Oral Hard Tissue Disease and Home Care Management

Module Transcript

Welcome to this module about hard tissue health. Here, you'll learn about dental caries and dental erosion - prevalent issues that are largely preventable and can cause considerable pain, quality of life issues, or both.

This module differentiates these two issues by explaining their causes, development processes, and how they can be prevented, and treated.

To get started, select the forward arrow.

To understand caries and erosion development, it's necessary to understand the anatomy of teeth and their environment - including the acquired pellicle that surrounds all exposed areas of the tooth, plaque that builds on it, and saliva. In response to an individual's diet, oral hygiene habits, genetics, and human protective factors within the oral environment work together to stop caries and can help to prevent erosion. To hear how these are interconnected, first look at the composition of teeth. Select 'teeth' when you're ready.

TEETH

Enamel is the hard tissue that makes up the visible part of a tooth - it's one of the hardest tissues in the body. It primarily consists of a calcium-phosphate mineral called hydroxyapatite, which forms crystals that orient toward the tooth surface. These tightly packed crystals are composed of millions of microscopic prisms and lattices that form rod structures surrounded by water and other organic materials. Together, these create enamel and give it a translucent appearance. The hydroxyapatite crystals can lose density by demineralization when subjected to bacterial acids and gain density and remineralize when conditions in the oral environment improve - most notably in saliva, plaque biofilm, and the acquired pellicle.

At its highest density, hydroxyapatite is as hard as steel. At its lowest density, it's as soft as a fingernail. Calcium loss in teeth can reduce hydroxyapatite hardness by up to 80%.

RETURNING AFTER TEETH

Now select one of the other 3 components in the oral environment that impact caries development and erosive tooth wear.

SALIVA

Saliva is the primary, natural component for protecting teeth against both caries and dental erosion.

(1) When saliva is in its balanced state, it is supersaturated with calcium and phosphate, which neutralize acids produced by bacteria in the dental biofilm - stopping enamel demineralization and enabling remineralization. But when saliva is undersaturated with calcium and phosphate it 'pulls' mineral density from the tooth structure to re-establish its equilibrium of calcium and phosphate. Sites poorly bathed by saliva or mainly bathed with mucous saliva (which typically contains fewer mineralizing ions) are more likely to be impacted by these processes.

(2) Components in saliva, including salivary proteins, also allow the formation of the acquired pellicle, which further provide protection from erosion and demineralization.

(3) Saliva also has bicarbonate as well as phosphate. Both neutralize and buffer acids - helping to protect enamel from erosion as well as to encourage salivary pH to return to levels that are more favorable for remineralization to occur after a cariogenic challenge.

The protective influences of saliva become apparent when its flow is reduced, which can result from head and neck cancers, diseases such as Sjogren's [show-grins] syndrome, or as a side effect from hundreds of medications.

ACQUIRED PELLICLE
The acquired or salivary pellicle is a protein film, about 1µm [micron] thick, that naturally develops on all exposed tooth surfaces from components in saliva. It protects against abrasive factors and acid attacks that can lead to either dental erosion or subsurface demineralization. It also provides a binding site for the micro-organisms that form the plaque biofilm.
Only a professional cleaning with pumice will completely remove the pellicle, which will begin to re-form within seconds of the cleaning to re-establish itself as a protective barrier.

PLAQUE BIOFILM
Dental plaque is a sticky pale yellow living biofilm that interacts with the oral environment. In an average healthy individual, plaque biofilm may include 300-500 different individual species When unbalanced - or dysbiotic - it can support disease processes that affect teeth and gums.

The "ecological plaque hypothesis" states that the oral environment is able to cause a shift in dental plaque ecology that can either lead to good health or disease.

