

Chemical-parasitic theory

Chemical-parasitic theory is a hypothesis about the etiology of dental caries. According to her, it is caused by acids and the activity of microorganisms in the mouth. The theory is named after the famous American dentist **Willoughby Dayton Miller**. He first published it in 1898 in the book "Die Mikroorganismen der Mundhöhle", a year later in English translation and distributed as "The Micro-Organisms of Human mouth". Chemical-parasitic theory is based on several theories that were published during the 19th century. These include, in particular, chemical and parasitic theory:

1. **Chemical theory** states that tooth decay is caused by acids formed by the fermentation of food around the tooth.
2. **Parasitic theory** states that caries begins as a chemical process, with microorganisms continuing to disintegrate both enamel and dentin.

Miller did not consider himself the discoverer of chemical-parasitic theory. In his book, he gave all credit to Milles and Underwood, who said, "Most decalcification is caused by acids, but we think they are the product of the bacteria themselves. (Transact. Int. Med. Congr. 1881)

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The essence of Miller's theory

Miller's theory is currently the most **accepted theory** of tooth decay. According to her, the formation of dental caries consists of **demineralization** and **destruction** of organic and inorganic parts of the **tooth**, which alternate with **remineralization** efforts of the organism to stop the caries. Carious lesions can only occur under a layer of bacteria that are able to produce a sufficiently acidic environment to cause demineralization.

Dental plaque

- **Dental plaque** is a key factor in the development of tooth decay. It is a bacterial biofilm that adheres relatively tightly to the tooth surface.
- **Bacteria** in plaque **metabolize fermentable carbohydrates** and, as a by-product, produce organic acids that dissolve hard tooth tissues. Carious lesions then progress as a series of deteriorations and improvements depending on the changing pH (bacterial metabolism).

Plaque formation

Plaque formation is a complex process. The individual **steps** are **interdependent** and **follow** each other :

1. Pellicula

Pellicula is an oral biofilm consisting of a monomolecular layer of acidic proteins rich in proline and phosphates and glycoproteins rich in sulfates. They bind to the Ca^{2+} ions of the enamel by their negative charge. Biofilm formed from salivary proteins does not form on teeth by accident. It serves as a protective layer against erosion, protects against neck hypersensitivity and has a controlling function during remineralization. It forms within a few seconds **after brushing the tooth**.

2. Initial colonization of the pellicle

Pellicula is a cornerstone in the formation of dental plaque. **Bacteria** from saliva and the environment react with their adhesins to pellicle receptors, which allows them to adhere. The primary colonizers are mainly aerobes, such as streptococcus sanguis, s. Mitis, s. Oralis, aktinomycetes, etc. During the first 24 hours after purification, the primary colonizers proliferate and microcolonies form.

3. Secondary colonization

Over the next **7 days** , new bacteria co-adhere. Pioneering bacteria serve as a substrate for further colonization and are being replaced by others. The plaque becomes more diverse, the number of streptococci decreases, and anaerobes gradually begin to predominate.

4. Plaque maturation

After about **2 weeks** , the composition of the plaque stabilizes - it matures.

Caries formation

Tooth decay is caused by acidic fermentation products of cariogenic bacteria. These disrupt the smooth surface of the tooth, deprive it of inorganic components, especially Ca²⁺ ions, and thus allow access to the organic component of the tooth.

There is a number of organisms in dental plaque that are able to cause decay. The best known are **streptococcus mutans , mitis, sanquis, sobrinus and lactobacilli**. In order for a bacterium to be classified as cariogenic, it must meet the following conditions:

- metabolize sugars and convert them into acids by acid anaerobic glycolysis (**acidogenicity**)
- produce **extra- and intracellular polysaccharides**. Extracellular forms the basis of the plaque matrix, intracellular can be used as a source of energy at a time when there is insufficient sugar supply
- survive at low pH (**aciduricity**)

The critical value for **hydroxyapatite** demineralization is pH = 5.7, the critical value for **fluoroapatite** is pH = 4.6. **Time** is also an important factor in the development of caries . It takes bacteria 24 to 48 hours to form dental plaque on a tooth, the bacteria of which are able to produce acids, enzymes and toxins (those after 48 hours), which are used in the development of tooth decay.

Summary

Miller's chemical-parasitic theory assumes that **4 basic factors** are necessary for caries :

- bacteria
- fermentable carbohydrates
- presence of teeth
- time

These factors must act **simultaneously** .

Bacteria metabolize fermentable carbohydrates through anaerobic glycolysis and, as a by-product, produce acids that cause hard tooth tissue to demineralize and cause caries.

Links

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- Tooth plaque

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- <http://lib.hku.hk/denlib/rarebook/bscience/microauthor.pdf>

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