth to be brown? To kind of expedite the story, eventually they found this factory in Arkansas. It was an aluminum factory, was dumping aluminum into this drinking water, and that community started getting the brown spot. And so they thought that there's something in the water causing this, and it's the Lumina that's causing people to get the brown spot. The Lumina company had to do some, I call CYA, type of research to figure out that it

wasn't Lumina. They figured out, okay, no, this is actually fluoride that is causing people to get these brown spots on their teeth.

The other thing I forgot to mention though about the people that have brown spots on their teeth, it was ugly, but these people didn't get cavities. A guy at the NAH, this Trendly Dean,

Dean had this idea. He said, "Well, what if we just put a little bit of fluoride into the drinking water, such that you wouldn't get the brown spots, but we'd put enough of it in there so that you wouldn't get cavities." They did some research at the NIH and they found out there'd be this concentration around one part per million in which you wouldn't get the brown spot and you wouldn't get cavities. They put fluoride in the drinking water at Grand Rapids, Michigan, and did this huge public health study. That's the famous study we know today which showed the benefits of putting fluoride in drinking water. Because this is classic study, just to show you about how it is, what they found was they found that if you looked at 1944 at a kid from 1944, ten-year-old, for example, in 1944, they'd had a DMFs score five.

That means there'd be five surfaces on their teeth that would be decayed missing or filled. And if you look 10 years later in 1954, that the 10 year old after they've introduced fluoride in the drinking water for 10 years would only have 2.5 surfaces decayed, missing or filled. So, it's not the same kid, it's different kids. So a 10 year old in 1944 would have five surfaces. A 10 year old in 1954 would have 2.5 surfaces. And what they showed is that over time in the same city, by putting fluoride in the drinking water, you reduced the surfaces that were getting cavities in these kids. And they did another type of study where they looked at the nice kids in Grand Rapids, Michigan got fluoride in their drinking water, the poor kids in Muskegon, which is another city in Michigan, didn't get fluoride in the drinking water. And they showed that the kids in Grand Rapids had less DMFs score than the kids in Muskegon. So that was the big evidence that fluoride in drinking water can help reduce caries.

And so, yeah, so I definitely do think that it works and what's the concentration of fluoride in drinking water? It has a concentration of about... it started off at one, and now it's at 0.7 parts per million, as far as fluoride concentration in drinking water, but there's something that's changed since the 1950s, when those studies were done and that is that people now have more access to fluoride in toothpaste. So let's just talk a little, a quick second here about fluoridated toothpaste. So how much fluoride is in fluoride to toothpaste? If you just look at the back of your toothpaste bottle or box, you're not going to be able to find out concentration related to [inaudible 00:02:34]. We said drinking water is one. How does toothpaste compare? So you got to just do, I'm not going to go through for the sake of time, this math with you, but you could just go through and do a little bit of math to figure out the molecular weight of the sodium and the fluoride.

And you find out that basically all the toothpastes on the market be it sodium fluoride or stannous fluoride. They all have about 1000 parts per million of fluoride in them. So that equals 0.454% stannous fluoride, or 0.243% sodium fluoride. It's all got about a thousand parts per million fluoride. It's about a thousand times as much fluoride as drinking water. Same thing, actually, I didn't realize this kid's toothpaste has the exact same amount of fluoride and it's just sparkle sale. And then like a high fluoride toothpaste might have like 5,000 times as much fluoride inside of it. So you're getting a very high exposure of fluoride with fluoridated toothpastes. And another interesting thing to see is how long does that fluoride stick around in your mouth for?

So this was a study that showed, if you look at the graph there, it shows basically the fluoride concentration in plaque, the fluoride concentration in your saliva, either if you don't use fluoridated toothpaste, if you use a regular toothpaste of the thousand part per million or high fluoride toothpaste, and what they show is that not only do you get a high concentration of fluoride in your mouth initially, but you also that high fluoride concentration remains in

your mouth for 12 hours after you've brushed your teeth.

So high fluoride in your toothpaste is high initially, and it stays around for 12 hours. So you're constantly getting fluoride exposure from brushing your teeth with fluoridated toothpaste. Although there's one thing I do want to say. This is funny because when you talk to patients about this, patients know this expression, rinse and spit, right? So you say, I'll do this and I'll rinse and spit. Ask a patient, how many of them rinse their mouth after they brush their teeth with fluoridated toothpaste. And you're going to be surprised how many people rinse their mouth and they think they're supposed to. Actually, a lot of times I talked to the first year dental students, half of the time they rinse their mouth after they brush their teeth with fluoridated toothpaste. And I always tell them, no, it's not rinse and spit, it's just spit.

