

Scientific Facts about Teeth and Gums

By

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As explained in the brochure, [How To Keep Your Teeth](#), there are two types of disease which generally affect teeth and gums. There are:

- Gum Disease
- Tooth decay

It is important to realise that neither of these diseases “happen overnight” (ie these diseases do not appear in a 24 hour period; they both take months and years to develop).

It is also important to realise that each disease has a different aetiology (cause) and therefore prevention is required in two different ways.

To prevent gum disease, you must mechanically clean the plaque and bacteria off the teeth and gums (particularly at the junction where the gum attaches to the teeth). You can eat as much sugar as you like and it will not cause gum disease. Only cleaning properly will prevent gum disease (and proper cleaning is not as easy as you might think).

In the case of decay (caries) the cause is different (see previous brochure) to gum disease. Sugar is the cause of decay (more explained later below). If you have no intake of sugar (which is almost impossible to avoid) then you will have no decay. Cleaning your teeth properly will reduce the amount of decay you get but in all honesty, if you eat a lot of sugar you will get decay irrespective of how well you clean your teeth.

Gum disease

This starts as disease of the gingiva (gums) around the teeth. In simple terms, if you do not clean your teeth and gums (using a mechanical device like a toothbrush) then plaque will form around your teeth. Even if your teeth are really well cleaned, plaque will form within 8 to 24 hours after cleaning. After plaque forms, bacteria colonise (grow) in the plaque and this causes inflammation and infection to occur. The result is swollen, bleeding gums which are unhealthy. However at this stage, provided proper cleaning is carried out, this initial disease process is reversible.

If the plaque and bacteria are not cleaned off, then the gum disease can become worse and this leads to infection and inflammation of the periodontal ligament which holds the tooth into the jaw and also of the bone surrounding the teeth. Thus, the bone starts to resorb (eat) away. Consequently the ligament and bone can be destroyed and eventually there will be no support to hold the tooth in place. Thus the tooth becomes loose or sore and either falls out by itself or has to be taken out. Since the introduction of fluoride into drinking water supplies, people have been keeping their teeth longer and thus it is usually gum disease which causes the loss of teeth in older age (although not always).

Therefore the key to preventing gum disease is to properly clean your teeth. Mouthwashes will not stop gum disease but a good antibacterial mouthwash can possibly reduce the

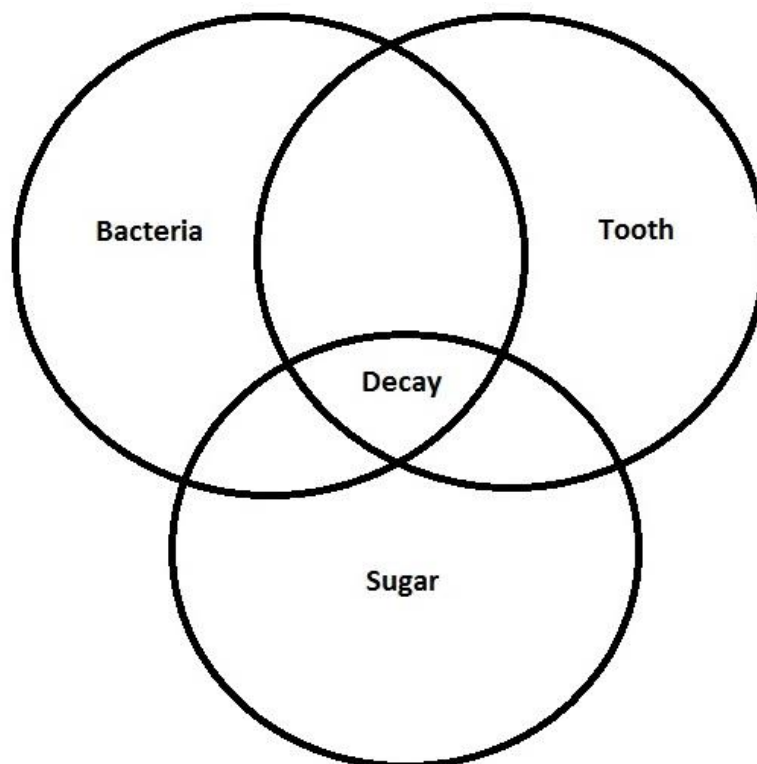
amount of gum disease you have (especially if cleaning is also done). Since plaque is quite thick and hard to penetrate, any chemical reduction of bacteria relies on two things: firstly being good at killing bacteria and secondly penetrating the plaque or biofilm. Unfortunately most mouthwashes are incapable of doing these things but there is a promising new development which potentially could be useful.

Tooth Decay

I should first explain the concept of “necessary and sufficient”. If we consider what is critical for decay to occur, there are three essentials:

- Tooth
- Bacteria
- Sugar

It can best be explained with this diagram.



It is necessary to have a **Tooth** to get decay but it is not sufficient (ie if you leave a tooth by itself for a 1000 years it will not get decay).

Similarly it is necessary to have **Bacteria** (the right type) to get decay but it is not sufficient (ie bacteria by themselves will not cause decay).

It is also necessary to have **Sugar** to get decay, but of course you can have a bowl of sugar sitting on a table and it will never get decay.

It is only when you have these three necessary essentials (and they overlap) that you have sufficient cause for decay to occur: ie Tooth, Bacteria and Sugar.

If you reduce the amount of bacteria you can reduce decay (ie clean your teeth).

Likewise if you remove sugar from your diet, you remove the primary essential for decay to occur. This is the most important aspect of preventing decay.

Since most people cannot or will not give up sugar then another possibility is to change the type of sugar (sticky, solid, solution) you eat and when (see the brochure *How To Keep Your Teeth* link above).

