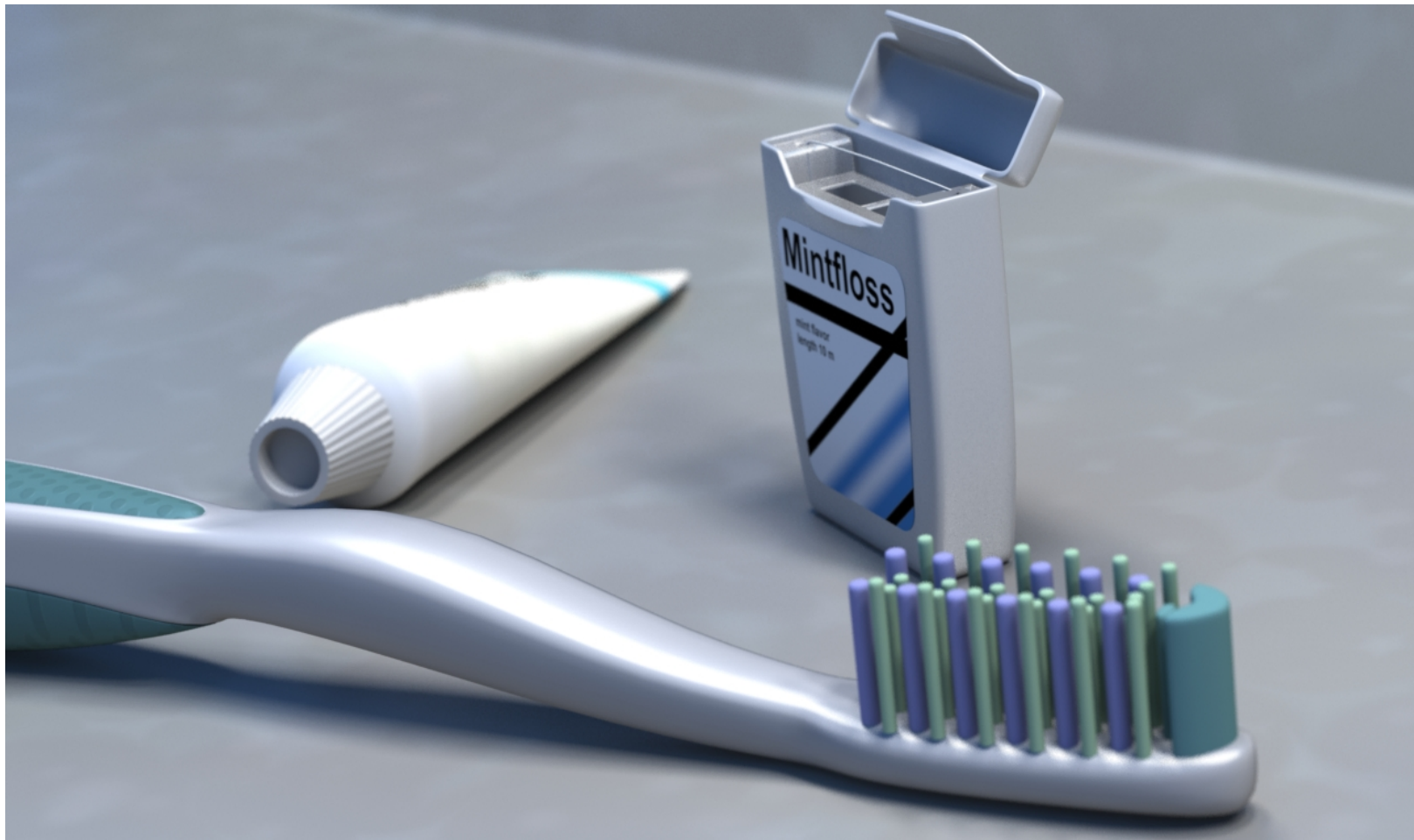


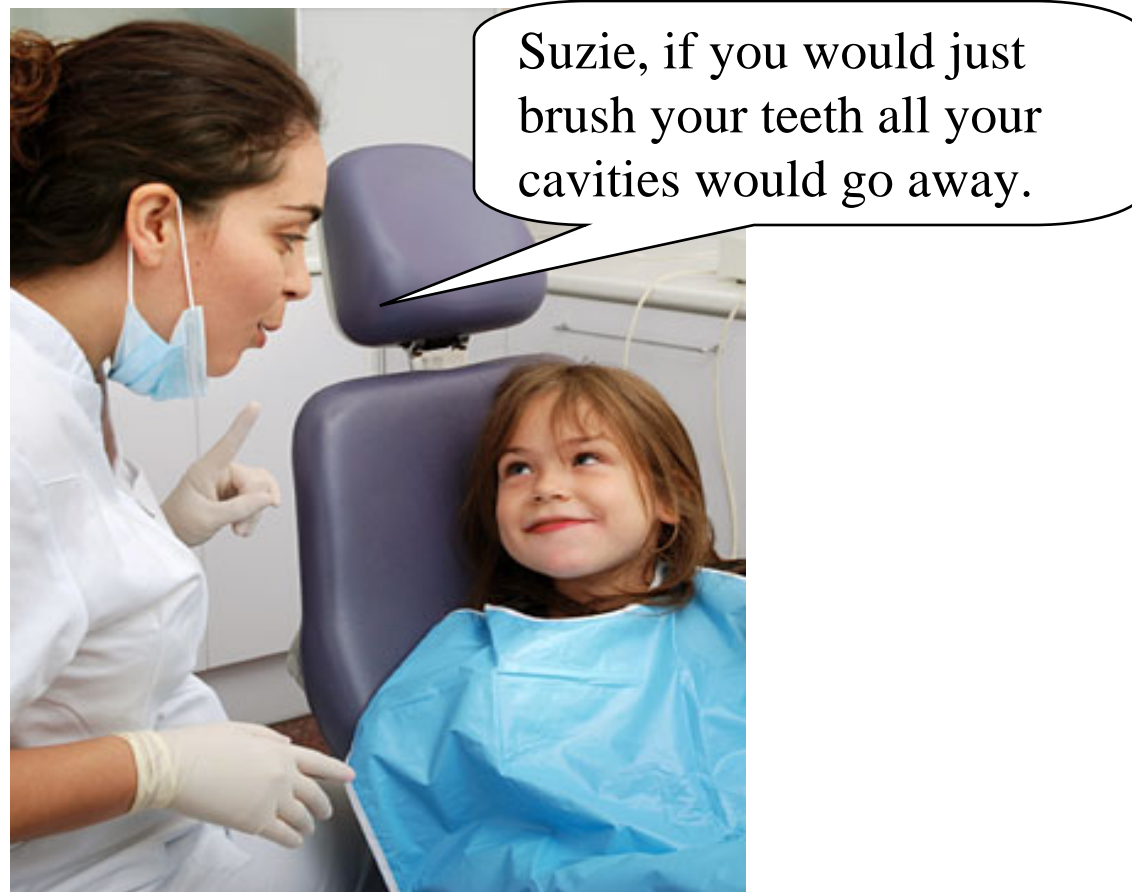
New Cavity Prevention Alternatives

Speaker: Steve Jensen

Cost effective cavity prevention for the masses:
A tooth brush and fluoride toothpaste.



But, how effective is brushing your teeth with a fluoride toothpaste?
If everyone just brushed their teeth would tooth decay end?
Is universal cavity prevention merely a compliance issue?



Is universal cavity prevention that simple? Apparently Not!

In the U.S, as of 2004:

- 92% of adults age 20-64 have had some form of tooth decay.
- 23% of adults 20-64 have untreated tooth decay.
- 51% of children 6-11 have had tooth decay in primary teeth.

Sources:

Dental Guide USA, http://www.dentalguideusa.org/dental_statistics/adult_tooth_decay.htm.

Dental Caries (Tooth Decay) in Children (Age 2 to 11), National Institutes of Health,
<http://www.nidcr.nih.gov/DataStatistics/FindDataByTopic/DentalCaries/DentalCariesChildren2to11>.

- The concept of cavity prevention has been around for a long time.
- Tooth decay has been a pox on all nations and societies throughout recorded history.
- The best minds from many civilizations have attempted to eradicate tooth decay.
- **What are the origins of modern cavity prevention practices?**
- How about the toothbrush - how did it originate?

Ancient Egyptian Toothbrush



The end of a stick was splayed to create soft bristles.

Removing residual food is beneficial.

Millennia later, the same purpose:

- Remove residual food particles from the teeth.
- Disrupts colonies of plaque bacteria.
- The toothbrush has a long track record.

✓ **Conclusion: Persistent tooth brushing is an effective cavity prevention measure.**



Fluoride toothpaste – how did it originate?

Discovered by observing the anomalies in our environment.

Fluorosis



It was observed that many individuals in some narrow geographical areas experienced mottled teeth.

The teeth would become opaque white and porous; sometimes with dark splotchy stains.

In milder cases the teeth would exhibit splotchy white patterns on the teeth.



