

PLAQUE

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ABSTRACT:

Dental plaque is a complex bio film consisting of bacterial aggregations that accumulates on the hard tissues (teeth and other hard surfaces such as restorations) in the oral cavity. Colonization of the plaque follows a pattern with adhesion of initial colonizers to the enamel salivary pellicle, followed by secondary colonization through inter bacterial adhesion. These steps contribute to the development of diseases such as caries and periodontal diseases.

KEY WORDS: *Supra gingival and sub gingival plaque, Bio film, Colonizers,*

Plaque adhesion and hypothesis.

INRODUCTION:

Plaque is mainly composed of microorganisms, which attaches to the hard surfaces. Taking the gingival margin as reference point, it is classified as Supra gingival and Sub gingival plaque. Plaque in contact with the gingival margin is referred to as Marginal plaque^[1,2] Material Alba is a term used to describe aggregations of bacteria and other host derived cells, but lacks the organized internal structure of plaque. It can be easily displaced with water spray. Pellicle is an organic film deposited on the tooth surface mainly derived from the saliva with few or no bacteria. A biofilm is defined as a community of microorganisms irreversibly attached to a surface, with increased resistance to host cellular and chemical responses.^[3]

History:

J. Leon Williams-1897 described dental plaque.

GV black- 1899 coined the term “gelatinous dental plaque”

Waerhaug-1950 described the importance of plaque in periodontal disease.

Loe et al- 1965 did a landmark study on plaque, saying that plaque is the main etiological agent in periodontal diseases.

W.Loesche- 1976 – Modern theories of specificity

PD Marsh- 1994 – Ecological plaque hypothesis.

Definition:

Dental plaque is defined as a specific but highly variable structural entity resulting from sequential colonization and growth of micro organisms on the surface of teeth and restoration consisting of microorganisms of various strains and species are embedded in the extra cellular matrix, composed of bacterial metabolic products and substance from serum, saliva and blood.

Who- 1978

Compositon Of Plaque:

It includes Water (80%) and Solid materials (20%). Solid materials include bacterial and nonbacterial microbes(70-80%) and Intercellular matrix (20-30%).Each milligram of wet weight of plaque consists of about 150-200 million bacteria. Organisms such as yeast, mycoplasma, viruses are also present in small numbers along with host cells such as epithelial cells, macrophages and leukocytes. Organic matter mainly consists of polysaccharide protein complex produced by plaque microorganisms. Calcium and phosphorus are the main inorganic constituents of plaque.^[4,5]

Classification Of Plaque:

Supragingival plaque - CORONAL AND MARGINAL plaque.

Subgingival plaque - TOOTH ATTACHED, UNATTACHED and EPITHELIAL ATTACHED plaque.

Supragingival plaque mainly presents with gram positive species, whereas subgingival consists of gram negative species.^[6,7]

Tooth attached plaque penetrates the cementum and Tissue attached plaque penetrates the epithelium and connective tissue.

FORMATION OF DENTAL PLAQUE:

Formation of dental plaque is formed in the sequence of four main steps

1. Formation Of An Organic Pellicle:

The first stage in pellicle formation involves adsorption of salivary proteins to apatite surfaces. The mechanism of selective adsorption includes ELECTROSTATIC FORCES between negatively charged hydroxyapatite and positively charged salivary glycoproteins. The pellicle thickness varies from 100nm at 2 hours to 500 to 1000nm^[8,9]

2. Bacterial Adherence:

During initial adherence, interactions occur mainly between specific bacteria and pellicle. They include:

BACTERIAL ATTACHMENT VIA ELECTROSTATIC INTERACTIONS,

BACTERIAL ATTACHMENT VIA HYDROPHOBIC INTERACTIONS,

BACTERIAL ATTACHMENT VIA SPECIFIC LECTIN-LIKE SUBSTANCES

A) Transport To The Surface:

Random contacts may occur:

1. Brownian motion
2. Sedimentation of microorganisms
3. Liquid flow
4. Active bacterial movement

B) Initial Adhesion:

Initial, reversible adhesion of bacterium takes place through long range and short range forces. The total interaction energy is called as TOTAL GIBBS ENERGY.

