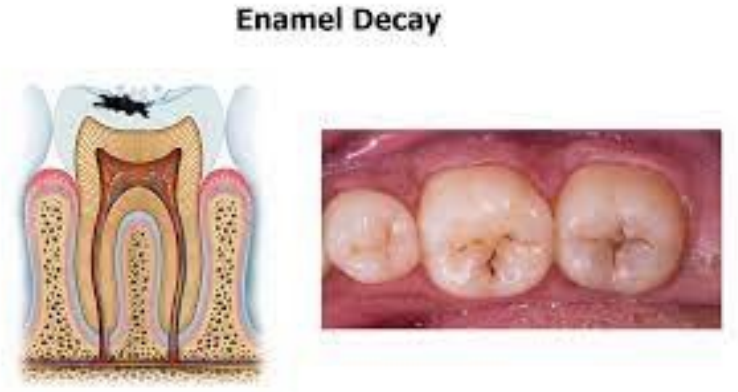
## Dental plaque and Dental Caries

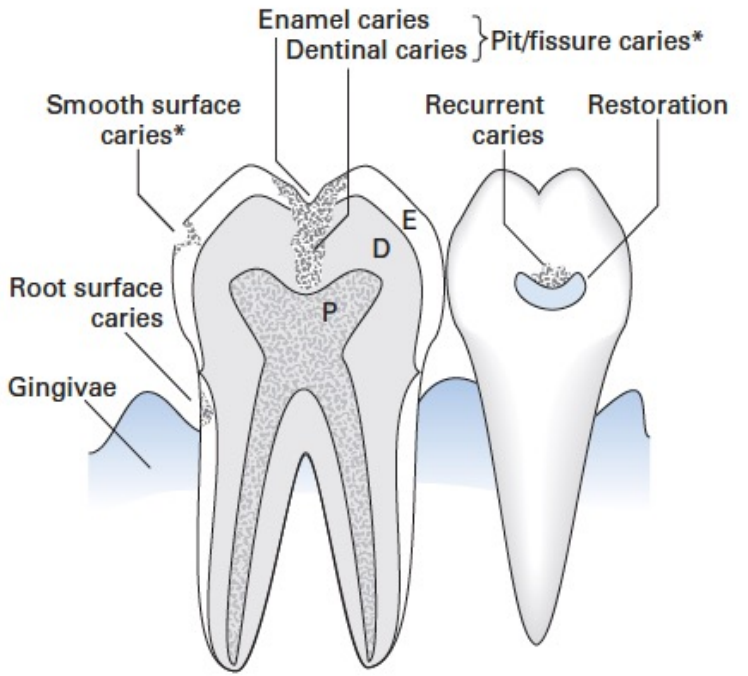
**Dental plaque** is a biofilm of microorganisms (mostly bacteria, but also fungi) that grows on surfaces within the mouth . It is a sticky colorless deposit at first, but when it forms tartar, it is often brown or pale yellow. It is commonly found between the teeth, on the front of teeth, behind teeth, on chewing surfaces, along the gumline, or below the gumline cervical margins.

- **Dental caries** is a chronic endogenous infection caused by the normal oral commensal flora. The carious lesion is the result of demineralization of enamel (and later of the dentine ) by acids produced by plaque microorganisms that metabolize dietary carbohydrates and the cavitation occur . once the surface layer of enamel has been lost the infection progresses to dentine, becoming firstly inflamed and then necrotic.




