

Dental Caries: Recent Update

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ABSTRACT

Dental caries is the second most common disease. In 1950s it reached its peak in children and young adults. Cariology science, has solved many mysteries but dental caries still remains a misunderstood phenomenon by the clinicians. This article describes about the etiological factor, pathogenesis, microbes causing dental caries and recent advances in prevention. Some of these, such as vaccines and antimicrobial varnishes, are still in the research stages, while others, such as sucrose substitutes, low-calorie sweeteners, and sugar alternates.

Keywords: *Dental caries, dental plaque, demineralization, re-mineralization, biofilm, sucrose, cariogenic, S. mutans, Lactobacilli*

INTRODUCTION

Dental caries originates from a Latin word "Caries" which stands for decay. Dental caries is a biofilm-mediated, dynamic, complex illness that results from demineralization and re-mineralization of dental hard tissues. Caries can occur in both dentitions, and can damage the tooth crown and, later the root surfaces. The pathological and protective factors influence the initiation and progression of caries. This reciprocation between the classification of individuals and groups into caries risk categories, allowing an increasing approach to care. Dental caries is a prevalent chronic infectious disease, transmissible which results from specific bacteria primarily "streptococcus mutans" that metabolize sugars to produce acid. The daily use of fluoride toothpaste is the main cause for the overall downswing of caries worldwide over recent decades.

ETIOLOGY

Dental caries is a complex illness, that depend upon varied factors principally on the presence of fermentable sugar, host factors, presence of cariogenic microorganism flora, and different associated environmental factors. Researchers have proposed numerous theories on dental caries. One of theory that has been accepted almost worldwide, but with modifications, is the 'chemo-parasitic' theory. This theory proposed by W. D. Miller in 1881[1] elucidated a combined effort of the acids (chemo) and the oral microorganisms (parasites) in tooth decalcification. Considering this theory as the backbone, J.L Williams thoughts of plaque-causing dental caries, Keyes and Fitzgerald model to elucidate the connection explain of presence of microorganism in dental plaque and incidence of dental caries. According to Louis Pasteur and Robert Koch theory, the microorganisms in the oral cavity metabolize the dietary starch and produce organic acid that dissolves tooth minerals. Miller's theory, in fact, had inadequacies within the clarification of feat of dental caries, however it became an inevitable backbone for future studies within in the discipline of cariology. They are as follows:

- Acidogenic (acid-producing) microorganism present in saliva were responsible for the decalcification of the tooth structure. On the contrary, G. V. Black and J. L. William 1898[2] states that 'dental plaque, on the tooth surface causes tooth dissolution.
- The studies of Orland *et al.* and therefore the 'Keyes and Fitzgerald revolution'[3] evidenced the robust causative relationship of bound specific microorganisms like Streptococci, Lactobacilli, and Actinomyces within the dental plaque with the incidence of caries.

On the other hand the etiology of dental caries can be described by a simple Venn's diagram, which consists of three circles and the interaction of these circles. Two circles depict diet, dental plaque, or microorganism load, and therefore the third one depicts the host. The intersection of all three circles shows caries. Recently, a fourth circle "time" has been added to the above circle, which describes the duration of the interaction. Plaque and dietary factors are mutualist upon one another in the progression of dental caries. [4] Specific microorganisms such as *Streptococcus mutans* (*S. mutans*) primarily deals with dental caries initiation, and *Lactobacilli* deals with the progression of dental caries. The substrates for these micro-organism are possible supermolecules and therefore the bacterial-generated carbohydrate reserve within the biofilm. These bacteria metabolize these substrates, and results in the formation of lactic and other acids. Lactic acid, along with host factors, lowers down the oxygen coefficient and results in dental caries. Acid generation result in the dissolution of calcified tissue in tooth and eventually into cavitation. Enamel demineralization occurs at a pH of 5.5 and below.

EPIDERMIOLOGY

According to a recent survey by Global Oral Health Data Bank, the prevalence of dental caries varies in the range of forty nine percentage to eighty three percentage. Dental caries affects almost all the age groups. Information gathered from various surveys have shown that adolescents aged 12 to 19 years had the highest number of dental caries followed by children and then adults. Infants are susceptible to "rampant caries" or "nursing bottle caries" that affects primarily one or more decayed teeth in any deciduous tooth between the period of birth and 71 months of age.[5][6]

PATHOGENESIS

Tooth becomes an ideal place for the adherence for many of species. This colonization occurs as a string of methodical adhesion, succession, and progression.[7] Organisms that are capable of adhesion adhere to the salivary pellicle on the tooth and form arena for the aggregation of other organisms that are incapable of initial adhesion. These are all external infectious agents and not endogenous / host microorganisms. For many years, either all plaque flora were collectively considered as being pathogenic (nonspecific plaque hypothesis—NSPH) or certain specific organisms were considered pathogenic (specific Plaque hypothesis—SPH[8]. a new hypothesis was proposed called the 'ecological plaque hypothesis' [9]. According to this hypothesis, pathogenicity to specific species that produce the disease only at specific sites caused by a certain change in the environment of the residential plaque flora. The ecological plaque hypothesis targets the factors that resulted in the environmental change of the plaque.

The pathogenesis is discussed in the following section as disturbances in homeostasis / physiological equilibrium. They are categorized as follows:

1. Disruption of microbial homeostasis in the 'biofilm'.
2. Disruption of mineral homeostasis that is seen between the tooth and the 'oral fluid'.

