

A Palette of Plant-based Dietary Patterns: How do they Impact Dental Health?

Video Transcript

Ellen Karlin:

Well, thank you for joining us. Sara and I are passionate about this topic, A Palette of Plant-based Dietary Patterns: How Do They Impact Dental Health? We know that evidence-based research shows us eating more plants is associated with protection against many diseases. Whether we're concerned for our health, our planet, animal welfare, sustainability, we are definitely eating more plants. So we have so much information to share with you. We thank you so much for joining us and let's get started.

Sara Karlin:

It is my pleasure to introduce Ellen Karlin, a nutrition consultant with vast personal and professional knowledge in nutrition, food allergy, and dental health. She was a nutrition consultant to dental healthcare professionals in Owings Mills, Maryland and a nutrition consultant at the Comprehensive Asthma and Allergy Center for over 30 years. Ellen holds a Master of Medical Science degree in Nutrition Education from Emory University. She became a fellow of the American Dietetic Association in 1999. Ellen is a spokesperson for the American Dairy Association North East and a nationally recognized speaker. She has delivered numerous webinars and nutrition lectures at healthcare conferences. She was the co-author of Dental and Oral Considerations in Pediatric Celiac Disease, published in the Journal of Dentistry for Children in May 2016. Ellen has contributed to a variety of other resources including Trendy Diets in Oral Health, published in the Access Journal of December 2019.

Ellen Karlin:

Thank you, Sara, and I am thrilled to be presenting this course with my daughter, Dr. Sara Karlin. She is a board certified pediatric dentist. Dr. Karlin is the Dental Director at Children's Rehabilitative Services in Phoenix, Arizona, and clinical adjunct assistant professor at Arizona School of Dentistry and Oral Health. She received her Bachelor of Science Degree from the University of Maryland College Park and completed her DDS at the University of Maryland School of Dentistry. Sara pursued her specialty training at NYU and Bellevue Hospital Center, earning a Certificate in Pediatric Dentistry. She is a member of the Academy of Pediatric Dentistry, the American Dental Association, and the Arizona Dental Association. Dr. Karlin is a nationally invited speaker on the topic of nutrition and oral health, and she's the primary author of the article that we published together, Dental and Oral Considerations in Pediatric Celiac Disease, and she has contributed to a variety of other resources as well.

Ellen Karlin:

The objectives for today are going to be discuss plant-based dietary patterns and plant-forward cooking and eating styles, discuss the synergy between whole-food, plant-based nutrition and the integrity of the oral microbiome and the oral cavity, and discuss the growing body of research supporting the benefits of plant-based dietary patterns for our optimal oral and systemic health.

Sara Karlin:

There is a synergistic relationship between our patient's nutritional status and their oral health.

Ann Wigmore, a Lithuanian American author stated, “The food we eat can be either the safest and most powerful form of medicine, or the slowest form of poison.” Nutrition and oral health go together like peas and carrots. When our patients are not making healthy choices in the foods that they eat on a regular basis, evidence-based research shows us time and time again that this leads to major oral health problems later in life. And of course, we need healthy dentition in order to consume a healthy dietary pattern. This link between nutrition and oral health is undeniable. The foods we eat and our daily dietary patterns play an integral role in the overall health and wellness of both the hard and soft tissues in the oral cavity. We will be spending the next hour discussing how eating a healthy plant-based diet as part of an overall healthy lifestyle will enable both you and your patients to prevent the onset of both oral and systemic diseases and to support a healthy oral microbiome.

Ellen Karlin:

Let’s talk about the newly released Dietary Guidelines for Americans. They are nutrition messages from government agencies that advocate for general health promotion and prevention of disease. The US Department of Health and Human Services and the US Department of Agriculture update these guidelines every five years. I as a registered dietitian, I am so excited that our newest guidelines were just updated and released in December of 2020. And I’m going to be referring to this guidance throughout the session. The tagline is “Make every bite count with the Dietary Guidelines for Americans.” It really gets across the message that we need to be focused on healthy eating.

Ellen Karlin:

The dietary guidelines tell us that there are three healthy dietary patterns that we can follow. And when we look at these, we can see that they are all plant-based. So we can be following either the healthy US style, the healthy vegetarian, or the healthy Mediterranean style. And when we look at this graphic to the right, which I actually took right out of the guidelines, they give us four

key bullets. So, number one, we should be following a healthy dietary pattern at every life stage. And my patients are always asking me, is it too late?... No, I haven’t been eating healthy for so long. But it is never too late. And then if you’re working with pregnant women, or you’re working with, uh, families, you want to make sure that mom during her pregnancy and children try to follow that healthy dietary pattern because that’s going to set them up for health systemic, and their oral health throughout their entire lifetime.