Don't rinse your teeth after you brush them, because you want that fluoride to hang around there longer, they've actually done studies like this, showing that even this study just looked at two hours later, that the concentration of fluoride in your mouth after you, if you rinsed, as compared to just spitting was less than half the amount of fluoride, if you rinsed as compared to just spitting, but going back to kind of my Opus or my thought related to fluoride and drinking water is that we know that putting fluoride in the drinking water is a great public health benefit. It reduced the amount of DMFs scores when we put fluoride in drinking water. But, as we read through the Cochran review, that has a little caveat statement there. And they said that a lot of those studies were done in the 1950s before we had great access to fluoridated toothpaste.

So if we look now with people having access to fluoridated toothpaste, the topical effect of having fluoride in their drinking water might not be as great, but don't let me confuse you at all by thinking that I'm one of those people that thinks that we should take fluoride drinking water though, because the way that I kind of look at it is that patients that have access to fluoridated toothpaste because their patients can afford it, or the patients brush their teeth and give them fluoridated toothpaste, aren't going to have. Maybe, they don't need to be drinking fluoridated water. It's maybe the patients that don't have access to fluoridated toothpaste either cause the parents can't afford it, or they just aren't brushing their teeth, they actually do need that fluoridated toothpaste.

So I'm running really low on time. So I'm going to skip the last part of my presentation, which is, are there any dangers of fluoride? I'd say the only true danger of fluoride is fluorosis, which affects maybe 7% of the population to a visible extent if you have too much fluoride, and fluorosis only can happen before your crowns have been completed. So after age eight, you don't have to worry about fluorosis anymore. So none of us can get fluorosis unless, unless there's someone that's seven in the audience.

So with that, this is my last slide here. That's my website. This is my Instagram, where I live and I spend a lot of time. We put out a lot of content on there at @dentinaltube. But we don't know what Instagram is, ask your kids. They can tell you what Instagram is. There's a lot of educational content. And then I also have a website, my speaking website, which is this drnatelawson.com. And I've got some resources on there about, mostly about dental materials, but I think there are some resources related to this topic as well. So Sarah, thank you so much for having me. I'm so sorry that I went late. I thought I was going to get done early and I got done way later than I thought I'm guilty. So thank you all for hanging in with me.

Speaker 2:
You're actually answering a lot of the questions that some people were asking and I don't even think he realized it. Real quick, guys. The code for today is nlawson420. Again, that's N-L-A-W-S-O-N-4-2-0. All one word, all lower case. Okay. So we are going to get to some questions here. A lot of them are about fluoride. So obviously again, how much fluoride would cause fluorosis?

Nathaniel Lawson:
Okay. So I have my little slide on that. So the

ADA has recommendations for how much toothpaste you should give your kid based on your kid's age. And they are basically between the ages of zero and two years old. Well, you don't need to give your kid toothpaste at zero. So six months to two years old, you would just do a little smear of toothpaste. And once they get between the ages of two years and six years, you can give them a piece size amount of toothpaste. Probably one of the primary places that they're getting fluorosis is from toothpaste. And then as far as drinking water, they have a recommendation based on the child's weight. So I think I had a little slide. I am so sorry I had to skip through it, but it showed how much drinking water a child at one year old can get? I think it was like 0.8 liters of water if you're one and if you're like eight, you can get... There's a formulation that's kind of based on that. And one of the things I think he had to be cognizant of is, sometimes if you're going to be giving your baby formula, sometimes formula will, if it's with fluoridated water, then you can kind of get close to exceeding that maximum. So that's one thing to be cognizant of.

Speaker 2:
I never even thought of that. That's great. On that same note, would you recommend bottled water or tap water for pregnant patients?

Nathaniel Lawson:
So it's an interesting question because we had gone in and tried to figure out if bottled water fluoridated or not. And, if you look at the button and one of these bottles, it won't tell you. It won't say I'm looking at this one. It doesn't say if they're fluoridated and even if you call it the company, they don't necessarily know it because it's dependent upon the bottling plant if the water that they picked was fluoridated. So they don't have to tell you if it's fluoridated or not. So you don't even really know if the bottled water that you have has fluoride in it. And I think there had been some research that was done at our school where people actually measured fluoride content and different drinking waters. Some of my friends and colleagues did a study related to that and they found that, I think that there were some that did and some that didn't. So I don't think that you can even make that recommendation because you don't know if your bottled water has fluoride or if it doesn't have fluoride. So...