- Cosmetically unattractive, but with a useful benefit:
Low incidence of tooth decay.
- The cause: High levels of fluoride ion in the
groundwater.
- At controlled levels, regular exposure to fluoride yields
reduced tooth decay without the mottled fluorosis
effect.
- The fluoride industry was born.



Fluoride toothpaste serves a single preventative modality:

- Deliver fluoride ion into the saliva, where it is available for uptake into enamel.

The fluoride ion reacts with the enamel to form a more acid-resistant structure (calcium fluoroapatite).

- ✓ **Conclusion: Controlled levels of fluoride ion are effective at preventing tooth decay.**

Modern prevention: Age-old practices and observational science.

Can we make any other observations about tooth decay?

Another anomaly: Cystic Fibrosis

- Patients with cystic fibrosis have a lower occurrence of tooth decay.
- Why? The average pH and buffering capacity (dissolved electrolytes) of saliva within these individuals is higher than normal.

Saliva is a complex mixture of organic and inorganic compounds that are vital to maintaining healthy teeth.

The effects of saliva deficiencies?

Rampant tooth decay



For example, individuals undergoing chemotherapy, some prescription medications, or illicit drugs experience reductions in the amount or content of the saliva.

- ✓ **Saliva is critical for healthy teeth. The quantity and quality of saliva relates to a person's tooth decay profile.**

Why do some people get cavities and others don't?

Genetics?

Hygiene?

Luck?

The answer: What I call a genetic slot machine.



Our DNA dictates the amount of saliva produced and the contents within it.

Some people never get a single cavity, while others know the dental chair like a 2nd home.



So, what are the components that make up saliva and how do they prevent cavities?

Saliva: Water, dissolved salts (electrolytes), polysaccharides, glycoproteins, enzymes, ...

Lets focus on a dissolved electrolyte critical for supporting tooth mineralization – Calcium.