Ellen Karlin:

Now, when we follow these patterns, we want to customize and enjoy nutrient-dense foods. And this just makes me think I’m in Arizona right now, and it’s very hot. I think about getting away to the beach, maybe one weekend. And think about the plant-based foods and beverages that are available along the boardwalk, right? You’re going to have your double fried cookies, you’re going to have funnel cakes, um, you’re going to have those soft pretzels, you’re going to have French fries. This is not nutrient-dense.

Ellen Karlin:

Nutrient-dense is going to be the focus of this presentation. These are going to be these foods in their whole form, not ultra-processed. And you want to select these foods when they reflect your personal preference, your culture, your tradition, and take into consideration of course, budget. And you want to focus on meeting food group needs. You want to stay within calorie limits. So, I tell my patients always, “Watch your portions.” You want to limit those foods and beverages, those ultra-processed foods that are going to be high in added sugars, saturated fats, and salt. And you want to definitely limit alcohol for many reasons, but particularly because alcohol increases excretion of magnesium in the urine. And we need magnesium for our immune and our overall health.

Ellen Karlin:

When we talk about whole-food, plant-based eating, I like to use this graphic or this visual with my patients. This shows them exactly what the plate should look like. When you take

a look at this plate, you can see that three quarters of this plate is actually plant-based. You want half of your plate to come from fruits and vegetables. You want a quarter of your plate to come from grains and half of those grains should be whole grains. And I know my patients are so confused because when I tell them whole grains, they think about maybe brown bread or white bread and they think, "Okay, so the brown bread is going to be whole grain," but that's not true. You have to read the labels and you want to see the term whole grain. And grains don't always have to be wheat. It doesn't always have to be whole wheat bread. It can be amaranth, they can be barley, buckwheat, bulgur, millet, fonio I just tried recently, quinoa, a lot of us are familiar with and the list goes on and on.

Ellen Karlin:

And then that other quarter of the plate, that could either be animal-based, so you could either fill that eggs, fish, meat, poultry, or you can select your plant sources of protein. For example, soy, nut, seeds, chickpeas, lentils. And from the dairy group, we can either choose to have dairy in our whole-food, plant-based eating pattern, or we can select a fortified soy beverage, so that we can be at least, uh, three quarters plant based or we could be 100% plant-based if we choose.

Sara Karlin:

Plant-based eating is recommended by so many professional and nonprofit organizations. This is just a partial list and as the research grows, this list will definitely grow as well. These organizations include the American Cancer Society, the American Heart Association, the World Health Organization, many others, and the American Academy of Nutrition and Dietetics. As dental clinicians, we can help support plant-based eating as well.

Ellen Karlin:

The American Academy of Nutrition and Dietetics actually also agrees with plant-based eating patterns and states in their position statement that that "appropriately planned vegetarian, including vegan diets are healthful, nutritionally adequate, and may provide health benefits for the prevention and treatment of certain diseases. These diets are appropriate

for all stages of life including pregnancy, lactation, infancy, childhood, adolescence, older adulthood, and for athletes."

Ellen Karlin:

While there is no formal definition of plant-based, there are specific terms within the plant-based category of eating that are well defined. So, you can see that plant based eating occurs on a continuum and there are different types of plant-based eating patterns. So when you look at this pyramid to the right, you will see that vegetarians and vegans follow a healthy lifestyle because the base of the pyramid states, be active, enjoy meals with others. Vegetarians and vegans eat fruits and vegetables. They eat whole grains, including rice and barley and millet, oats, quinoa, and other whole grains. They eat beans, peas, lentils, soy, all of your different tree nuts, cashew nuts, almond nuts, peanuts, seeds, nut butters, and they include herbs, spices, and plant oils as well.

Ellen Karlin:

Now as a dental healthcare professional when you're working with vegans, you want to make sure to remember that vegans do not have good sources of vitamin B12 in their diet because B12 is found only in animal-based sources. So if you see a patient with glossitis, stomatitis, or mucosal ulceration, for example, you might want to find out what type of dietary pattern that they're eating because undiagnosed B12 deficiency can show up in these manners. Now, when we're looking at the tip of the pyramid, we can see there are different types of vegetarians. There are lacto-ovo vegetarians, who eat eggs, dairy, and plants. Ovo vegetarians, who eat eggs and plants. Lacto-vegetarians who eat or drink dairy and eat plants. And all of these vegetarians and vegans also drink plenty of water. And we know that that's a great thing because water is not only environmentally friendly, and should be substituted for sugar sweetened beverages, but it's also inexpensive, and promotes oral health benefits, especially when fluoridated.