C) Attachment:

The bonding between bacteria and pellicle is mediated by specific extracellular components and complementary receptors on pellicle surface. Many bacterial species possess FIMBRIAE and FIBRILS that aid in attachment^[10]

3. COLONIZATION AND PLAQUE MATURATION:

1. The early colonizers (Streptococci and Actinomyces species) use oxygen and lower the reduction-oxidation potential of the environment.
2. Secondary colonizers do not initially colonize the tooth surfaces. They adhere to the bacteria already adherent on the tooth. This is termed as COAGGREGATION.

COAGGREGATION BRIDGES: is formed when the common partner bears two or more types of coaggregation mediators.

1. Initial bacterial community has gram positive cocci,
2. After 3 to 4 days- Filamentous forms
3. 4-9 days: more complex rod and filamentous forms
4. 7-14 days: Gram negative bacteria including VIBRIO, SPIROCHETE^[11,12]

Coaggregation are mediated by lectin like adhesion and can be inhibited by lactose and other glycosides.

Factors that include plaque maturation include: OXYGEN LEVELS, NUTRITIONAL SOURCES and INTERBACTERIAL RELATIONS.

Corn-Cob: Structure of plaque is typically complex with patterns of bacterial cells of cocci, rods, fusiform, filaments and spirochetes^[13,15]

Hedgehog Appearance: Bacterial aggregation characterized by a mass of CORNYBACTERIUM filaments with STREPTOCOCCOUS at the periphery.

Plaque Biofilm: Structure of biofilm protects the residing bacteria from environmental threats and permits trapping of nutrients. It displays a organized internal structure which allows bacteria to survive.

DEVELOPMENT OF PLAQUE AS BIOFILM, includes 5 steps:

- 1 Reversible adhesion
- 2 Colonization
- 3 Co-Adhesion
- 4 Multiplication
- 5 Detachment and Recolonization^[14,15,16,17,18]

PLAQUE HYPOTHESIS:

Specific Plaque Hypothesis: (Newman Mg, Socransky Ss 1977)

It states that, specific pathogens are responsible for the periodontal diseases. From 1880-1930, this concept was present. Treatment would be directed towards the elimination of the specific pathogen with narrow spectrum antibiotic^[19]

Non-Specific Hypothesis: (Walter Loesche 1976)

From 1930's, it stated that the entire bacterial flora in the plaque played a role in the periodontal destruction rather than any specific bacteria^[20]

Ecological Plaque Hypothesis: (Pd Marsh 1994)

The selection of pathogenic bacteria is directly coupled to the changes in the environment and any species with relevant traits can contribute to the disease progress.^[21]

Unified Theory:

According to this theory, the bacterial plaque may contribute to pathogenic potential of the subgingival flora to a greater or lesser extent. This is due to the ability to colonize and evade host defense and provoke inflammation.

Key Stone Pathogen Hypothesis (2012):

Certain microorganisms have the ability to influence their surrounding environment which is disproportionate to their relative over abundance.^[22]

Quorum Sensing:(Fuqua Et Al 1994)

It involves the regulation of the expression of specific genes through the accumulation of signalling compounds that mediate intercellular communications. It is mediated by small diffusible peptides and also a group of homoserine lactones in gram positive and negative bacteria.^[23,24,25]

PLAQUE ASSOCIATED WITH PERIODONTAL HEALTH AND DISEASE:

In periodontal health, balance is established between microorganisms in plaque and host defence mechanisms. Gram negative facultative organism have been associated with periodontal disease sites.^[26,27,28]

1. T.forsythia
2. P.intermedia
3. A.actinomycetemcomitans

PLAQUE RETENTIVE FACTORS:

1. Surface irregularities
2. Erupting teeth
3. Carious lesion
4. Restorative materials
5. Abnormal tooth position
6. Orthodontic therapy
7. Removable partial denture
8. calculus

PLAQUE CONTROL:

1. Mechanical Methods:

Toothbrushes- Ionic, Sonic,Manual,Powered
Interdental aids- Dental floss,Interdental brush, Unitufted brush^[29]

2. Chemical Methods:

Chlorhexidine gluconate^[30,31]
Povidone iodine
Delmopinol

CONCLUSION:

From the above discussion, it is clear that dental plaque should not be considered as a static ecosystem but as a dynamic one which is affected by the environment. Plaque is considered as a primary etiological factor for the development of periodontal disease and its control must be the first step in treating the disease.

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