Epidemiology of Dental Caries

Dental Caries is defined as progressive, irreversible microbial disease of multifactorial nature affecting the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic portion the tooth.

The caries process (pathogenesis): Dental plaque on the surface of the tooth consists of a bacterial film. Certain bacteria within the plaque are acidogenic that is; they produce acids when they metabolize fermentable carbohydrates. These acids can dissolve the calcium phosphate mineral of the tooth enamel or dentine in a process known as demineralization. If this process is not halted or reversed via remineralization (the redeposition of mineral via saliva) it eventually becomes a frank cavity. The critical pH value for demineralization is in the approximate range of 5.2 to 5.5. Conversely, tooth remineralization can occur if the pH of the environment adjacent to the tooth is high. Whether dental caries progresses, stops, or reverses is dependent on a balance between demineralization and remineralization.

Areas prone to dental caries

Bacterial plaque is the essential precursor of caries. Hence, sites on the tooth surface which encourage plaque retention and stagnation are particularly prone to progression of lesions. These sites are:

- Enamel in pits and fissures on occlusal surfaces of molars and premolars, buccal pits of molars, and palatal pits of maxillary incisors.
- Tooth surfaces adjacent to dentures and bridges which make cleaning more difficult, thus encouraging plaque stagnation.
- Proximal enamel smooth surfaces just cervical to the contact point.
- In patients where periodontal disease has resulted in gingival recession, caries occurs on the exposed root surface

- The enamel of the cervical margin of the tooth just coronal to the gingival margin.
- The margins of restorations, particularly those that are deficient or overhanging.

Classification of dental caries :

Various clinical classification systems for dental caries

i. According to location:

(a) Pit and fissure (b) Smooth surface (c) Root surface

ii. According to clinical appearance: (a) Incipient (b) Cavitation (c) Gross destruction **iii. According to rate of disease progression** (a) Acute (b) Chronic (c) Arrested (d) Rampant **iv. According to history**:

(a) Primary (b) Secondary or recurrent

Susceptibility of different teeth: The Hagerstown Study ranks the order of susceptibility of teeth to caries as:

1. Mandibular 1st and 2nd molars.
2. Maxillary 1st and 2nd molars.
3. Mandibular 2nd bicuspids, maxillary 1st and 2nd bicuspids, maxillary central and lateral incisors.
4. Maxillary canines and mandibular 1st bicuspids.
5. Mandibular central and lateral incisors, mandibular canines.

Factors affecting development of dental caries

-***Host Factors***

A. **Tooth** • Composition • Morphology • Position.

B. **Saliva** • Composition • Buffering capacity of saliva • Quantity.
•Viscosity of Saliva

C. **Gender**

D. **Age**

E. **Race and ethnicity**

F. **Socioeconomic status**

G. **Heredity**

H. **Emotional disturbances**

-***Agent Factors***

A. Microorganism

B. Dental plaque

- ***Environmental Factors***

A. Diet and nutrition

B. Geographic variation

C. Climate

D. Oral hygiene

E. Soil

F. Fluoride

-***Host Factors***

A. Tooth

i. **Composition**:. It was noted that surface enamel is more resistant to caries than subsurface enamel. Surface enamel is more highly mineralized and tends to accumulate greater quantities of fluoride, zinc, lead and iron than the underlying enamel. The surface dissolves at a slower rate in acids.

ii. **Morphology**: morphologic features which may predispose to the development of dental caries are the presence of deep, narrow occlusal fissure or buccal or lingual pits. These fissures trap food, bacteria and debris leading to development of caries.

iii. **Position**: Malaligned, out of position, rotated teeth are difficult to clean, favoring the accumulation of food and debris. This may predispose to the development of caries.

B. Saliva It can be considered as an environmental factor also as teeth are constantly bathed by it. This influences the process of dental caries.

i. Saliva composition: It has a critical role to play in the development of caries or its prevention. Saliva provides calcium, phosphate, proteins, lipids and antibacterial substances and buffers.

-Calcium and phosphorus: The quantity of calcium and phosphorus is inversely related to the rate of flow. Their quantities are less in case of caries active individuals.

-Ammonia: As the quantity of ammonia decreases, caries activity increases, because ammonia retards plaque formation and neutralizes acid.

-Urea: Urea gets hydrolyzed to ammonium carbonate by urease which has a neutralizing effect.

-Antibacterial properties of saliva: Salivary antibacterial substances or enzymes are 1. Lactoperoxidase 2. Lysozyme 3. Lactoferrin 4. IgA **ii. Buffering and neutralization**: Saliva buffering can reverse the low pH in plaque. The pH will vary mainly according to the bicarbonate content of the saliva. Other salivary components contributing to the ability of saliva to neutralize acid are salivary phosphate, salivary proteins, ammonia, urea and statherin. Saliva is alkaline and is an effective buffer system. These properties protect the oral tissues against acids and plaque. After eating a sugary food if saliva is stimulated by chewing substances such as wax or sugar free chewing

gum, the drop in pH in plaque which would have occurred is reduced or even eliminated. This salivary neutralization and buffering effect markedly reduces the cariogenic potential of foods. As the flow rate of saliva increases, the pH also increases. Saliva may be slightly acidic as it is secreted at unstimulated flow rates but it may reach a pH of 7.8 at high flow rates.

iii. Quantity: Quantity of saliva secreted normally is 700 to 800 ml/day. reduction in salivary flow adversely affects dental caries(there is an inverse relation between salivary flow and dental caries).

iv. Viscosity of Saliva :Viscosity of saliva is mainly due to mucin content. As the viscosity of saliva increases, the caries activity also increases.