Ellen Karlin:

According to the Culinary Institute of America, "plant-forward eating is the most significant mega-trend underway in America." As a

registered dietician, I believe, and I hope that this trend is here to stay, because this type of eating is so healthy. It's a style of cooking and eating that emphasizes and celebrates, but is not limited to plant foods. So, we are eating fruits and vegetables, whole grains, beans, other legumes, soy nuts, seeds, plant oils, herbs, spices and this all reflects evidence-based principles of health and sustainability. Now, some people consider themselves to be pescatarian, which means that they are eating fish along with these plant foods. And I know Sara and I consider ourselves and many of my patients to be what we call flexitarian or semi-vegetarian because as this definition states, we emphasize and celebrate plants that makes up the majority of our eating pattern. But we also eat animal-based foods such as meat and poultry, and fish, and eggs, and dairy, just less often.

Sara Karlin:

Whole-food, plant-based eating limits ultra-processed foods since they have added salt, saturated fats, preservatives, additives, and of course sugar. As dental clinicians, we are always advising our patients to cut back on added sugars. I like to take this advice one step further. I ask my patients to be A students, making whole-food choices at least 90% of the time. We should be encouraging all of our patients to eat more whole plant-based foods, and less industrialized grocery store or convenience store foods and beverages.

Sara Karlin:

While we all know that there are so many factors affecting the cariogenic process, including the form of the food, and the sequence in which the foods are eaten I am going to go through a quick review of what is happening when we consume refined carbohydrates and sugars in our diets. As we all know, when we eat fermentable carbohydrates, the salivary amylase breaks these down into oligosaccharides, which provides substrates for the cariogenic bacteria. This creates a shift in the oral microbiome towards caries causing bacteria such as *S. mutans* and *L. acidophilus*. This result in a decrease in salivary pH, which provides a demineralized environment. And as we all know, caries is a process of

demineralization and re mineralization. And when a tooth is in a demineralized state for too long, that's how dental caries are formed. If these caries are not treated in time, it can lead to chronic infection. This can lead to inflammation in the body, which is directly tied to bacteria in our mouth.

Sara Karlin:

Now let's talk about sugar. Intrinsic natural sugars are defined by the World Health Organization as the sugars incorporated in the structure of intact fruit and vegetables. They are naturally present and physically located in the cellular structure of these whole plant-based foods as well as grains and dairy. Intrinsic natural sugars do not contribute to caries. In fact, they even have protective factors against carries. For example, fruits, vegetables, and whole grains provide fiber. Fiber helps keep us regular, promotes fullness, satiety, and lowers LDL cholesterol. Fiber feeds the good bacteria in our gut, which contributes to a healthy gut microbiome, which is key to controlling inflammation. The mechanical stimulation of foods high in fiber helps increase our salivary flow promoting a healthy oral microbiome. The saliva contains bicarbonate, which helps to control plaque pH, resulting in a remineralized enamel. Studies have shown that vegetarians have a remarkable increase in the salivary flow rate, which also has a caries prophylactic effect.

Sara Karlin:

Fruits and vegetables also provide polyphenols, which are plant chemicals that contain antioxidants and are beneficial for our oral health. Milk contains the intrinsic sugar lactose, and also provides a matrix of 13 essential nutrients that are beneficial to our oral health, such as calcium, potassium, and vitamin D. According to the most recent Dietary Guidelines for Americans, the nutrients of concern include calcium, potassium, dietary fiber, and vitamin D. So, including these foods as part of the healthy plant based diet will help fill these nutrient gaps and protect our dental health.

Sara Karlin:

As opposed to intrinsic sugars found naturally in foods, there are over 50 terms for added extrinsic sugars. And some of these synonyms

are listed on this slide. They're the mono and disaccharides that are added to foods. There is minimal nutritional benefit from refined sugars even though some of them are healthy sounding and plant-based, such as beet sugar, date sugar, and coconut sugar. While some added sugars, such as molasses, honey, and maple syrup may contain trace amounts of healthy compounds and nutrients, they are still added sugars, and they still contribute to both caries and weight gain and should be limited as part of a healthy dietary pattern. This can be very confusing to our patients.

Sara Karlin:

So, where is the added sugar in our diet coming from? According to recent data from NHANES as shown in this figure, most of our sugar intake comes from sugar sweetened beverages and desserts, sweet snacks, sweetened coffee and tea, and candy. The dietary guidelines suggest that we can reduce our added sugar intake by reducing portions, choosing these foods and beverages less often, and swapping out these foods for more healthy options. This is also a good time to mention that even though non-nutritive sweeteners do not contribute to caries, they are not recommended in the diet of the infant or young child. Their safety profile has not been studied extensively in this population. I personally do not recommend the use of non-nutritive sweeteners to families because I have not found enough consistent research around long-term use and health outcomes.