An aggregate of microorganisms in which cells adhere to each other and/or to a surface called as dental biofilm. This aggregate of cells is inside a self-produced organic matrix of polysaccharides, proteins, and DNA. There are soft tissue, teeth, saliva, and others; each of these is a separate ecological niche. Colonization is dependent upon the specific organism and microbiological niche. The saliva act as a medium for free-floating or planktonic bacteria. A closer study of plaque reveals a much more organized of plaque depicts. Various microbial species are found to occupy their respective microcosms. These channels act like a two-way transport for the nutrition and byproducts of the microbes.[10] Oral fluid encompasses the saliva and the gingival crevicular fluid.

HISTOPATHOLOGY

Histologically carious tissue consists of four different zones, where three zones are visible clinically. The outer layer consists of two zones namely the necrotic zone and contaminated zone containing microbial

biofilm, which can be seen clinically as soft mineralized tissue of the tooth. This necrotic zone consists of a very high microbial load in the range of 10 to 10 per milligram. The next zone is made of demineralization which has very few microorganisms, minimal nutrients, and anaerobic atmosphere. This zone is seen as leathery dentine. The translucent zone of firm softer dentine is the innermost zone located near the pulp

EVALUATION

The most common used method is the conventional visual-tactile method. Other techniques are radiographs where, several radiographic techniques are effective, such as intraoral periapical radiograph, bitewing radiograph for occluso-proximal caries, panorex radiography, Xerox radiography and radiovisiography, recent advances in radiographic techniques includes digital imaging, computerised image analysis, subtraction radiography, tuned aperture computerised tomography (TACT), magnetic resonance microimaging(MRMI), based on the density of sound and carious hard tooth structure and chemical methods that include the use of caries detecting dyes, and most recent techniques like the use of ultrasonic illumination ,ultrasonic imaging ,fiber optic illumination (FOTI), digital fiber optic illumination (DIFOTI) and electric caries monitor. Digital techniques include fiber-optictransillumination (FOTI), digital imaging fiber-optic transillumination (DIFOTI). Lasers method use argon laser, diode lasers, qualitative laser fluorescence (diagonodent). Various dyes are used in chemical method. Caries meter is the most recent technique where there is an increase in pore volume and porosity at the microstructure level, which increases the electrical conductance.

TREATMENT PLANNING

Treatment planning includes primary, secondary, and tertiary prevention. Primary prevention assess the risk and efforts to decrease or remove that risk. Secondary prevention refers to detecting the presence of the disease early and prevent further development of the disease. This would involve referring for intervention. Tertiary prevention refers to assuaging the consequences and the effects of the disease and lies primarily rehabilitating the damaged tooth.[11]

PREVENTION

There are varies method to prevent dental caries which includes diet measures such as xylitol and sorbital as sugar substitutes. Xylitol reduces plaque formation and increases concentration of amino acid which neutralize the plaque acidity. Intake of fibrous food increase salivary flow. Other methods to improve oral hygiene are dental prophylaxis, tooth brushing and interdental cleaning. Chemical method includes uses of fluoride products such as topical fluoride, fluoride varnishes, mouth rinses, dentifrices, supplements in the form of fluoride tablets and drops, fluoridated salt. Pit and fissure sealants are used in early stage of permanent dentition with deep pits and fissures.Recent advances in pit and fissure sealants include Fluoride releasing flowable resin, Nanocomposites as pit and fissure sealant, Polyacid-Modified resin based sealants and hydrophobic and hydrophilic pit and fissure sealant. In a study done by Yan WJ et al, fluoride releasing flowable resin was used in treating early enamel caries of children and was observed fluoride releasing flowable resin was more effective than conventional sealant. Nanocomposites were excellent for penetration in deep pit and fissures. Hydrophilic pit and fissure sealant shows more retention that hydrophobic pit and fissure sealant. Other recent advances in pit and fissure sealant includeACP pit and fissure sealants (Amorphous calcium phosphate sealants) eg. Bosworth Aegis pit and fissure sealant, Etch-free light cured sealant eg. Beautifill sealant and Pen type handling of sealants eg. Ecuseal. Advanced method of caries prevention includes Caries vaccine, which have been conducted on development of an effective vaccine to dental caries, but a safe and effective vaccine is yet not marked.

MANAGEMENT

Dental caries is treated based on the extent, severity and stage of dental caries. In initial stage where re mineralization is possible, preventive treatment can be done using fluoride gel application, varnishes and pit and fissure sealant .If caries has involved hard tissues but is asymptomatic with no pulpal involvement, caries excavation and restoration with the different restorative materials is done. Now a days recent advanced

techniques are used in treating dental caries, such as Air abrasion, ozone treatment of dental caries, chemo chemical caries removal and lasers in the replacement of engine driven or rotatory instruments.[12]If the dental caries is active and involved both enamel and dentin with a close approximation to pulp, indirect pulp capping is enough. If the lesion is progressive and has involved the enamel, dentin, and pulpal tissue, root canal treatment is done, followed by extra-coronal restoration

DIFFERTIAL DIAGNOSIS

Differential diagnosis of dental caries includes dental fluorosis, developmental disorders like hypo mineralization and hypoplasia of the tooth, white spot lesion or periapical pathology, and pigmented lesion of the tooth. The early carious lesion is characterized, by altering the tooth's optical properties

PROGNOSIS

Dental caries prognosis depends on oral maintenance of patient. A lesion may be reversed with a preventive method and minor dental intervention like re mineralization if the individual reports with early signs of dental caries. If dental caries progresses to the next stage, the tooth must be filled and rebuilt. Prognosis depends on two things namely ordinary restoration or extensive restorative treatment. Prognosis is poor in extensive restorative treatment.[12]

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