However the other consideration is the type of sugar you eat (ie how refined is it). Raw sugars (eg sugar in fruit) are generally long molecular chains and it takes time for bacteria to break these chains down to smaller molecules that they can metabolise (and as a consequent create an acid by product which then dissolves the tooth enamel). By the time this lengthy breakdown process happens, the sugars have generally been diluted and therefore the acid attack is minimal. However short chain sugars (eg refined sugar like: sucrose, fructose, glucose) are easily metabolised by bacteria and the acid production is quite quick – so dilution by saliva and other foods and drinks does not have time to occur and so the damage is considerably more.

An Important Fact

As I mentioned, when bacteria metabolise sugar in your mouth, they create acid which decalcifies (dissolves) the tooth enamel. This acid creation occurs for about 20-30 minutes after sugar is eaten and is called an “acid spike”.

If you eat sugar, you should aim to have a minimal number of acid spikes per day: ie 1 or 2 spikes per day is usually tolerable, but a large number of spikes will mean that your teeth are exposed to acid more often (not just once or twice) and so the acid attack on your teeth will last longer (more often) and thus the damage will be much more severe.

Therefore, the objective to maintain healthy teeth is to not have continuous acid spikes (essentially creating an elevated “acid plateau”).

Therefore the message is to carefully consider the frequency that you eat sugar. For example: if you eat 1 kilogram of sugar all at one time – then you will have a minimal acid spike because it is a single event (although there could be medical consequences of doing this because of high blood sugar levels). Since there is only one spike, the detrimental effect on your teeth will be minimised.

However, if you eat only a teaspoon full of sugar at a time (ie you consume the kilo of sugar over many times a day – eg 5 to 10 and for many days – perhaps over 2-4 weeks), then it will spread the increased frequency of your acid spikes over many exposures. Thus there will be multiple acid spikes and so the detrimental effect to your teeth will be many times greater than just one exposure.

When we consider teeth (one of the three essentials to get decay), then if we can change the tooth in some way, we can also change how much decay occurs.

When the enamel crowns of second teeth are formed (generally between the ages of 0 to 8 years old) the enamel is laid down in parallel prism like rods and the enamel is usually about 2-3 mm thick (over the dentine). If the Fluoride concentration in drinking water is below about 0.7 parts per million then the enamel that is laid down is predominantly hydroxyapatite crystals. However if Fluoride ions are between 0.7 and 1.2 parts per million in drinking water, then fluorohydroxyapatite crystals are formed. It so happens that fluorohydroxyapatite crystals create an enamel structure that is much harder and more resistant to dissolving (by many times) compared to hydroxyapatite crystal enamel.

As mentioned above, when bacteria metabolise short chain sugar molecules, they create acid. If this acid is in contact with the teeth long enough then it will dissolve (decalcify) the enamel (calcium ions dissolve out and a little crater is formed in the enamel). If this acid attack reoccurs on a regular basis, the small crater becomes larger and larger and a cavity starts. Luckily if you stop eating sugar (or if you apply fluoride to the decalcified area) then the area can re-mineralise and a cavity will not occur. However if the cavity progresses due to more sugar being eaten, then eventually the cavity will break through the enamel layer into dentine. At this stage different bacteria take over and they start to eat away the dentine.

So you can immediately see that if fluoride in water creates stronger enamel (which is much less inclined to dissolve with acid attack) then there will be: fewer cavities, more remineralisation, and if cavities form – then they will grow slower and so consequently the size of the cavity will be smaller when the dentist fills the tooth. Hopefully you can now understand why fluoride is added to the drinking water so that the strongest possible enamel is formed in children's teeth and hence the rate of decay reduces and also the size of fillings is smaller. I should also emphasise that the fluorohydroxyapatite crystals go all the way through the enamel (ie the entire depth of enamel).

In a different situation, if you apply concentrated Fluoride to the surface of the tooth, then an ion exchange (penetration) occurs at the surface and calcium (in the enamel) exchanges with fluoride and a harder enamel surface results (about 10 microns thick). This harder layer of enamel is also much more resistant to acid attack, so it reduces the rate of decay. This is the logic of dentists painting your teeth with fluoride after your teeth have been cleaned. It is also the reason why fluoride is in toothpaste because it has been proven to reduce decay.

Unfortunately, the ion exchange can reverse again and fluoride can leach out of the enamel in exchange for calcium. When this happens the enamel can become less strong again. Therefore fluoride needs to be consistently applied to the tooth enamel to maintain a tougher surface on the enamel. This is why fluoride in toothpaste is so beneficial – because it coats the enamel with fluoride ions every time you clean your teeth. It is also why your dentist will re-apply fluoride to your teeth every time you have a recall examination.

You can therefore understand why I advocate a high Fluoride level in toothpaste.

Saliva

I should also mention saliva at this time. Saliva acts to protect teeth is several ways.

Firstly, it is a buffer and so if there is acid attacking the tooth, the saliva will buffer or neutralise the acid to some degree (acid has a pH value of less than 7 – generally about 2 to 4 - and saliva usually has a pH of about 7 to 7.4).

Secondly, the saliva acts as a lubricant and helps remove food and plaque off the teeth.

Thirdly, saliva dilutes any acid in the mouth – in fact when there is food or acid in your mouth, you will usually salivate more than usual.

Sadly as people get older, their saliva flow often reduces. This is especially the case when people are taking specific medications for medical conditions, or they have had radiotherapy near the salivary glands. When this happens, food sticks more easily to the teeth, dilution of acid is less and of course there is less buffering of any acid. The consequence is that usually the respective persons have a huge increase in decay rate. The only way to combat this is to use artificial saliva mouthwashes, to remove bacteria by thorough cleaning and to reduce all sugar intake. As well, regular fluoride application to their teeth is necessary (usually with very, very high concentrations of fluoride toothpaste).