Sara Karlin:

I tell my patients that cutting out sugar-sweetened beverages will make a very big difference in their caries risk and their overall health. A recent cross-sectional study looking at more than 14,000 people ages two to 74 found an independent association between sugar-sweetened beverage consumption and caries all throughout the lifespan. Also, a cross-sectional study found that increased sugar-sweetened beverage intake was associated with decreased calcium intake in young children. Unfortunately, children are drinking more sugar-sweetened beverages and less milk. We see this occurring time and time again in our patients. I know I see it in

my patients, and we see it in the literature as well. Sweetened beverages contributes 30% of added sugar to the diet of young children, 50% of added sugar to the adolescent's diet, and 60% of added sugar in adults. So cutting back on or even cutting out sugar sweetened beverages altogether is definitely key to optimal oral and systemic health for all of our patients.

Ellen Karlin:

Let's switch gears now and look at food synergy. According to the dietary guidelines, in recent years researchers, public health experts, and registered dietitians have acknowledged that nutrients and foods are not consumed in isolation. Rather, we consume them in various combinations over time, a dietary pattern, and these foods and beverages act synergistically to affect our health. So think about it. Plants are complex, they work synergistically within our body, and it's almost as if mother nature intended for us to eat this way. All foods offer important nutrients for our systemic and our oral health because they all work in synergy to enhance a healthy eating pattern.

Sara Karlin:

Phytonutrients or phytochemicals are plant chemicals with antioxidant and anti-inflammatory properties. And they are found solely in plant foods, which include fruits, vegetables, nuts, seeds, whole grains, soy, beans, and lentils. There are more than 25,000 phytochemicals found in plant foods, and they can be in the roots, stems, seeds or flowers of the plants. These phytochemicals protect plants from disease and damage and the quantity is dependent upon the variety, the climate, and the health of the soil. And it's important to note that our plants may not be as nutrient-dense as they used to be. Our soil is depleted of nutrients due to pollution, pesticide use, industrial activity, and climate change. Also, these phytochemicals give plants their aroma, flavor, and color, which we will discuss on the next slide.

Sara Karlin:

As the pediatric dentist, I find that parents want to know what to feed their children and I recommend more plants and less ultra-

processed foods such as crackers, chips, and cookies, particularly at snack time. I'm surprised to find out that many times parents just don't think about healthy snacks such as carrots and hummus or celery with nut and seed butter. These are great ways to incorporate more plant foods into the child's diet and kids tend to love these snacks. Plant foods provide plenty of vitamins such as vitamin A, C, and D, and a variety of minerals such as calcium, fluoride, magnesium and phosphorus, which help to preserve and remineralize tooth structures.

Sara Karlin:

Fruits and vegetables have colors that signal beneficial antioxidants. Antioxidants are compounds that neutralize free radicals and prevent damage caused by oxidation. When we eat the rainbow, phytonutrients work synergistically to benefit our health. In general, the more colorful plants you eat, the more anti-inflammatory immune supporting nutrients you will get. Think about it, what makes a carrot orange? What makes spinach green? And what makes cherries red?

Sara Karlin:

Now, let's discuss vitamin C also known as ascorbic acid. It is an essential nutrient, meaning we cannot produce it. It must be consumed in the diet every day because it is water soluble. Vitamin C is extremely important as part of a plant-based diet since vitamin C enhances iron absorption, which is also another example of food synergy. Vitamin C is a potent antioxidant, free radical scavenger, and has anti-inflammatory properties. Vitamin C influences our cellular immunity and vascular integrity, and it supports the synthesis of collagen, which we need to support connective tissue for healthy gums and bones.

Ellen Karlin:

When we think about citrus, we think about vitamin C. But when we look at the synergy, that's what's important between the vitamin C, the flavonoids, and the carotenoids, because when we eat the whole fruit, we have the ability to combat free radicals more effectively when these vitamins, and flavonoids, and carotenoids are combined. So, for example, in oranges we have the carotenoids, lutein and zeaxanthin. In grapefruits we have lycopene, and in lemons we

have hesperidin. And there are some studies to confirm how eating the fruit is beneficial for dental health and I wanted to review these three with you and we have also included all of our references for you if you would like to look up more information about these or any studies that we're going to be discussing moving forward.

Ellen Karlin:

There was a randomized control trial that found that just eating two kiwis a day for five months reduced gingival inflammation. A longitudinal study looking at 58 patients with chronic periodontitis found that after eating two grapefruits a day for just two weeks, these patients had increased plasma vitamin C levels and less gingival bleeding. And then an older study back in 1969 by Stanton that was published in the Journal of Periodontology. He looked at the total food intake from just one week of diet histories and found that eating foods high in vitamin C resulted in lower calculus formation rate. So, we all know that vitamin C is a powerful antioxidant with the anti-inflammatory properties as Sara mentioned. And as came to light during the pandemic, right? It was all over the news and our patients were popping vitamin C supplements as if it was candy. So surely you saw your patients were taking chewable vitamin C tablets gummies. You probably were seeing more caries and enamel erosion as a result.