Caries, for example, can occur when sugar is consumed. Bacteria metabolize the sugars creating an acidic biofilm in which acid-tolerant bacteria (like S. mutans and Lactobacilli) thrive - over populating acid-sensitive bacteria like S. sanguinis. This disrupts the healthy balance between dental plaque and the tooth surface - ultimately it leads to more acid production and more demineralization. When sugar exposure stops, the bacteria have less to metabolize - resulting in a lower acidic environment. Acid-sensitive bacteria like S. sanguinis are then able to repopulate. This keeps acid production lower and increases the chances for remineralization.

As plaque grows, it can become more virulent and if not removed will likely cause disease. Select the icon on screen to see the 5 stages of plaque development.

PLAQUE BIOFILM DEVELOPMENT STAGES
(1) Plaque biofilm forms on top of the acquired pellicle's protein network.

(2) Over the first 24 hours after a professional cleaning, an initial round of bacteria will attach to the pellicle. The most common early colonizers are Streptococci such as Streptococcus sanguinis and Streptococcus mutans, which are normal inhabitants of the mouth. (Cawson, 2008, 43) Initially their adherence is weak but if not removed they anchor with more adhesive structures.
Early colonizers form above the gum line and are aerobic bacteria, which are associated with caries. (Nield-Gehrig, 2011, 128)

(3) At stage 3, organisms that were unable to attach to the pellicle previously now adhere to the first layer of colonizers with irreversible attachments. The bacteria replicate and form microcolonies embedded in an extracellular matrix. These later bacteria are anaerobic so can grow below the gum line. They're also more virulent and associated with gingivitis and periodontitis.

(4) At stage 4, existing bacteria produce a thick mucus-like polysaccharide layer that: provides adhesion, allowing them to resist physical stresses; provides protection from the body's immune response; and provides a structure allowing further growth into a colony. Good oral hygiene - including brushing, fluoride toothpaste, and interdental cleaning aids - prevents plaque reaching this stage.

(5) In the final phase, the plaque biofilm is considered 'mature' when it can grow undisturbed. Micro-colonies comprising thousands of compatible bacteria form into a mushroom shape. Each has its own environmental conditions, including acidity level, depending on the bacteria in it.

AFTER VIEWING ALL
You've now seen how teeth are affected by the 3 primary components of the oral cavity. Select the forward arrow to continue.

Dental caries and dental erosion both result from acid damaging the tooth structure. But can you differentiate them?

Consider the following few questions... which condition can fruit drinks cause?

That was a bit of a trick question as sugary acidic drinks can cause dental erosion and caries. The acidity of some soft drinks can be as low as 2.51. Remember that enamel begins to break down at 5.5, regardless of the presence or absence of plaque.

Sugar in drinks can be metabolized by plaque bacteria to acids that demineralize teeth, which can lead to caries. Sugar-free drinks are acidic so can still cause erosion.

Which do you think is a subsurface phenomenon?

Yes, dental caries begins subsurface. The earliest visual signs of caries are white spot lesions, which form as the structure of the rods under the surface breaks down.

Dental erosion begins at the outer surface.

Actually, dental caries begins subsurface. The earliest visual signs of caries are white spot lesions, which form as the structure of the rods under the surface breaks down.

Dental erosion begins at the outer surface.

Which do you think is reversible?

Yes, that's right. Dental erosion is caused by strong acids - like citric and gastric acids. It's physical deterioration begins at the surface and it's irreversible.

Caries is caused by weaker bacterial acids that chemically deteriorate the subsurface minerals. It IS reversible if treated in early stages.

Given what you've just reviewed, identify the condition described and shown.

Yes, that's right. Dental erosion is caused by citric acid and digestive acid. Deterioration by erosion begins at the surface and it's irreversible.

Caries is caused by weaker bacterial acids that demineralize the subsurface initially. It IS reversible if treated in early stages.

Dental decay and dental erosion are similar in that they both damage a tooth's mineral structure but their causes, development process, clinical presentation, and how they're controlled differ.

Select a topic here to hear more.

