

TODAR'S ONLINE TEXTBOOK OF BACTERIOLOGY

The Normal Bacterial Flora of Humans (page 5)

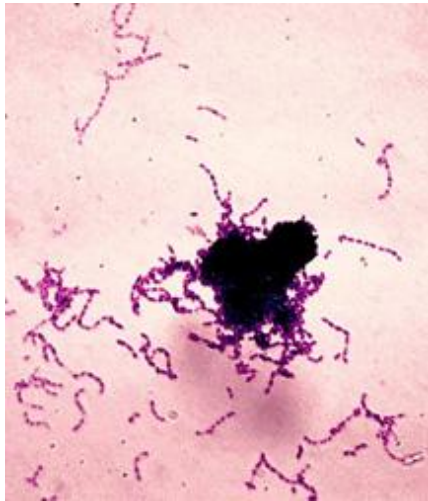
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Dental Caries, Gingivitis and Periodontal Disease

The most frequent and economically-important condition in humans resulting from interactions with our normal flora is probably dental caries. Dental plaque, dental caries, gingivitis and periodontal disease result from actions initiated and carried out by the normal bacterial flora.

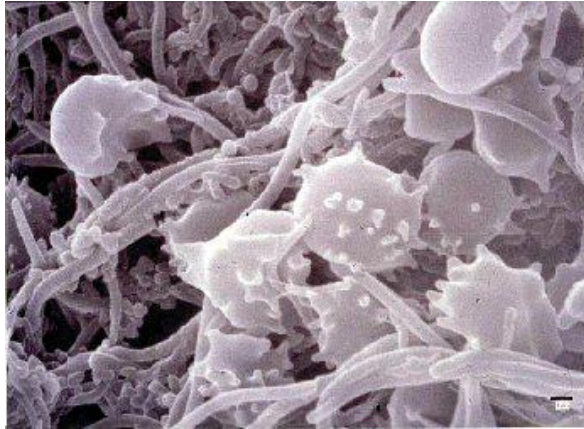
Dental plaque, which is material adhering to the teeth, consists of bacterial cells (60-70% the volume of the plaque), salivary polymers, and bacterial extracellular products. Plaque is a naturally-constructed biofilm, in which the consortia of bacteria may reach a thickness of 300-500 cells on the surfaces of the teeth. These accumulations subject the teeth and gingival tissues to high concentrations of bacterial metabolites, which result in dental disease.

The dominant bacterial species in dental plaque are *Streptococcus sanguis* and *Streptococcus mutans*, both of which are considered responsible for plaque.



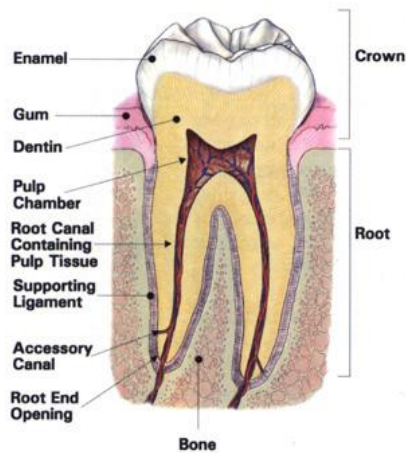
***Streptococcus mutans*. Gram stain. CDC.**

Plaque formation is initiated by a weak attachment of the streptococcal cells to salivary glycoproteins forming a pellicle on the surface of the teeth. This is followed by a stronger attachment by means of extracellular sticky polymers of glucose (glucans) which are synthesized by the bacteria from dietary sugars (principally sucrose). An enzyme on the cell surface of *Streptococcus mutans*, glycosyl transferase, is involved in initial attachment of the bacterial cells to the tooth surface and in the conversion of sucrose to dextran polymers (glucans) which form plaque.



Dental plaque, scanning electron micrograph illustrating the diversity of microbes in plaque.

Dental Caries is the destruction of the enamel, dentin or cementum of teeth due to bacterial activities. Caries are initiated by direct demineralization of the enamel of teeth due to lactic acid and other organic acids which accumulate in dental plaque. Lactic acid bacteria in the plaque produce lactic acid from the fermentation of sugars and other carbohydrates in the diet of the host. *Streptococcus mutans* and *Streptococcus sanguis* are most consistently been associated with the initiation of dental caries, but other lactic acid bacteria are probably involved as well. These organisms normally colonize the occlusal fissures and contact points between the teeth, and this correlates with the incidence of decay on these surfaces.



Cross section of a tooth illustrating the various structural regions susceptible to colonization or attack by microbes.

Streptococcus mutans in particular has a number of physiological and biochemical properties which implicate it in the initiation of dental caries.

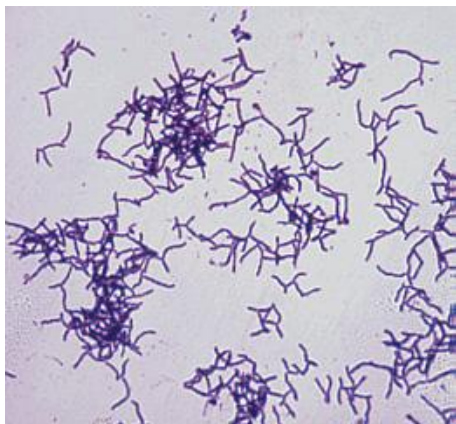
1. It is a regular component of the normal oral flora of humans which occurs in relatively large numbers. It readily colonizes tooth surfaces: salivary components (mucins, which are glycoproteins) form a thin film on the tooth called the enamel pellicle. The adsorbed mucins are thought to serve as molecular receptors for ligands on the bacterial cell surface.

2. It contains a cell-bound protein, glycosyl transferase, that serves as an adhesin for attachment to the tooth, and as an enzyme that polymerizes dietary sugars into glucans that leads to the formation of plaque.

3. It produces lactic acid from the utilization of dietary carbohydrate which demineralizes tooth enamel. *S. mutans* produces more lactic acid and is more acid-tolerant than most other streptococci.

4. It stores polysaccharides made from dietary sugars which can be utilized as reserve carbon and energy sources for production of lactic acid. The extracellular glucans formed by *S. mutans* are, in fact, bacterial capsular polysaccharides that function as carbohydrate reserves. The organisms can also form intracellular polysaccharides from sugars which are stored in cells and then metabolized to lactic acid.

Streptococcus mutans appears to be important in the initiation of dental caries because its activities lead to colonization of the tooth surfaces, plaque formation, and localized demineralization of tooth enamel. It is not however, the only cause of dental decay. After initial weakening of the enamel, various oral bacteria gain access to interior regions of the tooth. Lactobacilli, Actinomyces, and various proteolytic bacteria are commonly found in human carious dentin and cementum, which suggests that they are secondary invaders that contribute to the progression of the lesions.



Actinomyces israelii

Periodontal Diseases are bacterial infections that affect the supporting structures of the teeth (gingiva, cementum, periodontal membrane and alveolar bone). The most common form, **gingivitis**, is an inflammatory condition of the gums. It is associated with accumulations of bacterial plaque in the area. Increased populations of Actinomyces have been found, and they have been suggested as the cause.

Diseases that are confined to the gum usually do not lead to loss of teeth, but there are other more serious forms of periodontal disease that affect periodontal membrane and alveolar bone resulting in tooth loss. Bacteria in these lesions are very complex populations consisting of Gram-positive organisms (including Actinomyces and streptococci) and Gram-negative organisms (including spirochetes and Bacteroides). The mechanisms of tissue destruction in periodontal disease are not clearly defined but hydrolytic enzymes, endotoxins, and other toxic bacterial metabolites seem to be involved.