Common calcium compounds in saliva:

- Free calcium ions.
- Calcium citrate (ascorbate).
- Calcium phosphate.
- Calcium lactate.
- Calcium hydrogen carbonate.
- Calcium bound to proteins.

These calcium compounds are either produced by the salivary glands or are salts formed when introduced from external sources.

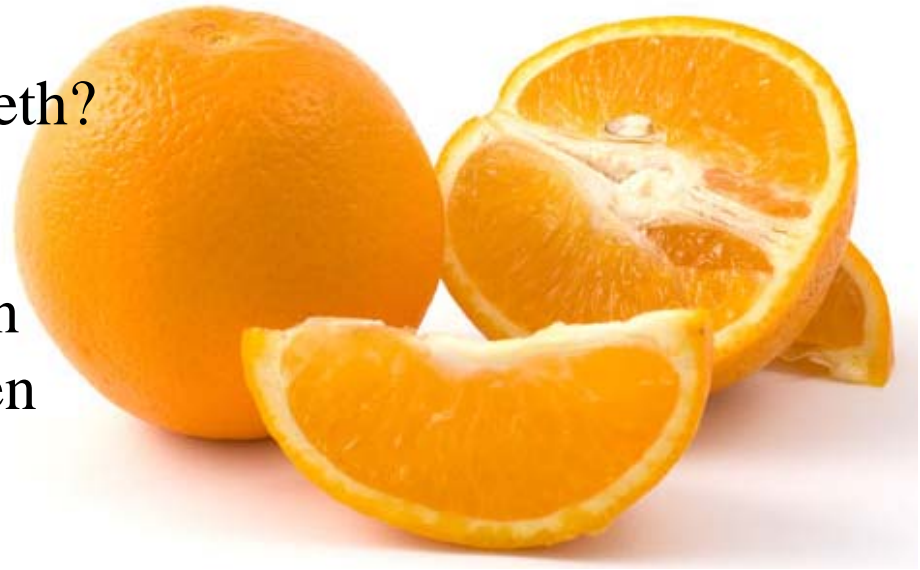
A more detailed look:

- **Calcium Lactate:** The calcium salt of lactic acid. Lactic acid is one of the waste byproducts produced by microbial metabolism. Lactic acid production by bacteria is how the saliva becomes acidic.
- **Calcium hydrogen carbonate:** The calcium salt of carbonic acid. Humans exhale carbon dioxide and some of it absorbs into saliva where it combines with calcium to form calcium hydrogen carbonate.
- **Calcium phosphate:** The calcium salt of phosphoric/phosphorous acid - The compounds that form teeth. This salt is water insoluble.
- **Calcium bound to proteins:** Calcium that has an affinity to various proteins.

- **Free calcium ions:** The saliva contains a significant quantity of free calcium ions. Soluble calcium ions are the real engines of tooth re-mineralization.
- **Calcium citrate (ascorbate):** The calcium salt of Vitamin C. a water soluble calcium salt produced by the saliva glands. Provides both a source for free calcium ion and a buffering agent.

Vitamin C is vital for healthy teeth?

This knowledge was well known several decades ago, but has been largely forgotten.



Vitamin C (Ascorbic Acid)

Why do we need Vitamin C?

Vitamin C is a water-soluble, antioxidant vitamin. It is important in forming collagen, a protein that gives structure to bones, cartilage, muscle, and blood vessels. Vitamin C also aids in the absorption of iron, and helps maintain capillaries, bones, **and teeth.**

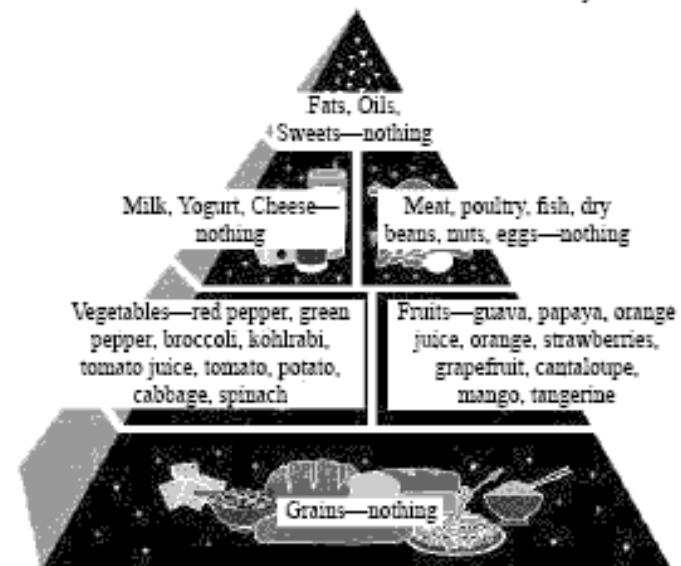
HYG-5552-05

This fact sheet is one in a series containing information to help you select foods that provide adequate daily amounts of vitamins, minerals, and dietary fiber. The Dietary Guidelines Advisory Committee just released the Dietary Guidelines for Americans 2005 that convey the following nine major messages concerning these topics:

Ohio State University Extension Fact Sheet

Department of Human Nutrition and
OSU Extension.

Where to find vitamin C in the Food Guide Pyramid.