Ellen Karlin:

So, let's take a look at what this very recent 2021 systematic review looking at only randomized control trials published between 1990 and 2020 found out. They looked at the administration of vitamin C as an adjunct to non-surgical periodontal therapy, and this did not result in clinically significant improvements in pocket probing depths at three months in periodontitis patients. And they concluded "inclusion of vitamin C supplements and non-surgical treatment protocols may not offer any additional benefit clinically in improving treatment outcomes for patients."

Ellen Karlin:

And I want to tell you that in addition, if your patients are taking more than 1,000 milligrams of vitamin C, this may cause GI upset. So if

you can recommend vitamin C in terms of food, maybe citrus to your patients, that is a great idea. I know I always recommend that my patients squeeze a little bit of lemon or lime on their salad just for an extra boost of vitamin C. And you also want to keep in mind that of course grapefruit interacts with some medication. So before recommending citrus, you want to check out what meds your patients are on. And also many patients can't tolerate citrus. Maybe they have mouth sores, or for other reasons. So you can get vitamin C from other great plants as well-broccoli, potato, strawberry, spinach, sweet potatoes, just to name a few.

Ellen Karlin:

Dietary polyphenols, they're chemically a large group of compounds with aromatic ring and hydroxyl group. They have antioxidant and antibacterial properties. They have been shown in many studies to protect the teeth from erosion and caries. And there are several polyphenols that promote health including polyphenolic acids, stilbenes, lignans, tannins, and flavonoids. And we're going to take a look at some of this research now. So flavonoids, they're found in bright colored fruits, vegetables, grains, tea, coffee, wine, chocolate, walnuts, herbs, and spices. And they have been shown in research to be associated with oral health benefits. In fact, an in vitro study found that the theaflavins found in tea inhibit *P.gingivalis*. And when we look at that food synergy again, we see synergism between the flavonoid quercetin and the bioactive compound piperine, as anti-inflammatory effects.

Ellen Karlin:

Who doesn't love spicy foods, right? If you love spicy foods, then this is your slide. Whole-food, plant-based diets include everything that comes from a plant, of course, including herbs and spices. Now, the dietary guidelines tell us that we shouldn't be adding extra salt. We talked about that at the very beginning of the presentation. We shouldn't be eating foods high in salt. We shouldn't be adding salt to foods at the table because this can contribute to high blood pressure. So, we can season our foods with herbs and spices.

Ellen Karlin:

Now what we realize is that we're not only having delicious food. So, for example, turmeric is very popular in Indian cooking, but we're also getting beneficial effects for our systemic and our oral health at the exact same time. So, let's look at some of the research. Phytochemicals have been shown to be potent antioxidants, antimicrobials, and anti-inflammatories. And we've all heard a lot about turmeric because it's the curcuminoids, specifically the curcumin that gives that turmeric that bright yellow color. And what we find is that the benefit is increased, we can find that when we combine turmeric with let's say black pepper, for example, it's that piperine, again, that we talked about, that has these potent anti-inflammatory, antimicrobial, and even potentially anti-metastatic effects.

Ellen Karlin:

When we have ginger, we see that the gingerols are very, uh, potent in terms of helping to maintain a healthy microbiome. When we use cayenne pepper, we have the capsaicin and the beta carotene. And cinnamon, the cinnamaldehyde and the, the quercetin also have not only been shown to have anti-inflammatory and antimicrobial properties, but blood sugar lowering properties as well. So, it is definitely time to spice up your life because study after study suggests an association between spices high in polyphenols and their ability to reduce inflammation in the body and the oral cavity as well. When we look at this in vitro study performed at Mahidol University in Thailand, these researchers extracted essential oils from sweet basil, cinnamon bark, sweet fennel, kefir lime, black pepper, peppermint, spearmint, and they all showed anti-plaque and anti-cariogenic properties. And they concluded all essential oils reduce *S. mutans* biofilm. So, we all have these herbs and spices in our kitchen, we might as well use them.

Sara Karlin:

Saliva plays an important role in oral health. When we see patients presenting with xerostomia, in addition to trying to address the underlying cause, we also need to recommend sialogogues. Let's not forget about the sialogogues that our patients already have in their kitchens such as lemon, fennel,

cardamom, ginger, and cayenne pepper. These all have the potential to increase the flow rate of saliva. For lemon, of course, I'm asking you to think about recommending a spritz of lemon on a fruit cup or a salad, for example. We definitely want to be careful that our patients with xerostomia are not sucking on lemons or eating lemon drops.