**Classification of dental caries** Dental caries can be classified with respect to the site of the lesion

- pit or fissure caries ( seen in molars, premolars and the lingual surface of maxillary incisors)
- smooth surface caries (seen mainly on approximal tooth surface just below the contact point)
- root surface caries (seen on cementum or dentine when the root is exposed to the oral environment)
- recurrent caries ( associated with an existing restoration)

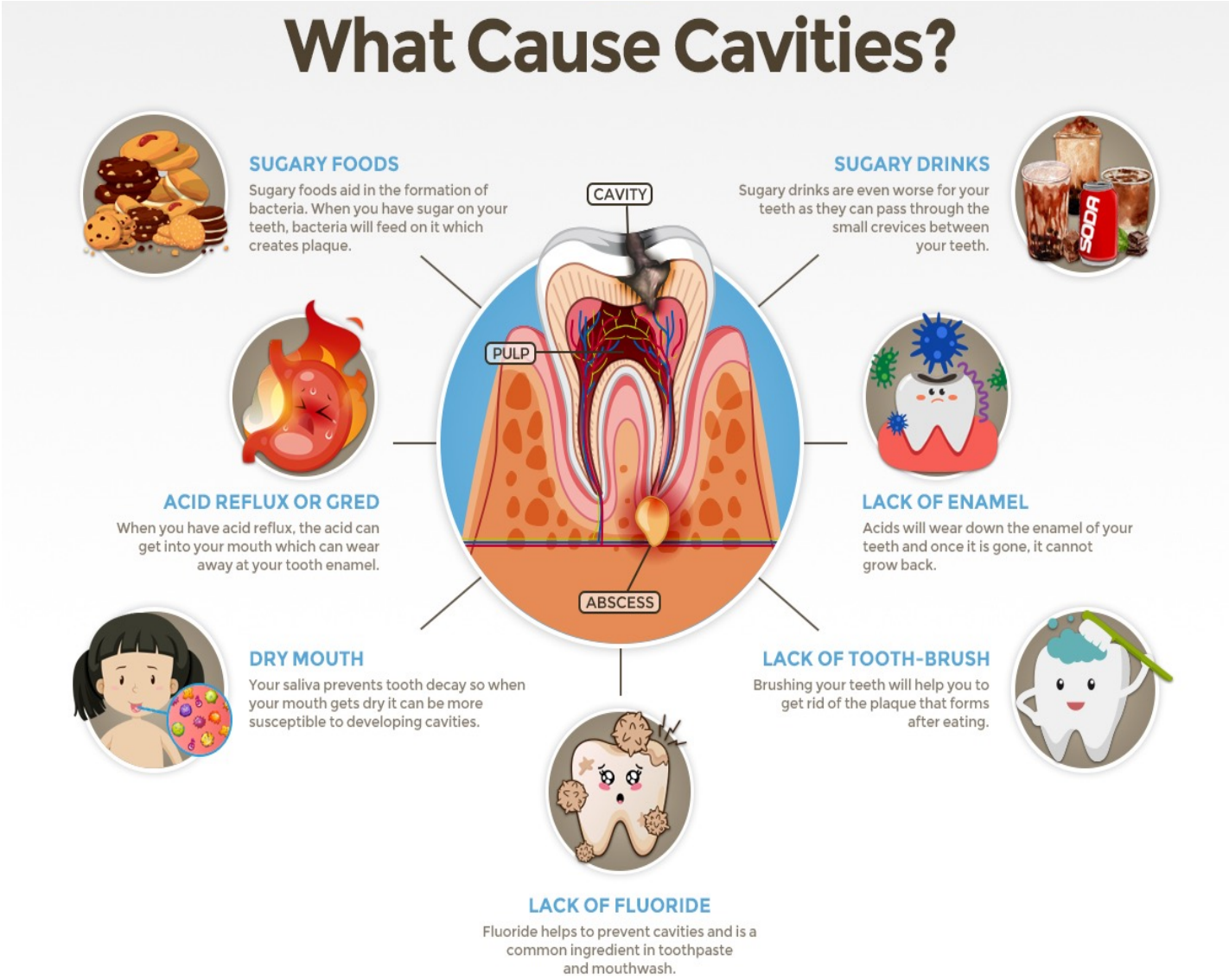



Nomenclature of dental caries. D, dentine; E, enamel; P, pulp.
*Also termed occlusal caries.