CARIES DEFINITION
Caries is the chemical deterioration of the tooth structure caused by bacteria metabolizing fermentable carbohydrates into acids. The process begins beneath plaque biofilm and the damage that occurs is initially subsurface. As the loss of density increases, a white spot will be visible on the surface. At this stage the lesion can heal if treated. If not treated, the lesion may progress to cavitation where there is total loss of the local structure. The development of caries is slow and may take more than a year to develop into a lesion.

Patients with advanced caries that reach dentin or the pulpal chamber may complain of pain on chewing, but often are unaware of the disease developing in earlier stages.

EROSON DEFINITION
Dental erosion refers to the chemical softening and irreversible loss of the outer surface of the teeth primarily due to acid exposure from dietary sources. Gastric acid from the stomach - as a result of bulimia or reflux - can also lead to erosion.

It's included under the umbrella term "Erosive Tooth Wear", which includes other types of wear that are physical processes - like 'attrition' - caused when teeth rub against each other; 'abrasion' caused by other non-tooth contact; and 'abfraction' - caused by loading forces. (*https://pubmed.ncbi.nlm.nih.gov/24250083/*)

Unlike caries, which starts beneath plaque, erosion starts from the enamel surface.

It also differs from caries in that patients with erosion tend to have good oral hygiene - they're health-conscious people who drink fruit juices or sports drinks.

CARIES: Risk & Protective Factors
Caries develops when the balance of risk outweighs protections.

See if you can identify the items listed here as risks factors or protective factors. Drag each to the correct category.

Well done - you placed all of those correctly. Caries risk factors includes visible plaque, frequent consumption of sugar, areas that are difficult to clean, reduced salivary flow - which could be from medication or radiation, and exposed roots.

Fluoride, plaque control, and antibacterials can help to protect from caries development.

CARIES: Prevalence
Dental caries is endemic globally (Beaglehole et al. 2009). It particularly affects people in regions where consumption of refined sugar is high.

It is estimated that 2.3 billion people suffer from dental caries of permanent teeth, globally. [*https://www.fdiworlddental.org/key-facts-about-oral-health*]

As an indicator of the global experience of caries by age, shown are maps of caries experience of children aged 12 years old and of adults aged 35-44.

To hear how caries impacts people, select either of the 2 people here.

[Female]
"One of my medications was making my mouth dry and my grandson made a comment about my breath so I started sucking on mints. I hadn't realized how sugary they were - i just assumed they were sugar free. I saw my dentist last week and had to get a small filling. There is another spot he said we'd need to watch. The hygienist gave me specific advice about brushing that area thoroughly and suggested I swap to a xylitol gum instead of the mints.... oh and I no longer rinse after brushing. She told me that rinses out the paste. Even at this age I'm still learning things about bettering my health."

[20s Male]
"I thought it would be amazing when I got my braces taken off, but then I saw all these white spots where the brackets were. I was warned it could happen but seeing it! I spent so much money to get my teeth straightened - I didn't expect it to look back when they came off. My orthodontist assured me it would go away after brushing with a fluoride toothpaste. Sure enough, after a few weeks they were gone. I was embarrassed there for a bit but now I get compliments about how nice my smile is."

CARIES: Acid
Dental caries is a result of acids produced when bacteria metabolize sugars. When sugar is consumed, bacteria in the plaque biofilm - primarily streptococcus mutans - metabolize it into acids. Lactobacilli are also noted, although these are less cariogenic than S. mutans.

The resulting acids lower the pH in the biofilm from a neutral 7 to less than 5.5 - the point at which hydroxyapatite in enamel is subject to demineralization. This value is known as the critical pH. In patients with active caries, pH may be as low as 4.

Each single drop in pH represents a 10-fold increase in the solubility of the apatite that forms tooth enamel. After 30 to 60 minutes without sugar exposure, saliva will help the pH return to its original resting value.

The more often the pH drops below the critical value of about 5.5, the more likely that acids generated in the plaque will progress through

the protective layer of pellicle and into the subsurface region of the tooth. This results in slow progressive damage unless the process is halted or reversed.