Ellen Karlin:

Who doesn't love chocolate? I know I love chocolate. And luckily it's a rich source of minerals, flavonoids, and antioxidants. In fact, an in vitro 2006 study published in the European Journal of Oral Sciences found that cocoa polyphenols from the cocoa beans were able to reduce biofilm formation by *S. mutans*, *S. Sanguinis*, and inhibit acid production. And an in vitro 2019 study published in *Cureus* showed how a dentifrice that contain theobromine was able to remineralize carious lesions. Now, if you want to go ahead and recommend dark chocolate to your patients, you want to make sure to remember that it's the cocoa that has these minerals, flavonoids, and antioxidants. So, you should either be recommending 100% cocoa nibs or cocoa powder, or in terms of dark chocolate at least 85% cocoa.

Ellen Karlin:

So, no nutrition presentation would be complete without talking about vitamin D, right? With the pandemic we know that vitamin D has such an important role in our immune health. There is so much research about vitamin D currently. So let me review with you the current research and how vitamin D impacts the oral cavity. First of all, vitamin D is a fat-soluble vitamin. Its food sources include fortified cereals. You can get vitamin D in dairy milk or plant-based milks. Your plant-based milks are going to be everything from soy which we talked about, hemp milk, rice milk, pea milk, almond milk, oat milk, chia milk, and every time you turn around they're coming out with a new plant-based milk. But you want to make sure that it's fortified with vitamin D.

Ellen Karlin:

You can find vitamin D in mushrooms, fatty fish, liver, eggs, and dairy. We know that the

body synthesizes vitamin D from sunlight. Vitamin D is essential for mineralization of teeth and alveolar process, enhances calcium absorption in the intestine. We know that reduced risk for vitamin D infections when vitamin D levels are adequate, okay? So, so think about that. I'm not saying that we have a reduced risk for respiratory infections when we take vitamin D supplements. That is not the case. We only know that we need adequate vitamin D in order to reduce risk for respiratory infections. And it's important that we think about this because we always want to correct all deficiencies. If a patient has a vitamin D deficiency, then they should be taking a supplement. Now, vitamin D deficiency can also lead to caries, gingival inflammation, and periodontal disease. Another reason to correct vitamin D deficiencies. And a rat study suggested that adequate vitamin D levels are needed for titanium implant osseointegration. And the current recommendations remain 600 to 800 international units per day.

Ellen Karlin:

Another nutrient that's essential in our diet that we're not getting enough of is omega-3 fatty acids. These are polyunsaturated or the healthy fats that are associated with so many health benefits. So first of all, we feel more full when we eat healthy fats, which is a good thing. We feel satisfied after a meal. We see synergy with healthy fats in our diet because they help us absorb those phytonutrients that Sara and I spoke about. What makes that carrot orange Sara was telling you, it's that beta carotene. The lutein makes those greens green. The lycopene makes those tomatoes red, and they are absorbed better when we have healthy fat in our diet.

Ellen Karlin:

Healthy omega-3 fats are anti-inflammatory, and they show immunomodulatory effects as well. And there are three different types. The ALA which we find mostly in our plant-based sources, so they're found mostly in hemp seeds, flax seeds, chia seeds, walnuts, and plant oils. And for our vegan patients, they can use algal oil as a plant-based source of EPA and DHA because EPA and DHA is found mostly in our fatty fish. A nationally representative cross-

sectional study published in the Journal of the American Dietetic Association looking at over 9,000 adults showed an inverse relationship between high dietary intake of DHA and periodontitis. So, fish is a great example of food synergy because it's an important source of both vitamin D and omega-3 EPA and DHA. And there are many other beneficial fatty acids found in fish. So, since, um, you can tell I'm really recommending fish here, I want to also talk to you about the fact that when we do recommend fish, we're recommending the fish low in methylmercury. So that's going to be your smaller fish like your salmon, your herring, your sardines, for example.

Ellen Karlin:

So, let's spend a few minutes talking about the oral microbiome. The oral microbiome we want to be healthy because this is necessary for digesting food, maintaining homeostasis in the oral cavity, resisting pathogens, protecting teeth from erosion and caries, and protecting our periodontium. But we all have our unique oral microbiome because it's impacted by so many factors. Our medications that we may take. Uh, if we have any diseases, our genetics, smoking, oral hygiene, stress, lifetime, salivary flow rate, and diet which we'll be talking about.

Ellen Karlin:

Prebiotics are defined as a substrate that is selectively utilized by host microorganisms conferring a health benefit. Now, these prebiotics are soluble dietary fiber that are naturally present in plants that we eat. So, for example, I had oatmeal for breakfast and oats contain beta-glucans, which is a prebiotic. Apples contain pectin. Sara likes her bananas not very ripe, practically when they're green. And so, these are good sources of resistant starch. I like my bananas extremely ripe, so I'm getting lots of inulin. These prebiotics serve as food sources for probiotics. So since prebiotics help probiotics to flourish, it is super important that we eat foods rich in prebiotics. They support our oral health as well.