Vitamin C and Saliva

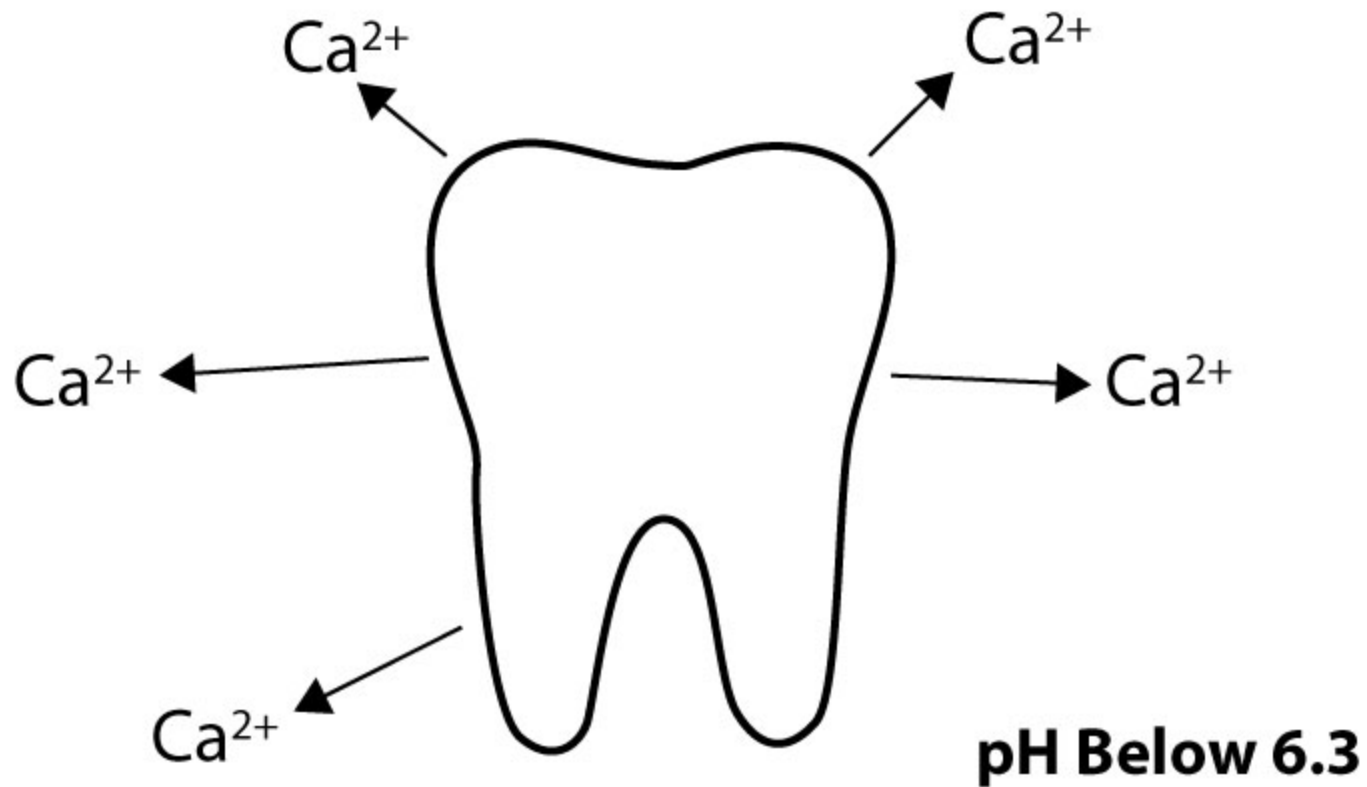
- Government-funded studies 50 years ago established that the body utilizes Vitamin C to transport calcium in a soluble form.
- Established a correlation between low incidence of cavities and high saliva pH and high saliva buffering capacity.

The Nature of Teeth

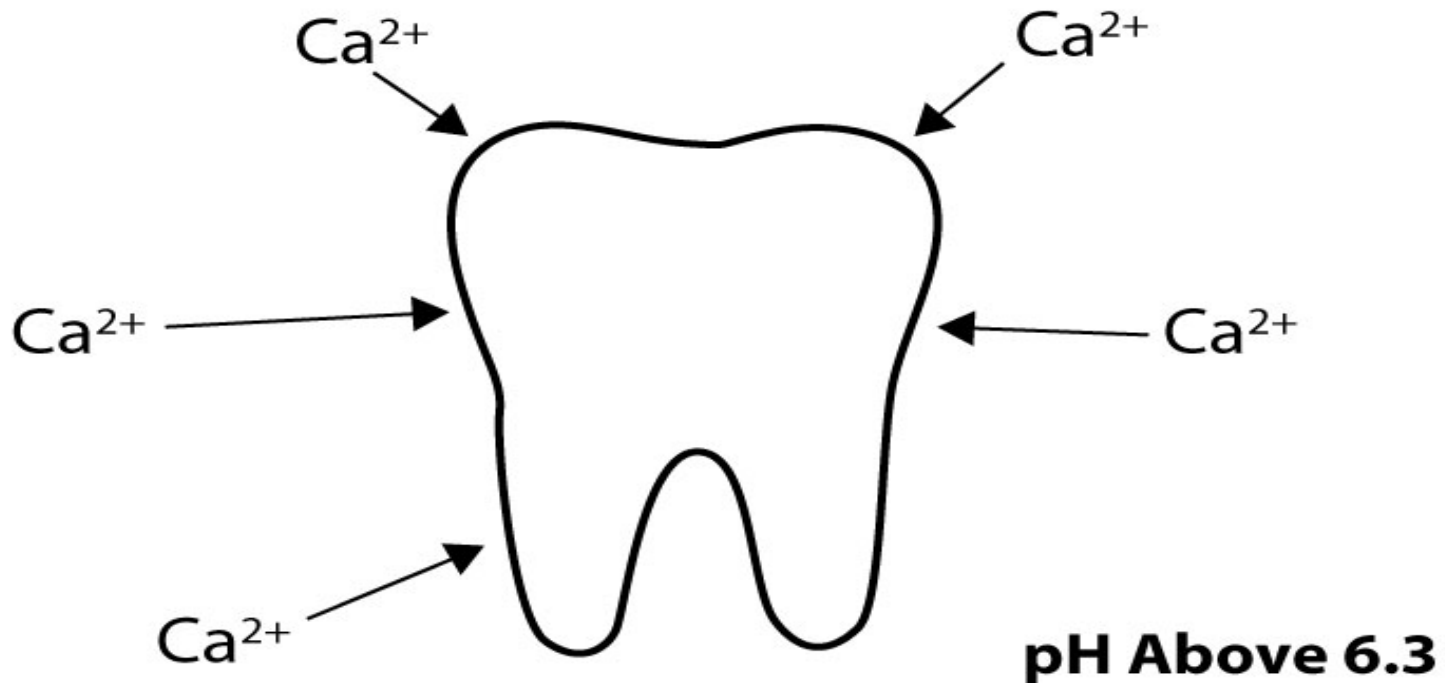
- Teeth are composed of a water insoluble calcium phosphate salt called calcium hydroxy apatite.
- Teeth go through a constant cycle of loss and re-growth, called de-mineralization and re-mineralization.
- De-mineralization - the surfaces of our teeth are dissolving away.
- Re-mineralization - the surfaces of our teeth are re-growing.
- Saliva with high pH and buffering capacity promotes re-mineralization.
- Saliva with low pH and buffering capacity promotes de-mineralization.