CARIES: DEMIN/REMIN ANIMATION

Dental caries is a dysbiotic biofilm disease driven by a complex biological process.

In a healthy oral environment, saliva and the plaque biofilm are supersaturated with calcium, phosphate, and hydroxyl ions.

The surrounding oral microflora are stable in a dynamic equilibrium called homeostasis.

When sugar is consumed, the healthy balance is disrupted.

Sugar penetrates the plaque biofilm ...

....where bacteria - most notably streptococcus mutans - metabolize it into acids....under the biofilm where they begin to attack the tooth surface and begin the demineralization process causing the pH to drop from neutral to acidic....

At pH 5.5, the plaque biofilm community remains stable...

...but as the pH drops towards 4.5, bacteria that thrive in acidic conditions - like S. mutans and Lactobacilli - begin to proliferate and dominate adding more acids.

The more often the pH drops below 5.5, the more likely that acids - shown here as red hydrogen ions - pass through the protective layer of pellicle.

Acid diffuses below the surface of the tooth between the interprismatic enamel rods - where the fluoride content is lower.
As the process continues, the edges of the enamel crystals begin to dissolve and lose density. The acid causes calcium and phosphate to dissociate from the crystal and begin to flow toward the surface with some flowing into saliva. As calcium and phosphate flow out some attaches to the surface and supports the sound outer layer - a process known as re-precipitation. "This is a natural protective mechanism we have that is designed to help limit mineral loss during an acid challenge"

This reinforces the necessity of early caries diagnostics as the surface of the tooth may retain density.

When sufficient mineral is lost, a white spot lesion forms.

However, density can be improved and restored to this area via the process of remineralization.

When sugar exposure stops, acid in the plaque biofilm is cleared and neutralized by saliva

The pH increases and at pH 5.5 or above...

.... the plaque biofilm is supersaturated with respect to hydroxyapatite

... which allows the remineralization process to take place.

When fluoride is present and the pH is higher than 4.5, fluorapatite forms, which enhances the remineralization process.

In this way, fluoride helps to reduce the net mineral loss during demineralization and enhances the density of the reformed mineral beyond the natural remineralization process.

Fluoride also inhibits an enzyme called enolase [E-no-lace], which slows bacteria metabolism. While this isn't a primary mechanism, it is noteworthy.

At this point, acid-sensitive bacteria like S. sanguinis can survive, keeping acid production low and increasing the chance of remineralization.

If a person's diet is balanced, protective factors, such as saliva, can offset the bacterial acid challenge so that no net demineralization occurs.

If the acid attacks continue, over time and with enough of challenge a white spot lesion will form - an indication that the caries process

is active in that area of the tooth. In its early stages, caries is a completely reversible process; this reversible process can be enhanced with fluoride.

If the process is not stopped, mineral continues to lose density, the surface cracks (like a sink hole) and forms a complete cavity.

Shown are caries categories as they pertain to clinical practice. Select each for details.

If good oral hygiene isn't followed or there is high sugar exposure, demineralization leads to initial caries. These lesions can be reversed.

If the oral environment doesn't improve, the lesion may progress to 'moderate caries' where there is some surface or subsurface breakdown.

If the lesion progresses further, a distinct cavity will eventually occur.

CARIES -PATIENT BEHAVIOR MODIFICATION

The first step in minimizing the caries damage potential is controlling the proliferation of cariogenic plaque. Patients should be advised to limit the frequency and duration of consuming fermentable carbohydrates (sugars), encouraged to rinse with water after sugar exposure, and if needed be provided with saliva stimulants.

Dietary advice should be coupled with oral hygiene advice that includes brushing for at least two minutes twice a day with a fluoride toothpaste - which should be spat out but not rinsed with water. Interdental cleaning aids should also be used along with fluoridated or antimicrobial mouthrinses.

CARIES & FLUORIDE
Fluoride in toothpaste - a primary source of fluoride for most people - can help to prevent and treat caries by creating 'fluorapatite' during remineralization. Fluorapatite is able to withstand stronger acid attacks than hydroxyapatite.