Speaker 2:
Interesting. I guarantee a lot of people don't know that. I didn't know that. And if they knew they'd be mad. Cause I mean, some of the questions I'm going to ask you here, a lot of people think fluoride is poison. What's the best way to explain this to our patients that it's not?

Nathaniel Lawson:
Oh, okay. I thought you said that a lot of people listen to the lecture about fluoride poison. And I was like, oh my God, they're going to hate me.

Speaker 2:
No. [inaudible]

Nathaniel Lawson:
Yeah, no. I mean, of course you're going to have talked to some patients that are, I call them fluoride diverse patients. And the thing that I think about as well, even if the patient comes into me and they, and they're a very low caries risk patient and they want to give their child bottled water because they're afraid of them consuming fluoride in the water. I think, well maybe that's not so bad. As long as they haven't realized that there's fluoride in the toothpaste and they continue to brush with fluoridated toothpaste because it's got a thousand times more fluoride than drinking water. And if they're just worried about ingesting fluoride, then I say, okay, that's not such a bad deal, but if they don't want to use fluoridated toothpaste, again, I think it's kind of dependent upon if they also have many caries frustrations in their mouth and you have to do a little bit of explanation, I guess about, what are the potential negative effects of fluoride?

And I tell them fluorosis is one that's real. You just have to monitor the amount of fluoride that your child's exposed to. Beyond that, they try to say that there's some additional systemic effects of fluoride, like it can have a negative effect on your thyroid and your IQ and a skeletal fluorosis, which is a flier pulling calcium out of your bones. There's a nice review by, I think I believe her name is McDonna, it's like a British dental research

where she's gone through and reviewed a bunch of different studies, which have not found association between negative systemic effects and a fluoride. And it's a review paper, which is a really nice kind of reference to show that. I think that many of the studies that were done were done in rodents again, that showed negative effects. And so, I mean, there's some education related to just proving that there's not systemic negative effects with fluoride. And then, making also the determination, about how much you want to push it with that particular patient, depending on their caries risk. Like if they have a pretty low caries risk and maybe what they're doing isn't so bad. If they're high caries risk and their fluoride verse, then maybe you had to go a little deeper in the subject.

Speaker 2:
Okay. Do you happen to know the pH of the crest mouthwash you were recommending?

Nathaniel Lawson:
I don't, and that's a really great point. And I think that one thing that I've seen now is that there's also a number of mouth rinses, which are acidic. And in response to that, there's been mouth rinses that are non acidic. And I do think that's an important thing to look at. And I don't know, I think the BIM, it could be acidic. There might be some that have a pH lower than 6.5, which could not be a good thing, but I don't know for specific brands.

Speaker 2:
Okay. Did any of those toothbrush studies address long term compliance?

Nathaniel Lawson:
No. I don't know. I don't know of a study that looked at compliance, I don't know if they're saying electric versus manual toothbrushing. For us, even when we're doing our clinical trials on restorative materials, like we don't usually go beyond three years cause it's just so hard to get recalls of patients more than three years long. Long Term clinical trials are like not very existent because they're just so challenging to rehaul patients that long. So, I don't know of anything like that.

Speaker 2:
Okay. What happens if a child eats half a tube of toothpaste for kids?

Nathaniel Lawson:
Yeah. So I have a slide about that, there's a level of fluoride, which can cause fluorosis, and then there's a level fluoride, which is actually toxic, which can actually kill you. So I think for a little kid, it's like a quarter of a tube of toothpaste. And when we get up to like suicide by fluoride for an adult person, it would be like two tubes of toothpaste almost you'd have to eat. But for little kids, it's a lot more dangerous. I think it's somewhere around like a quarter to third of a tube of toothpaste, depending on their weights, could actually be a lethal dose of a fluoride. So that's one reason to keep little kids away from fluoridated toothpaste.

Speaker 2:
If you found a child that's eaten half a tube of toothpaste?

Nathaniel Lawson:
What'd you say?

Speaker 2:
Is there anything you can do immediately? Yeah.