DE-MINERALIZATION

(ACIDIC SALIVA)



RE-MINERALIZATION (BASIC SALIVA)



Re-mineralization occurs when the pH is above ~6.3 and the saliva contains the necessary mineralization compounds to do so.

Critical Concept: The combination of a pH above ~6.3 *and* sufficient mineralization compounds are required to promote re-mineralize.

- Raising pH alone is not enough – electrolytes are needed as building blocks for re-mineralization.
- Enriching the saliva with electrolytes alone is not enough – low pH promotes dissolution of the calcium ions.

Previous studies have shown that both actions are needed.

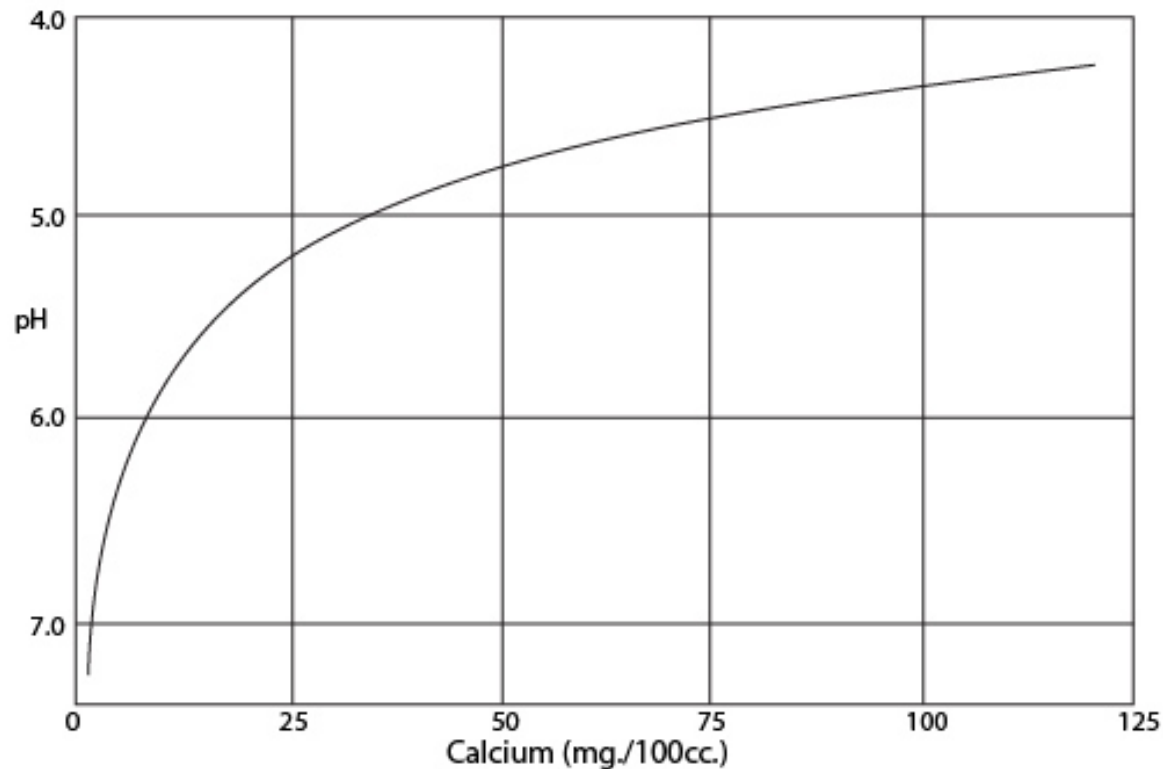
Effects of Low pH

Microbes produce lactic acid as a by-product of metabolism. Below is a tooth that has been subject to 4 immersions in 1M lactic acid solution over a 2 week period.