At neutral pH, fluoride is present in the mouth in its ionic form as F-. In the presence of acid, F- is converted to Hydrofluoric Acid (HF), which enables the F to penetrate the tooth surface more efficiently, where it can then form Fluorapatite as the pH neutralizes.

The most commonly used fluorides approved for use in oral care products are sodium fluoride, sodium monofluorophosphate, amine fluoride and stannous fluoride. Of these, only stannous fluoride has the ability to prevent the proliferation of bacteria and their metabolic acids as well as creating a barrier on the surface to reduce surface loss associated with erosion while still providing optimal levels of the fluoride ion for remineralization. Stabilization and formulation are key to the superiority of stannous-containing products.

Select each to hear more.

SODIUM F & CARIES
Sodium fluoride is probably the most widely used fluoride in oral care products. It's effective against caries.

Sodium fluoride releases on contact with saliva - making the fluoride ion available to react with tooth surfaces almost immediately. Stable and bioavailable sodium fluoride products containing between 900 and 1500 parts per million fluoride are effective at fluoridating demineralized areas of the teeth (enamel and dentin) as well as aiding in the formation of fluorapatite, which is more resistant to cariogenic bacterial acids. For children, toothpastes at 500ppm fluoride are also effective.

SODIUM MONOFLUOROPHOSPHATE (SMFP) & CARIES
Sodium monofluorophosphate - or SMFP - is recognized as a slower acting fluoride. SMFP is a covalently bound form of fluoride and this bond must first be broken before the active fluoride ion is released and then able to aid in the remineralization process. Releasing the fluoride ion from SMFP is a two-step process that makes SMFP less efficient compared to ionic fluorides, such as sodium fluoride and stannous fluoride. Like other fluoride sources, SMFP has been proven to be clinically effective against caries.

AMINE FLUORIDE (AMF) & CARIES
Amine ["A-mean"] fluoride products are slightly acidic and claim to attach to the tooth surface via a surfactant chain, where they then release fluoride.

SNF & CARIES ANIMATION
Select the icons to hear more about differences in stannous dentifrice formulations and about the efficacies of different stannous dentifrice products.

SNF - EFFICACY & CARIES
Stannous fluoride has been the subject of more than 50 reported clinical trials that have verified its anticaries efficacy. For more than six decades, P&G has continued research & development to improve the efficacy of stannous fluoride paste formulations by developing proprietary stabilization techniques that improve its bioavailability. Dentifrices using stabilizing techniques developed at P&G are now considered the standard of excellence for delivering stannous fluoride for anticaries efficacy.

SNF - FORMULATION & CARIES
The ideal formulation for a stannous toothpaste allows all stannous to be released during the average brushing time. Not all manufacturer's products can do this.

With more than 50 years of developing dentifrices containing stannous fluoride, Crest Oral-B found an ionic complex that binds with stannous fluoride at just the right strength - not too strong or too weak. It's like a magnet at just the right strength to hold stannous fluoride together with other ingredients while in the tube, on the toothbrush and on to deliver it to the tooth surface where it binds with toxins at the right location for greatest efficacy. Other formulations hold the stannous fluoride ion too tightly or too weakly.

CARIES -TREATMENT
Treatment for early caries includes non-operative measures to enhance tooth-mineral density. For more advanced lesions, tooth-preserving operative care should be treatment planned.

Non-operative care includes dietary counseling, in-office prevention measures, and improved oral hygiene at home based on personal care instructions and optimal product recommendations.

More information about non-fluoride caries-preventive agents can be found by accessing the ADA link here.

Select the forward arrow to continue.

EROSION: RISK & PROTECTIVE FACTORS
Erosion can take place when teeth are repeatedly exposed to risks that outweigh protective factors.

See if you can identify these as risks for development or protective factors. Drag each to the correct category.