## Aetiology

The major factors involved in the caries:

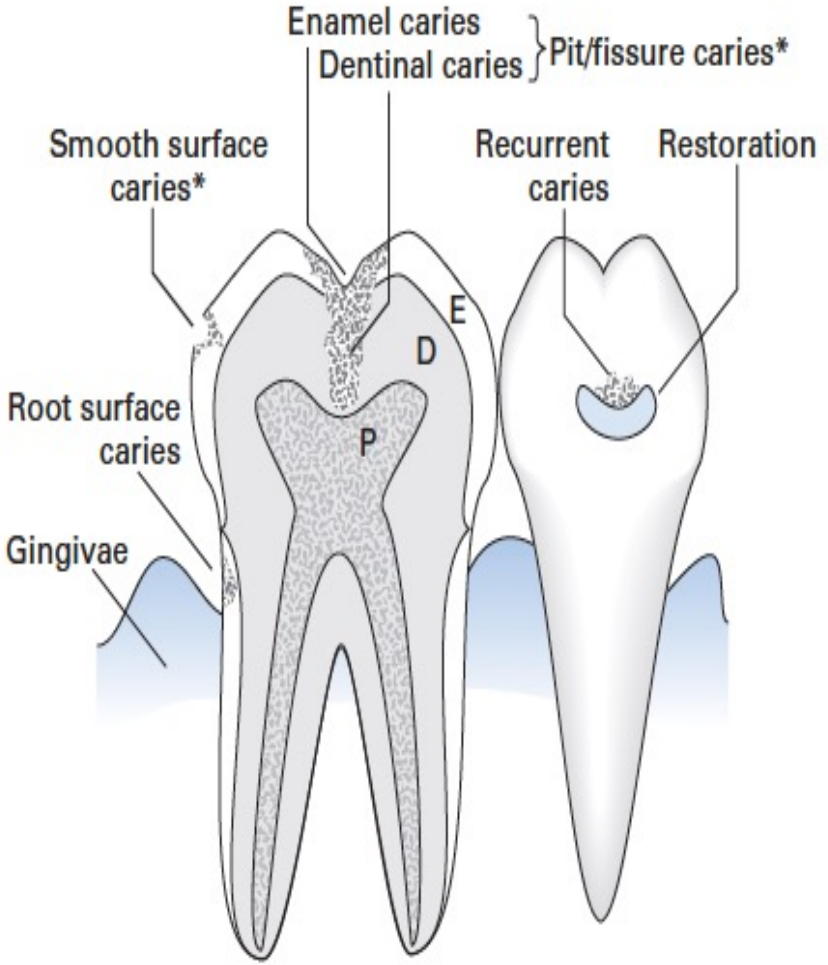
- Host factor (tooth and saliva)
- Diet
- Microorganisms



## Host factors

## 1-Tooth structure

Some areas of the same tooth are much more susceptible to carious attack than others, possibly because of difference in mineral content (especially fluoride).

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**Host factors**

**2-Flow rate and composition of saliva**

-The mechanical washing action of saliva is a very effective mechanism in the removal of food debris and unattached oral microorganisms.

- it has buffering capacity

-it acts as a delivery vehicle for fluoride.

## Diet

There is a direct relationship between dental caries and the intake of carbohydrates. The most cariogenic sugar is sucrose. Sucrose is highly soluble and diffuse easily into the dental plaque acting as a substrate for the bacteria to produce extracellular polysaccharides and acids. For example, Cariogenic streptococci produce water-unsoluble **glucan** from sucrose, which **in addition** to facilitating **initial adhesion** of the organism to the tooth surface, it serves as a **nutritional source and matrix** for farther plaque development.


- Other cariogenic carbohydrates are glucose and fructose.

**Microbiology**

Microorganisms in the form of dental plaque are a precondition for the development of dental caries.

## Dental plaque hypothesis

There two hypotheses for dental plaque and caries according to the relationship with microorganisms:

- The specific plaque hypothesis: One or more specific group of bacteria are principally involved in caries ( e.g. *mutans* streptococci group).

- Non-specific plaque hypothesis: the disease is caused by heterogenous mixture of non-specific bacteria.