The tooth turns into what feels like a white mush that easily rubs off.



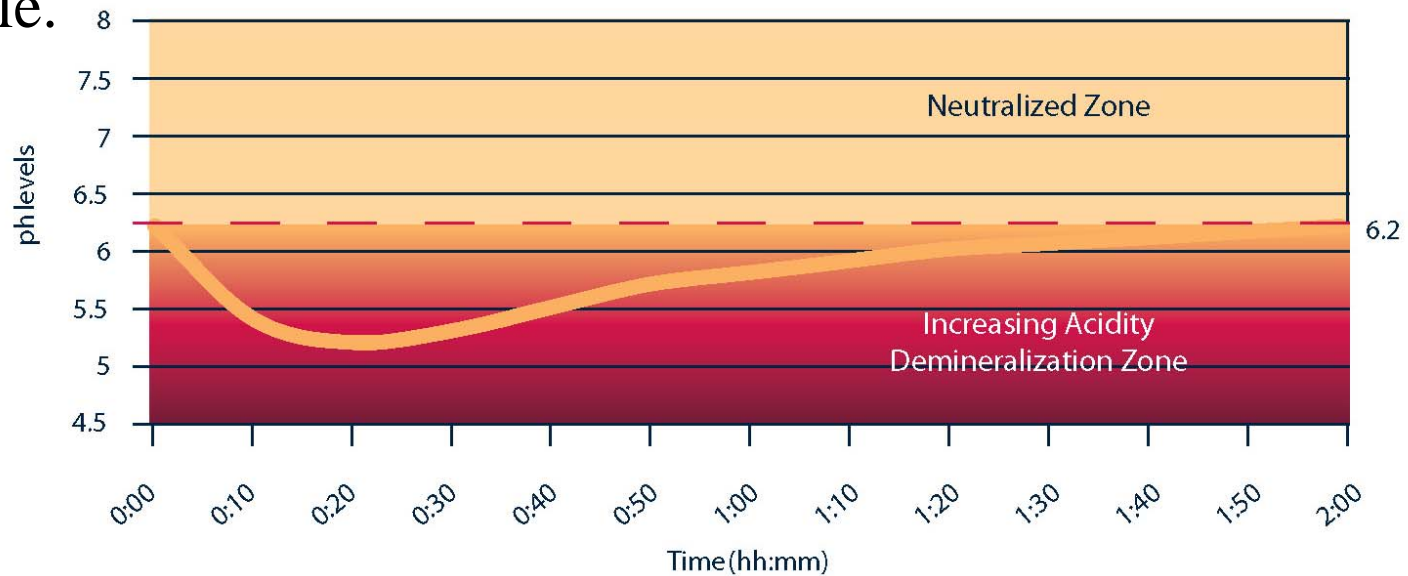
Solubility of Calcium vs. pH



Graph 1. Solubility of enamel in saliva at various pH Levels - Calcium

Non-linear relationship – a dramatic change below ~ 6.3

- Above pH 6.3 the solubility of calcium is significantly minimized. Keeping saliva above this level is preferred.
- The average “fasting” pH of healthy patients is about 6.4 - 6.9.
- The pH changes when we eat. At first the pH rises slightly as we begin to salivate, then drops by about a pH of 1. After about an hour it returns to normal again. This is our pH cycle.



Based on this knowledge, the preventative approach should include:

- ✓ Maintain the pH of saliva above 6.3; especially after eating.
- ✓ Flood the saliva with re-mineralization salts.
- ✓ Maximize buffering capacity.

In short, create the same oral environment that occurs to patients with cystic fibrosis.