Well done - you placed all of those correctly. With dental erosion, there are few protective factors and many more risks.

EROSION: ACID
Dental erosion is the irreversible loss of tooth structure due to dissolution by acids. Primarily this is a result of acids ingested from food and beverages. Research has identified beverages with low pH as a primary cause. There are, however, cases caused by gastric acid entering the mouth from the stomach as a result of gastroesophageal disease or bulimia. Gastric acid can have a pH as low as 1, so its destructive capabilities are especially severe, and significantly more so than dietary acid.

To see the effect acidic drinks can have, select the orange juice glass here.

ACID CHALLENGE FROM OJ
Just 10 minutes after drinking orange juice, the pellicle has broken down. Regardless of the origin of the acid, the effect is the same: a low pH environment in the oral cavity. With numerous acid challenges in a day, erosion can be noticed can place as quickly as a few months.

At low pH, the protective ability of the pellicle layer can be overwhelmed, with subsequent

damage occurring as a total loss of mineral, rather than partial demineralization of the individual crystal rods. This damage is 10 to 20 times higher if teeth are brushed immediately after acid exposure when tooth minerals are soft.

Erosion initially takes places at the surface of teeth and on tooth surfaces that are not heavily plaque covered, as opposed to caries, which usually occur under plaque and is subsurface.

EROSION: PREVALENCE
On average it is estimated that 30% of adults have experienced some type of erosive tooth wear. Studies vary between 4 - 100%* in adults depending on the indices applied. (* Jaeggi, A. Lussi, Prevalence, incidence and distribution of erosion in: A. Lussi, C Ganss (Eds.) Erosive Tooth Wear: From Diagnosis to Therapy, Karger, Basel, New York, 2014, pp. 55-73)

One recent study in Germany found the prevalence for deciduous teeth to be 30 to 50% and for permanent teeth to be 20 to 41% - with prevalence increasing in the decade preceding the 2016 study.

Over the last three decades dental erosion has become an increased risk as patients live longer and their teeth last longer due to greater availability of dental care. Both factors also more exposure time allowing teeth to erode. Additionally, consumption of more acidic drinks - especially in young athletes - has increased - like 'quote' healthy sports drinks, fizzy drinks, and citrus drinks.

One issue has been that in the past, dental professionals were focused more on caries than they were on dental erosion; so as the problem increased, quite a bit was unintentionally missed.

To hear how erosive tooth wear affects quality of life, select any of the 3 people shown here.

[30 YR OLD FEMALE - ISSUE: SPORTS DRINK]
"I've been a jogger and hiker for most of my life - I always had a sports drink with me to keep me going. But my dentist recently told me that it's the reason my teeth have worn on the back and look dull in places. She says it's not too bad but sometimes it's very sensitive when I have something hot or cold. If I'd known earlier, I would have stopped."

[50+ MALE - ISSUE: REFLUX & MULTICAUSE]
"It's funny - or not really - but I've spent much of my life trying to keep weight off and I've damaged my teeth (and my wallet) in the process. I used to drink 4 to 5 diet sodas a day until my dentist told me it's why I was experiencing these intense pangs in my teeth. I also used to grind my teeth at night, which added to the problem along with a bit of reflux that I get at night. I've had several expensive restorations now, wear a mouth guard at night, and I take acid-inhibitors often now too - anything to prevent more damage. I always thought I took care of my teeth too."

[22+ FEMALE - ISSUE: BULIMIA?]
"It's still hard for me to admit but I've struggled with bulimia. People thought I just exercised too much, but when I went to my dentist - she saw the tell-tale signs in my teeth. I'm active and try to keep my body fit but some of my behaviors have been unhealthy. It was easy to quit the sports drinks once I found out they were a problem but I've had to see a therapist as well - we're talking through some things. I'm glad my dentist raised it and spoke with me before things got too far out of hand."

EROSION: PREVALENCE - 2
Acidic beverages are associated with tooth wear. An observation study was conducted at Ohio State University to determine how regularly athletes consumed acidic sports drinks, which are associated with erosion. What percentage do you think regularly consumed these drinks?