Sara Karlin:

Maybe an apple a day, which is also rich in prebiotics can help keep the doctor away. This was a small study looking at 20 dental

students and comparing 10 who brushed with the manual toothbrush and sterile water for two minutes versus the other 10 dental students who ate a golden delicious apple. This study showed that chewing an apple produced an immediate reduction in salivary bacterial viability similar to that after tooth brushing. I know this was a very small study, but I definitely keep this in mind when I am recommending snacks for my patients. I usually recommend apples or celery as snacks along with other crunchy vegetables because they massage the gums, they stimulate saliva to neutralize bacteria, and they can scrub the enamel clean.

Ellen Karlin:

There are many dietary sources of prebiotics as Sara and I were just mentioning. The apple, the artichoke, banana, asparagus, berries, garlic, onions, leeks, cocoa, chicory, green vegetables, legumes, oats, barley, wheat, flaxseeds, jicama, seaweed, and tomato. And if you take a look at this picture on the right, this was actually a dinner that my sister-in-law had prepared and I don't even think she realized how healthy this meal is. She's got the omega-3s and the vitamin D and the salmon. And she's got those prebiotics going on with the onions and the asparagus.

Ellen Karlin:

Probiotics, the Food and Agriculture Organization and the World Health Organization define probiotics as "live microorganisms, which when administered in adequate amounts confer a health benefit on the host." Probiotics are currently being studied for everything, right? Several health benefits including immune health, digestive health, women's health, weight management, allergy prevention, and not as many studies but a few on oral health. Probiotics are characterized by genus for example lactobacillus species, for example, rhamnosus, and strain, for example, GG. And it's important to keep in mind that the benefit is strain specific, and fermented foods support a healthy gut and oral microbiome. So, you can recommend probiotic rich foods to your patients. And these would include aged cheeses, yogurt with live active cultures, kefir, miso, tempeh, sauerkraut, kimchi. Now,

kombucha is a fermented drink with probiotics, however, it's acidic and it has added sugar. So, you just want to be careful that your patients aren't getting caries and enamel erosion from drinking too many kombucha beverages.

Ellen Karlin:

So, if you eat a yogurt every day, you may be helping protect your oral health. This was a small study, but it was a randomized controlled clinical trial and they looked at 42 adults. This was done in Italy. And I thought this was interesting because these researchers first had all of these adults have a professional dental cleaning and oral hygiene instructions before they were randomized in either the yogurt group where they ate fruit yogurt twice daily for eight weeks, or the control group, where they ate a fruit soy ice cream twice daily for eight weeks. And they were told they could not have any sugar containing food or drink between meals. And what they found was salivary counts for *S. mutans* and lactobacilli were lower in the yogurt group. Results suggesting that yogurt consumption may help to decrease the number of *S. mutans* often found in dental plaque, and full disclosure, my husband is a periodontist. And he helped me and Sara put together a few of these slides. And when he... When I told him about this study, he now recommends yogurt to all of his patients. So, just something "food for thought."

Ellen Karlin:

Now, probiotic drinks have also been shown in recent studies to impact oral health. There are several studies but I've just highlighted two that I wanted to share with you. One was a study published in the *Journal of Clinical Periodontology*, where they looked at 50 male and female students mean age 25 years. This was a parallel design non-blinded study where 25 drank a probiotic milk drink for eight weeks and they did have better gingival health than the control group as shown by significantly lower elastase activity and MMP-3, which is an inflammatory mediator in the gingival crevicular fluid. And a small perspective study published in *BMC Nutrition* very recently looked at 19 participants, 10 were lean and nine were obese, and these individuals drank a fermented soy beverage twice a day for four

weeks, and they had beneficial changes in their oral microbiome.

Ellen Karlin:

Let's take a look at this study by Laiola about the Mediterranean diet and how this reflects a healthy oral microbiome. We can see from the graphic to the right that the Mediterranean dietary pattern also is a lifestyle where we eat with others. We enjoy our meals. We're physically active. The base of our meal, again, is composed of fruits, vegetables, whole grains, olive oil, beans, nuts, legumes, seeds, herbs, and spices. We would eat fish and seafood at least two times a week. And we have moderate portions of poultry, eggs, cheese, and yogurt. And of course, meats and sweets less often. We have wine, wine in moderation, and we drink plenty of water. And this recent study looked at 49 overweight and obese individuals, where half of them were told to eat a Mediterranean style dietary pattern for eight weeks. And sure enough, after eight weeks, these individuals had reduced levels of oral pathogens, *P. gingivalis*, *P. Intermedia*, and *T. denticola* that were found in their salivary microbiome.