C. Gender: In young people caries has been seen to be higher in the females but some studies show no significant difference between the genders. Girls may be more prone to caries due to early eruption of teeth and hormonal changes (puberty and pregnancy).

D. Age :although present in all ages, it was believed that dental caries was disease of childhood. WHO global data bank has shown a decline in DMFT values in 12-year-old children. Root caries is seen in over 60 years age group people, mainly due to exposed root surface because of gingival recession and reduced manual dexterity (tooth brushing).

E. Race and Ethnicity: A number of studies indicate that blacks [Negroes] of comparable age and sex have a lower caries scores than Caucasians. Chinese population has shown to have a lower caries rate than corresponding white population. These differences are probably more due to environmental factors.

F. Socioeconomic Status :There is an inverse relationship between socioeconomic status and dental caries experience.

G. Heredity: Environmental factors have a greater influence than genetic factors but latter also contributes to the causation of caries.

H. Emotional Disturbances :Emotional disturbances, particularly transitory anxiety states tend to increase the incidence of dental caries.

-Agent factors:

A. Microorganisms: The mouth has a diverse resident microbial flora. The normal inhabitants become established early in life. Epidemiological studies investigated the link between oral flora and dental caries. Streptococcus mutans and Lactobacillus acidophilus (acid producing bacteria) were found to be associated with the formation of dental caries.

B. Dental Plaque: Bacterial plaque is a dense non-mineralized, highly organized mass of bacterial colonies in a gel-like intermicrobial substances. It can be supragingival(coronal to the gingival margin on the clinical crown of the tooth) and subsgingival(apical to the margin of the gingiva).

- Environmental factors:

A. **Diet and nutrition: Diet** is defined as the types and amounts of food eaten daily by an individual. Thus, diet may exert an effect on caries locally in the mouth by reacting with the enamel surface and by serving as a substrate for cariogenic microorganisms. According to acidogenic or chemoparasitic theory, dental caries occurs when acid is produced by bacteria in dental plaque when refined carbohydrates are eaten. The presence of refined carbohydrate as sugar is essential for the caries development(Total consumption of carbohydrate , frequency and form of carbohydrate) .Sucrose is the most cariogenic of all sugars. In human consumption, sucrose accounts for 60 percent of all sugars eaten. **Nutrition** is food that our bodies need to consume daily to function optimally. Epidemiological evidence shows that severe chronic malnutrition during the development of teeth can result in hypoplastic condition and later predispose to dental caries. The malnutrition itself does not produce caries without exposure to strong cariogenic challenge.

B. **Geographic Variation** It is well documented that dental caries experience has been decreasing in children in developed western countries.

C. **Climate:** Sunshine and high temperature areas seem to have lower dental caries ,UV light from sun is known to promote vitamin D productions thus tend to reduce dental caries[inverse relationship]. Whereas areas with more relative humidity and rainfall have shown increase dental caries.

D. **Oral Hygiene:** Inverse relationship has been seen between oral hygiene and dental caries. Poor oral hygiene increases the rate of dental caries.

E. **Soil:** Trace elements in soil have shown a relation with caries. An increase in dental caries is seen in areas where selenium, magnesium, cadmium, lead and silicon are present in soil, whereas molybdenum , vanadium and phosphorus are said to decrease dental caries.

F. **Fluoride:** Fluoride in water and soil decreases incidence of dental caries.

Primary Prevention of Dental Caries:

1. **Dietary control**: Eat nutritious and balanced meals and limit snacks. Avoid carbohydrates such as candy and chips, which can remain on the tooth surface.

2. **Oral hygiene:** daily plaque removal by proper brushing and flossing

3. **Xylitol:** Sucrose is a well-known cause of dental caries, and higher sucrose intake increases the risk of dental caries. Therefore, sugar substitutes have been developed to reduce caries risks. Xylitol is one of these sugar substitutes. Xylitol has a sweet flavor comparable to sugar, and it is not only non-cariogenic, but also anti-cariogenic. It keeps sucrose molecules from binding with *Mutans Streptococci*, thereby blocking its metabolism. It also reduces the adhesion ability and number of *Mutans Streptococci*.

4. **Pit and fissure sealants:** Pits and fissures are more susceptible to dental caries because the anatomy favors plaque accumulation; these areas are often too narrow for any oral hygiene measures to be effective. By filling such irregularities with flowable restorative material(**fissure sealants)**, the area becomes less morphologically susceptible .This is especially recommended in young patients with erupting teeth and adults with a high caries index.

5. **Fluoride therapy:** Fluoride prevents dental caries by inhibiting demineralization of the tooth and enhancing remineralization. The remineralized surface is resistant to acid attack. In addition, fluoride inhibits bacterial enzymes . Methods of fluoride application include water fluoridation, fluoride tooth paste, fluoride mouth rinse, dietary fluoride supplements, and professionally applied fluoride compounds such as gels and varnishes.

Common Factors Contributing to the Decline of Dental Caries in developed countries:

1. Fluoridation of water supplies
2. Use of fluoride supplements
3. Use of fluoride dentifrices
4. Availability of dental resources
5. Increased dental awareness
6. Adoption of preventive approach by the practitioner
7. Changes in diagnostic criteria
8. Decrease in sugar consumption.

Reasons for Rise in Dental Caries in underdeveloped countries:

1. Increase in sugar consumption.
2. Lack of dental resources
3. Socio economic factor
4. Lack of water fluoridation
5. Lack of preventive dental health programs