Yes - that's right. 92% of athletes were found to drink erosive sports drinks. Within the same group of young athletes, erosion prevalence was already 36.5%.

Awareness of the causes of dental erosion - especially at a young age - can help form good habits to prevent damage that can be challenging to treat. Young athletes in particular should be made aware of measures to prevent dental erosion before it begins.

EROSION: PROCESS
After as little as 10 minutes of erosive acid exposure, the acquired pellicle is challenged. With repeated challenges over time, the natural protective pellicle is overwhelmed, the enamel surface is eventually destroyed by the partial and complete dissolution of the enamel crystallites, resulting in the initial softening of the outer few micrometers of the tooth surface as calcium (Ca2+) and phosphate ions begin to dissolve

Initially, the enamel softens as mineral is lost up to a few micrometers below the surface. As erosive acid exposures continue, softening progresses and dissolution, coupled with abrasive factors present in the mouth, can completely remove layer after layer of enamel, eventually to the point of exposing the dentin underneath.

These images depict just how soft the outer layers of enamel can get and just how easily it might be removed by occluding or even a tongue swipe.

The 'dissolution plus abrasion' process continues with more and more loss of tooth structure.

On exposed root surfaces, erosive processes can remove the cementum, exposing dentinal tubules on the roots.

At this point, the patient may begin to experience hypersensitivity to temperature changes or touch as the normal flow of dentinal fluid is disturbed.

This in turn stimulates the pulpal nerve receptors that innervate the ends of the tubules, resulting in the sensation of pain.

After use of fluoride toothpaste, the fluoride ion forms a layer on the surface of the tooth. However, due to the severity of an erosive acid challenge, most fluoride sources are unable to provide sufficient protection to vulnerable tooth surfaces against erosive tooth surface loss. Even fluorapatite can be overwhelmed by the drop in pH and the level of challenge. Prescription strength fluoride toothpastes - even at 5000ppm - will not provide a sufficiently protective benefit against erosion.

Any mineral deposition on the dentin surface can be easily removed with an acid challenge, such as those found in carbonated beverages, sports drinks and juices made from citrus fruits; particularly when accompanied or followed by an abrasive challenge.

The best approach to manage erosive tooth surface loss is to focus on prevention because remineralization of erosively softened layers of tooth crystal structure is not likely to occur before abrasive factors present in the mouth (even the constant motion of the tongue is an abrasive factor) remove these layers and result in their irreversible loss.

EROSION - CLINICAL PRESENTATION
Teeth that are eroding may initially appear whiter then yellow, their shape may change, they may appear glassy, shorter, and they're likely to be sensitive to hot or cold.

The severity of the disease is graded using the Basic Erosive Wear Examination - or 'BEWE'. loss of tooth surface across all categories - erosion, abrasion, attrition, and abfraction. Each sextant is examined and the highest score is recorded. All scores are added to give a total that measures overall severity. Ideally this is conducted at each exam to evaluate if the condition is progressing.

Select the forward arrow to continue.

EROSION -PATIENT BEHAVIOR MODIFICATION
The first step in minimizing the irreversible damage from dental erosion is to increase awareness of the issue with your patients so that they can avoid the causes. Acidic foods and drinks should be consumed less frequently and consumed with a straw. If a patient's erosion stems from reflux, bulimia, or even medications, they should speak with their doctor to control the underlying issue.

Research supports brushing with a stannous fluoride toothpaste for two minutes twice daily to protect the teeth from erosion. After exposure to acidic foods and drinks, patients

should be advised to avoid brushing for 1 to 2 hours as their enamel may be softened, to drink acidic beverages with a straw to minimize contact of the acids with the teeth and to avoid swishing the beverages in their mouths, as the force of the swishing provides a greater challenge to exposed tooth surfaces.