Nathaniel Lawson:
Try to induce vomiting in the child. I think there's something that you can keep at home, I forgot what they're called. Things, certain types of salts that can induce vomiting or they'll take them to the emergency room to try to induce vomiting.

Speaker 2:
Okay. Should we be recommending that patients not filter their tap water?

Nathaniel Lawson:
Yeah. That's a good question. And that's not something I've looked into that much cause I've had that question before about if the filters actually remove fluoride from drinking water. And I don't want to say something that I'm going to say inaccurately. So I can't say that I remember if we ever figured out the answer to that question.

Speaker 2:
Okay. How about mineral water, carbonated water or sparkling water? Is there any concern consuming these?

Nathaniel Lawson:
So that was one of the worst days of my life, well, probably not the worst in my life. Well, one of the terrible days in my life was the day that I measured the pH of a natural flavored LaCroix and found out that the carbonated water had a pH of, I think at a pH of 4.5. So it was acidic enough to be below the critical pH for an animal. So yes, some of these carbonated waters will have a pH that's acidic. And the scary thing is that sometimes even bottled waters will have a pH below 6.5. So that can erode the root of your cementum. So yeah, that's a real thing.

Speaker 2:
Does fluoride go unchanged through the body?

Nathaniel Lawson:
I don't know. I'm not sure. I'm not totally sure how to answer that question.

Speaker 2:
Okay. Is there a way to get the fermented food list that you showed?

Nathaniel Lawson:
Yeah, I found that via Google. I'm trying to think what I Googled to find that, but it was in a publication that I was able to access for free via Google. I think I typed in like fermentable sugars. Non-nutritive sweetener and I think that's how I found that. I don't know. I mean, I could share the link if there's a way, but, but I think that's how I found it.

Speaker 2:
Okay. I'm going to take two more questions, okay? What about fluoride tablets? Are you saying that they are not effective either?

Nathaniel Lawson:
Yeah. That's not something I can say I'm an expert on all things who I've talked about. Cause for tablets, I'm thinking of like systemic fluoride and looking into it and I could be wrong on this topic, is that topical is more effective than systemic fluoride. So, I don't want to leave anybody astray because there's probably someone that's a bigger expert than me that can tell you, oh no, the guy's totally wrong. Like, fluoride tablets are the bees knees. And like everybody in a non fluoridated county should be having them. But yeah, that's the best I can answer.

Speaker 2:
That's fine. What are your thoughts on natural toothpaste that have liquid calcium in place of fluoride?

Nathaniel Lawson:
I've never heard of that. So, I guess for me the thing I think about natural toothpaste is exactly that. It's like a lack of fluoride. And I don't know in toothbrushing studies, I know that when we look at restorative materials and we look at demineralization prevention from restorative materials that can either release calcium or fluoride, actually the fluoride is more effective at preventing demineralization than calcium. So like, I'm a fluoride person. I mean, I like fluoride. I mean, I would prefer to have fluoride, but that is a good point though. If you have a patient who is fluoride averse, there are some products like MI paste is a product from GC that doesn't contain. If MI paste regular plus doesn't contain fluoride, and so that's a calcium phosphate containing product that you could give to a patient that was fluoride versus.

Speaker 2:
Okay. Awesome. Well, thanks Nate. We appreciate having you on today. This is great. Very informative. Jeff, can you pop up his slide again? Actually? I don't know if we can, your last slide with your information. If you can't, will you type it in the box here in the comments, just cause people are asking for your slides, they want to know how to get a hold of you and that's totally up to you what you feel comfortable sharing.

Nathaniel Lawson:
Yeah. Let's see. For some reason I don't.

He sounds like an intergalactic, man.

Speaker 2:
Go, just go.

Nathaniel Lawson:
So my email is nlawson@uab.edu. The Instagram is @dentinaltube. D-E-N-T-I-N-A-L-T-U-B-E. And my website is drnatelawson.com. That'd be cool to put that back up on here. I just don't know how.

Speaker 2:
I think it's that the presentation is over. So we got to go through all your slides to get it back up.

Nathaniel Lawson:
Oh, okay

Speaker 2:
Yep. Okay.

Speaker 2:
All right. Well thanks Dr. Lawson and we'll have you on again. I'm sure this was very informative. All the comments on the side were very positive. Everybody was excited.

Nathaniel Lawson:
Thank you, Sarah. Thank you all for tuning in, and have a great day.

Speaker 2:
You too.

Nathaniel Lawson:
Bye.