Ellen Karlin:

So, microbial homeostasis is the symbiotic relationship or healthy balance between the oral microbiome and the host. This is what we want to see in all of our patients. Prebiotics and probiotics, along with plant-based eating pattern does benefit this dynamic balance in the oral microbiome. However, there is not research to show either the ability to prevent or treat oral disease with prebiotic or probiotic supplementation. So what Sara and I are telling you is to please recommend a whole-food, plant-based dietary pattern that includes foods rich in prebiotics and probiotics to help your patients maintain this microbial homeostasis in their oral cavity.

Ellen Karlin:

So, we're going to conclude by looking at some of the research behind plant-based eating, caries, and periodontitis. Okay, this study was published in the *Journal of the American Dental Association*. I love this study because it was, number one, it was a cross-sectional study looking at over 7,000 adults from NHANES

data. And what these researchers did was they... We know that sugar contributes to caries, but they looked at the total overall eating pattern, okay? And what they did was they looked at the healthy eating index scores. What this means is how closely these individuals followed the Dietary Guidelines for Americans.

Ellen Karlin:

If you follow the Dietary Guidelines for Americans exactly and eat exactly the way we should be eating, we would have an HEI score of 100, for example, okay? So, these higher HEI scores, sure enough were found to be associated with less untreated caries. And specifically, these individuals ate less sugar, more fruits, more whole fruits, more greens, and more beans. And these authors concluded integration of oral health promotion with nutrition education, and guidance is crucial to ensure comprehensive care for patients of all ages. And the literature tells us that plant-based, whole-food dietary patterns reduce risk from many inflammatory diseases, including periodontitis, gingivitis, and cardiovascular disease. So I threw this study in because it was a large cohort study, part of the Atherosclerosis Risk in Communities Study where these individuals were followed for 25 years. And sure enough, a healthy plant-based diet resulted in 19% lower risk of cardiovascular disease. And we know that there's such a strong correlation between chronic inflammatory diseases like cardiovascular disease, diabetes, periodontitis, and gingivitis.

Ellen Karlin:

So, this study was a very small study. This was a German study where these researchers looked at plant-based, whole-foods diet to see if it may reduce gingivitis. And half of these individuals did eat plant-based, whole-foods for four weeks. And sure enough, the results showed significant reduction in gingival bleeding in the plant-based, whole-foods group. And these researchers state and I quote, "Dental teams should address dietary habits and give adequate recommendations in the treatment of gingivitis since it might be a side effect of a pre-inflammatory Western diet." So what they're referring to is that boardwalk

diet where you're getting all of that processed foods, that added salt, and that added sugar.

Ellen Karlin:

This study looked at plants and periodontitis because we know periodontal disease affects about 90% of the world's population. This was a systematic review looking at over 10,000 people. And these researchers found that incorporating at least five servings of fruits and vegetables a day may help to prevent the progression of periodontal disease and tooth loss. And I love this because it, I believe it was back in 1988 when as a registered dietitian I was telling people, "Eat five a day."

Ellen Karlin:

Do raw vegans have better periodontal health? Well, a recent cross-sectional study of adults in Iran, a 2020 study was actually the first study to look at the raw vegan diet and periodontal conditions. These researchers looked at 59 raw vegans who were following the raw vegan dietary pattern for at least 18 months compared to 59 omnivores, and a periodontal exam was performed by a periodontist and periodontal parameters were assessed in both groups. And the results showed that the probing depth and bleeding on probing were significantly lower in the raw vegans.

Ellen Karlin:

And our last study looking at vegetarians and periodontal disease looked at 200 patients. 100 followed a vegetarian lifestyle for over two years and again, periodontal parameters were assessed, and the results showed that the vegetarians had significantly lower probing pocket depths, less bleeding on probing, lower periodontal screening index, better hygiene index, and less mobile teeth. And they say that a plant-based eating pattern provides high levels of antioxidants which we discussed, which can decrease oxidative stress in periodontal tissues to help minimize tissue damage and inflammation.

Sara Karlin:

We would like to encourage you to be creative, be innovative, and have conversations with all of your patients about the oral benefits of eating whole-foods and incorporating

more plants into their daily eating patterns. Remember that many patients see their dentist and dental hygienists more often than they see their primary care physician. I believe that as dentists we should be proactive specialists and encourage all of our patients to include a variety of plants in their eating patterns, so that they can get the, all of the nutrients that are so important for the integrity of their oral mucosa. Whole-food plant-based eating patterns are nutrient dense, fiber rich, and provide the plethora of phytochemicals, which promote oral health.

Ellen Karlin:

Diverse plant-based whole-food eating styles help close the gap on those critical nutrient shortfalls that Sara mentioned-the dietary fiber, the calcium, the potassium, and the vitamin D, and build a foundation that will lead to lifelong healthy dentition. We thank you for joining us, and we have posted our emails and we encourage you to encourage healthy, whole-food plant-based dietary patterns amongst all of your dental patients.