EROSION & FLUORIDE
Fluoride in toothpaste - a primary source of fluoride for most people - can help to fight erosion by strengthening the resistance of tooth mineral to acid attack.

However, the strengthened mineral (fluorapatite) is only able to withstand low levels of erosive challenge rather than those that are likely to occur during more common erosive challenges that teeth are likely to endure.

The most used fluorides approved for use oral care products are sodium fluoride, solidum monofluorophosphate, amine fluoride and stannous fluoride.

Regardless of strength of any of the fluoride variants, only stannous fluoride has been demonstrated to be highly effective against erosion; but stabilization and formulation are key to superiority. Unlike other fluorides, it effectively 'galvanizes' the tooth to provide anti-erosion protection.

Select each to hear more.

SODIUM F & EROSION
Sodium fluoride is probably the most widely used fluoride in oral care products. It's effective against caries but provides only minimal protection against erosion - even at prescription level.

SODIUM MONOFLUOROPHOSPHATE (SMFP) & EROSION
Sodium monofluorophosphate - or SMFP - is effective against caries, but has not been demonstrated to provide significant protection against erosion.

SNF - WITH FOCUS ON EROSION
Stannous fluoride prevents mineral loss in three ways.

Firstly, like other fluorides, it reverses subsurface mineral loss - reinforcing the hydroxyapatite crystals with fluorapatite. This makes the enamel more resistant to bacterial acids.

Secondly, and uniquely to stannous, it has bacteriostatic and bactericidal properties against cariogenic bacteria helping to prevent future attacks.

Finally, it forms an invisible protective barrier on the surface of teeth that reduces mineral loss from erosive acids in the diet or stomach acid.

While some pastes form an easily removable smear layer, stannous penetrates deeper into the tubule and creates a highly acid-resistant plug...

...that blocks and protects the dentinal tubule to significantly reduce fluid movement - effectively preventing tooth hypersensitivity.

The anti-bacterial effects of stannous fluoride also help reduce plaque, gingivitis and halitosis.

Like sodium fluoride, stannous is an ionic form of fluoride - allowing it to more efficiently bond with tooth minerals. Some formulations do this more effectively.

One of the difficulties in formulating products containing stannous fluoride is that it is a highly reactive species that is difficult to not only formulate into effective products, but also to maintain long-term stability. Products demonstrated to be the most effective are those that have been stabilized using a specific proprietary ionic complex, like those in Crest/ Oral-B dentifrice products. These are more effective and work for 12 or more hours.

SNF - EFFICACY
The efficacy of stannous fluoride over other fluorides against erosion was noted by the European Federation of Conservative Dentistry in their 2015 consensus report on erosive tooth wear diagnosis and management. It supports the use of products with stannous fluoride or stannous chloride to slow the progression of

erosive tooth wear. Select the reference shown to link to the full report.

SNF - FORMULATION
The ideal formulation for a stannous toothpaste allows all stannous to be released during the average brushing time. Not all manufacturer's products can do this.

With more than 50 years of developing dentifrices containing stannous fluoride, Crest Oral-B found a unique ionic complex that binds with stannous fluoride at just the right strength - not too strong or too weak. It's like a magnet at just the right strength to hold stannous fluoride together with other ingredients while in the tube, on the toothbrush and on to deliver it to the tooth surface where it binds with toxins at the right location for greatest efficacy. Other formulations hold the stannous fluoride ion too tightly or too weakly.

EROSION -TREATMENT
Treatment for low erosive tooth wear focuses on oral hygiene, dietary counseling, and routine maintenance. For patients classed as having 'medium' erosive tooth wear, treatment would also include fluoride.

With patients who have 'high' erosive tooth wear, restorations may also be needed.

Where an underlying medical condition may be involved - like reflux disease or bulimia - refer the patient to a specialist.

Select the forward arrow to continue.

SUMMARY
You're at the end of this module, which explained hard tissue health relevant to dental caries and dental erosion. You can review either topic again here or select 'close' to leave the program.