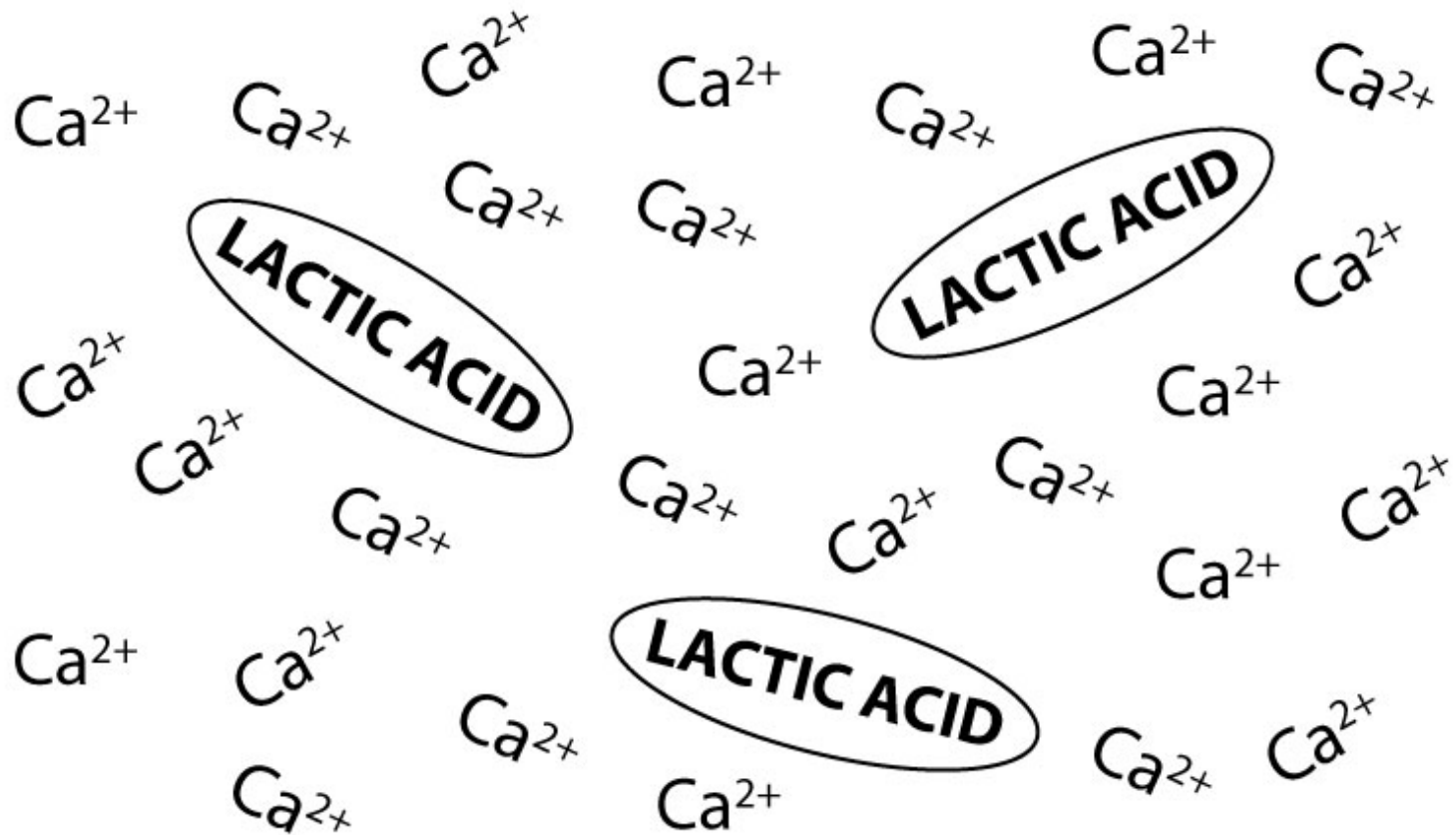
For introducing calcium, the best source is calcium ascorbate.

Benefits:

- Naturally occurring within the body.
- A 10% solution has a pH of about 7 (neutral).
- Fully soluble in water.

The goal: To flood the saliva with calcium ions in excess of lactic acid production.

Buffering occurs when calcium ions overwhelm lactic acid



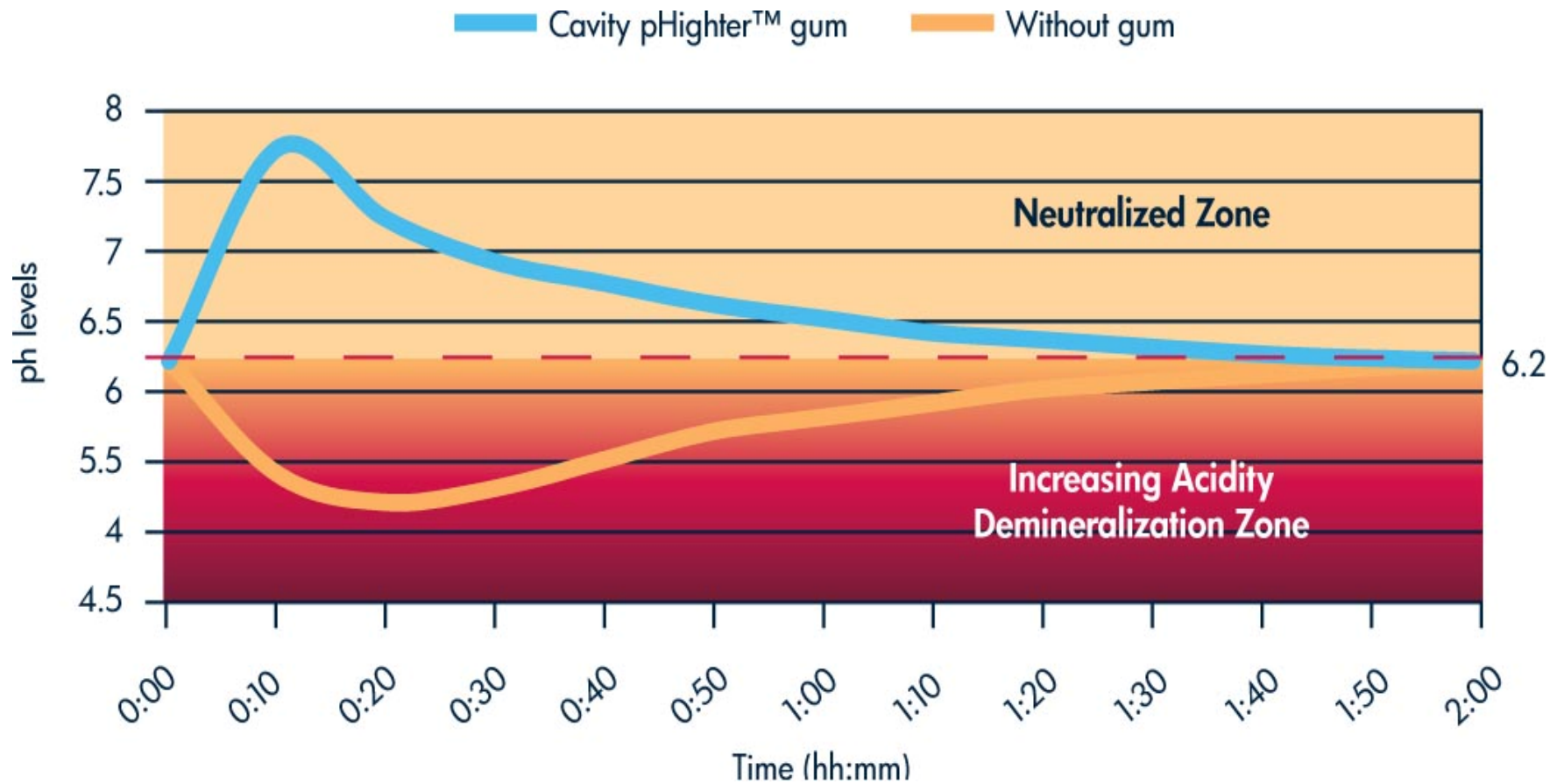
The ideal treatment modality:

