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Literature Review

Microbiology and Clinical Implications of Dental Caries: A Literature Review

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Abstract

Aim: Examining the microbiological implications of recent research carried out on decayed tooth or dental cavities clinically.

Methodology: Literature available was searched using different databases (PubMed, Google Scholar, Scopus) by the keywords like dental caries, carcinogenic bacteria and oral biofilms as well as additionally standard textbooks was also searched.

Results: Bacteria in the oral cavity show growths often in the forms of planktonic and biofilm. The vast majority of research conducted earlier focused mainly on the planktonic form of bacteria. Oral biofilm is mainly produced by clustering of bacterial cells and sticking to the surface of the tooth. The Bacterial cells gets attached to debris on the surface of tooth leading to formation of pellicle and thereby grow to form a colony of microorganisms. This colony of microorganisms when left undisturbed for a week will mature into sort of biofilm. The metabolism of biofilms leads to formation of different acids, which results in changes in the PH of the oral cavity and also causes alteration of the chemical composition of the tooth surface. These fluctuations in the level of PH for extended duration of time causes loss of calcium and phosphate, thereby making surface of the enamel porus. The fluctuations in the equilibrium between the loss of tooth minerals and biofilm fluid to be the main causative factor of dental caries. The prevention of growth of oral bacteria, adhesion and maturation becomes more difficult in the presence of resistance to antibiotics in dental practice. Brushing and flossing regularly and limiting the intake of sucrose-rich food can play a vital role for prevention of dental caries.

Discussion and Conclusion: This review showed a strong correlation exists between dental caries and various microorganism like *S. mutans, Lactobacilli* and *Actinomyces*. The possibility of other microorganism as a causative factor for dental caries is not ruled out.

Keywords: *Caries; Oral Microbiology; Periodontitis; Acid*

Introduction

Microbiology is defined as the study of the biology of microscopic organisms like viruses, bacteria etc. Microbes plays a significant role in causing various diseases. Research in the field of microbiology will continue to be significant to meeting many of the global aspirations and challenges in various aspect of health care system [1].

Dental caries can be defined as a localised and chemical loss of the tooth structure caused by the metabolic activity of dental biofilm which covers the surface of tooth. According to data available globally shows that 2 billion people suffers from caries of permanent teeth and 520 million children suffers from caries of primary teeth. The literature shows that the prevalence of diseases of oral cavity shows an increasing tendency in lower and middle income country [2].

Dental caries can occur in any part of the tooth surface: enamel, dentine or cementum. However, most commonly occur in the sites where the dental biofilm is not well protected, which allows it to mature and grow. The prevalence pattern and severity of dental caries may vary according to age, sex, race, socio-economic status, geographical location, food habit and oral hygiene practices either in the same country or in various parts of the world [3].

Bacteria, the most dominant form of microorganisms present in the oral cavity are: *S. sanguis, S. mitis, S. mutans, S. salivarius, L. acidophilus, L. salivarius, L. casei, Staphylococcus* spp, *Eubacterium* spp, *Neisseria* spp, *Actinomyces* spp, *Peptostreptococcus* spp, *Micrococcus* spp, etc. Amongst them *Streptococcus*, *Actinomyces* spp, *L. acidophilus* are mainly present in the larger quantity in the oral cavity [4].

The normal oral flora of oral cavity is maintained by saliva and also maintain the tooth surface integrity through bacterial clearance, buffering capacity, direct antibacterial activity and remineralization. Reduction in salivary flow results in various oral health problems such as dental caries and oral infections [5].

Methodology

An electronic search of the available dental literature was carried out using different databases (PubMed, Google Scholar, Scopus). The following keywords were searched - dental caries, carcinogenic bacteria and oral biofilm as well as standard textbooks.

Results

According to available literature it is proven that human race lives with dental caries since decades, even the Palaeolithic and Mesolithic ages. There was an increase in the prevalence of dental caries sharply in 1850 due to use of sugarcane and sweetened items in the western world. *Streptococcus mutans* was isolated from a carious lesion in 1924 by James Kilian Clarke, but interest in this bacteria was initiated in late1960s when researchers began studying dental caries.

Pathogenicity of *Lactobacillus*

Lactobacillus are mostly non-pathogenic which attaches to dental plaque and starts to demineralize the enamel of tooth. They are second most common bacteria of oral flora which mainly leads to progression of caries and possess acidogenic and aciduric property but not causes initiation of caries. Additionally production of acid is one of the cariogenic properties of *Lactobacillus*. These are acid tolerance bacteria and survives below pH 4.5 [6,7].