## The role of *mutans* streptococci

The species *Streptococcus mutans,* with its serotypes (c, e, f and s), and *Streptococcus sobrinus,* with serotypes d and g, are the most commonly found in humans.


The evidences of their role in dental caries are:

- Correlation between mutans streptococci counts in saliva and plaque with prevalence and incidence of caries.
- production of extracellular polysaccharides from sucrose and intracellular polysaccharides as glycogen (acts as a food store for use when dietary carbohydrate is low). .
- Ability to produce and maintain microbial growth (biofilm formation) to continue acid production.
- Rapid metabolism of sugars to lactic and other organic acids.
- Ability to attain the critical PH for enamel demineralization more rapidly than other common plaque bacteria.

## The role of lactobacilli

lactobacilli has impotent role in dental caries. because of:

- Their high numbers in most carious lesions affecting enamel.
- The positive correlation between their number in plaque and saliva, and caries activity.
- Their ability to grow in low-pH environments and to produce lactic acid.
- Their ability to produce extracellular and intracellular polysaccharides.

**It is so important to mention that lactobacilli are rarely isolated from plaques before the development of caries. It is believed that they are involved more in the progression of the deep enamel lesion.**

- **The role of *Actinomyces spp.***

*Actinomyces spp.* are associated with development of root surface caries.

- **The role Veillonella**

Veillonella is gram-negative anaerobic coccus that is present in significant numbers in most supragingival plaque samples.

**Plaque metabolism and dental caries**

Oral bacteria have developed a number of regulatory mechanisms, which act at three pathways:

- 1. transport of sugar into the organisms
- 2. the glycolytic pathway.
- 3. conversion of pyruvate into metabolic end products.

## 1. transport of sugar into the organisms

The bacterial metabolism products are responsible for enamel demineralization. The process begins when dietary sugar is broken down by bacterial extracellular enzymes such as glucosyl and fructosyl transferases, with the release for glucose and fructose, respectively. These monosaccharides are then converted into polysaccharides glucans and fructans, respectively.

Glucose $\xrightarrow{\text{Glucosyl transferases}}$ Glucans

Fructose $\xrightarrow{\text{Fructosyl transferases}}$ Fructans

- Glucans are mostly used as a major bacterial food source
- Fructans contribute to the plaque matrix while facilitating the adhesion and aggregation of plaque bacteria and serving as a ready, extracellular food source.

**2. the glycolytic pathway.**

- During glycolysis, glucose is degraded immediately by bacteria via the glycolytic pathway with production of two bacterial pyruvate molecules from each molecule of glucose (Pyruvate is the conjugated base of pyruvic acid).

**3. conversion of pyruvate into metabolic end products.**

- The pyruvate can degraded farther into other chemical molecules.
- under low sugar condition, pyruvate is converted into ethanol, acetate and formate.
- in high sugar level, pyruvate is converted into lactate molecules and then lactic acid.

Different species produce acids at different rate and very in their ability to survive under such conditions. the mutens streptococci bacteria reduce the plaque PH to low levels creating hostile conditions for other plaque bacteria.

## Microbiology of root surface caries

- Approximately 60% of individuals in the West aged 60 yeas or older now have root caries. This has arisen mainly because of the reduction in enamel caries and the consequential retention of teeth later into life, accompanied by gingival recession. The root soft cemental surface is highly susceptible to microbial colonization, due to its irregular and rough surfaces.

## Prevention of dental caries

The major approaches to prevention of caries are:

- **Sugar substitutes**: stopping or reducing between-meal consumption of carbohydrates or substituting non-cariogenic artificial sweeteners.

- **Fluorides**: making the tooth structure less soluble to acid attack by using fluorides rich products.

- **Sealants**: to protect susceptible areas of the tooth ( e.g. pit and fissures) that cannot easily be kept plaque-free by routine oral hygiene measures.

- **Reducing cariogenic flora by Probiotics nutrition:** replacement of cariogenic bacteria by organisms with low or no cariogenic potential.