- ✓ Can be applied after a meal
- ✓ Simple and convenient, for patient compliance
- ✓ Flood the saliva with electrolytes, particularly calcium ascorbate
- ✓ Artificially raise the pH of saliva.

CAO Group has developed such a treatment...



This emerging technology is designed to raise the pH of saliva by about 2. It also contains 5% calcium ascorbate to flood the mouth with buffered calcium ions.

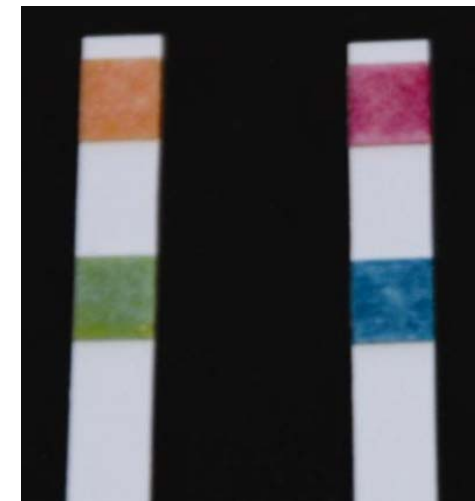
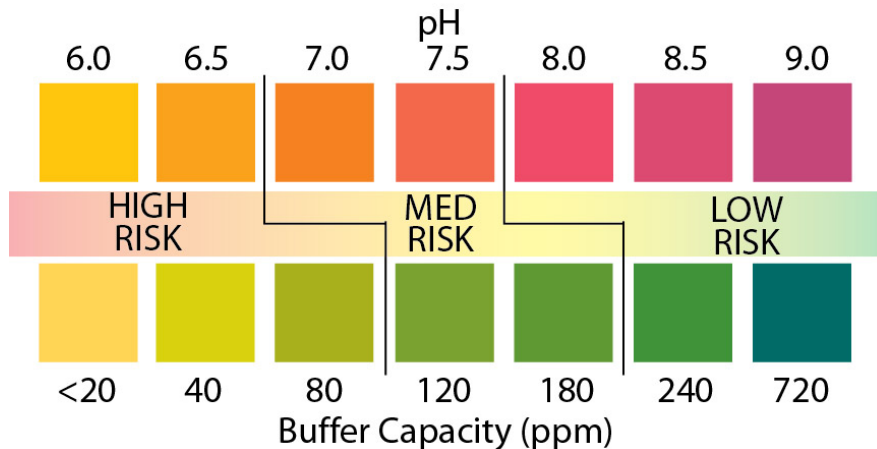


Cavity pHighter was initially developed as a sugar free gum, but other delivery methods are possible such as mints, rinses, and other common confections.



A saliva assessment test has also been developed.

A simple color-changing test strip quickly reveals the saliva pH and buffer capacity



For compliance, a treatment needs to be convenient to the patient at anytime.

Convenience is the biggest disadvantage to the tooth brush – we only brush when a sink is handy.

We brush our teeth at all the wrong times:

- Many people brush their teeth before they eat breakfast.
- Almost no one brushes after lunch.
- Most people brush right before going to bed – a couple of hours after eating dinner when the pH cycle has already passed.



The biggest advantage of Cavity pHighter is convenience: Chewing a piece of gum or enjoying a mint after a meal is much easier, thus supporting greater patient compliance.

In addition to simple consumer solutions, doctor-administered modalities for this concept have also been explored.



Cavity pHighter is not a panacea cure for tooth decay, simply a new tool in the prevention arsenal:

- ✓ Toothbrushing
- ✓ Fluoride toothpaste
- ✓ Flossing
- ✓ Water fluoridation
- ✓ **Cavity pHighter (modify pH and buffering capacity)**

Multiple modalities allow tailored treatments to each individual.

CAO Group has developed other fluoride application technologies:
Sheer FluorX – A dentist administered 5% sodium fluoride applicator.

- Based on the “whitening strip” approach, a sticky film that brings high-level fluoride in direct contact with teeth.
- Prevents fluoride from dissolving into saliva and getting swallowed.
- Higher fluoride uptake than varnishes, in less application time.
- Can be patient applied.



SUMMARY

- ✓ Tooth decay continues to be a wide ranging and difficult condition to manage.
- ✓ Current preventative practices, while positive, continue to be inadequate.
- ✓ Cavity pHighter, by CAO Group, adds an innovative and potentially far-reaching modality.
- ✓ Through Cavity pHighter and Sheer FluorX, CAO Group joins the forefront in cavity prevention technologies.

Thank you for your attention.