Role and pathogenicity of *Streptococcus*

According to the researches available on dental caries till 1950, *Streptococcus mutans* got the most importance but in 1960 it was identified as the most causative agent for the formation of dental caries. As they forms biofilm on all the surface of tooth but mostly resides on the dorsum surface of the tongue. The pathogenesis of *Streptococcus mutans* is described in three steps firstly by colonization of hard surface of tooth by synthesis of large number of extra cellular polymers of glucans from the sugar sucrose, secondly it transports and metabolizes an increasing amount of carbohydrates into organic acids due to property of acidogenicity, thirdly due to property of acidurity. The survival of *Streptococcus mutans* is possible in very low pH and adverse environmental condition. *Streptococcus mutans* secretes glucosyl transferase on its cell wall which provokes the bacteria to produce glucan from sucrose which is responsible for the

aggregation of bacteria with each other and adheres to the enamel to form biofilm. *Streptococcus mutans* has the ability to modulate their environmental stress responses through quorum sensing [8].

Role and pathogenicity of *Actinomyces*

Actinomyces spp. are gram-positive facultative or strict anaerobic rod-shaped bacteria. Literature shows a significant association between dental caries and *Actinomyces* spp. *Actinomyces* spp are mostly seen in root caries. It is revealed that the association between bacteria and dental caries in a root surface using a culture-dependent approach aiming to detect the root caries pathogen. A culture-dependent approach could detect the presence or absence of the microorganism; however, it is not possible to determine whether the bacterial cells are viable or not and whether it is not feasible to determine the bacteria cells virulence factors and their contribution to caries development [8].

There is significant evidence that when tooth enamel is exposed to *Veillonella* bacteria acids for longer duration, it results in tooth decay. *Leptotrichia* gram negative anaerobic bacteria are commonly observed in human oral cavity which is also responsible for caries. *Dialister pneumosintes* anaerobic bacteria and *Bifidobacteria* also plays an important role in the pathogenesis of human dental caries and periodontitis.

Laboratory diagnosis

Streptococcus mutans and *Lactobacillus* are isolated by collection of swabs from the carious tooth and saliva. The collection of swabs must be done before prescribing any medications. The swabs collected should be identified by staining methods, culture on appropriate medium, biochemical and immunological tests. Nested PCR (polymerase chain reaction) is able to identify Streptococcus mutans more rapidly and directly in saliva [9].

Prevention of dental carries

An antibacterial treatment should be considered as part of the overall management when the patient has a significant issue of bacterial loads or metabolic dysfunction of the biofilm. Usage of chlorhexidine in mouth washes which holds antibacterial properties for cleaning of mouth. Antibiotics like penicillin, vancomycin, erythromycin and combination of amoxicillin and clavulanic acid also can be used. The local use of monoclonal antibodies is effective against the antigens of *Streptococcus mutans* which can also prevent further recolonization of the organism. The interference of bacteria can be implemented by using less virulent forms of *Streptococcus mutans* which are harmless and are highly competitive by replacing the wild types of *Streptococcus mutans* strains [10,11].

Discussion and Conclusion

This review shows that there is a stronger correlation between dental caries and various microorganism like: *S. mutans, Lactobacilli* and *Actinomyces* as well the possibility of other microorganism as a causative agent for dental caries process is not ruled out. The reduction of risk of dental caries is frequently carried out by reducing the growth or activity of *Streptococcus mutans*. The Bacterial cells get attached to debris on the tooth surface and formed pellicle wherever there are non-shedding surfaces and grows to form a microcolony. The microbial colony when left undisturbed for a week will result into formation of a mature sort of biofilms. Biofilm metabolism leads to formation of different types of acids, which causes a change in oral pH under the critical level leading to alteration of the chemical composition of the tooth surface. Fluctuations of pH for longer period of time causes loss of calcium and phosphate, which makes the surface of enamel porus. An imbalance in the equilibrium between tooth mineral loss and biofilm fluid are the main cause of dental caries. Resistance to antibiotics also makes it difficult to prevent growth of oral bacteria, adhesion, and maturation. Brushing and flossing regularly and limiting intake of sucrose-rich food plays an important rule for prevention of dental caries. Oral microbiology advances will continue to

provide a deeper knowledge of the ecological tug-of-war between the indigenous microbial flora and periodontal pathogens. It will also serve as a springboard for more targeted and preventive ways to treating dental and periodontal problems.

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