

CURRENT APPROACHES AGAINST DENTAL CARIES- A REVIEW

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Abstract: Dental caries is considered to be one of the most prevalent infectious disease in humans across all age groups because they affect 60-90% of the world's population. With the introduction of refined sugar into the modern diet and an improved understanding of the pathogenesis of dental caries, the need for novel approaches to caries prevention has become a key undertaking for addressing the caries burden in the 21st century. Here, we focus on current and prospective therapeutic approaches against dental caries, including chemical modalities such as fluoride and chlorhexidine, vaccines, antimicrobial peptides, replacement therapy, quorum sensing targets, nanoparticles and natural products. Further research is needed to develop a safe and efficacious approach against caries, or specifically *Streptococcus Mutans*, in humans.

Keywords: Dental caries, infectious disease, fluoride and chlorhexidine, vaccines, antimicrobial peptides.

I. INTRODUCTION

Oral diseases and disorders affect health and well-being throughout life. According to the Oral Health in America: A Report of the Surgeon General in 2000, dental caries is the single most common chronic childhood disease - 5 times more common than asthma and 7 times more common than hay fever^{1,2}.

Dental caries is one of the most common childhood diseases. It is estimated that over 90% of the world's population will experience dental caries at least once during their lifetime (Marchisio 2010)³. Dental caries is considered to be one of the most prevalent infectious disease in humans across all age groups because they affect 60- 90% of the world's population (Petersen 2005)⁴.

II. THERAPEUTIC APPROACHES AGAINST DENTAL CARIES

A. CHEMICAL MODALITIES - FLUORIDE, CHLORHEXIDINE

Fluoride reduces the acid tolerance of bacteria and is most effective at acidic pH values. Fluoride can prohibit glycolysis in *Streptococcus mutans* in acidic conditions. The anticaries effect of fluoride not only consists of remineralization but also inhibition of acidogenic bacteria in acidic conditions^{5,6}.

Study also reported that after treatment of mature *Strep mutans* biofilms with SDF, the bacterial count decreased to zero (Chu et al 2012) SDF contains high concentration of silver (253,870ppm) and fluoride (44,800 ppm) ions. Nano silver fluoride (NSF), is a combination of silver nanoparticles and chitosan (Santos Jr VE 2014). From previous studies, it was noted that the antibacterial activity of silver nanoparticles increases as the particle size decreases^{6,7}.

Chlorhexidine (CHX) is still the most frequently used antimicrobial for reduction of plaque for caries control due to its broad antimicrobial spectrum. However, chlorhexidine rinse has been approved for use to reduce gingivitis but not for caries prevention (Vollmer 2010)^{7,8}.

B. VACCINES

Active immunization and passive immunization against dental caries have been extensively documented in the literature. Many active immunization studies demonstrate the important anti-caries role of salivary IgA (Russell et al 1999).

Mucosal immunization with GTF could also influence the emergence of Strep mutans in young adults after dental prophylaxis. Passive immunization was tested in earlier studies using mouth rinses containing bovine milk (Filler et al 1991) or hen egg yolk IgY antibody (Hatta et al 1997) to Strep mutans. These studies led to modest short-term decreases in the numbers of indigenous strep in saliva or dental plaque^{8,9}.

C. ANTIMICROBIAL PEPTIDES

Several compounds with antimicrobial properties were isolated from secretions of living beings, and these compounds showed biological activity in small concentrations, with selectivity for both gram positive and negative bacteria. (Rocha da Silva 2012).

Lactoferrin is an iron-binding protein found in the innate immune system of mammals biological fluids. It is known to exert broad-spectrum antimicrobial activity against bacteria, fungi, protozoa and viruses^{10,11}.

More recently, the discovery of Specifically Targeted Anti-Microbial Peptides (STAMP) has led to a more targeted approach to control oral microbial pathogenesis. /A STAMP have been shown to be effective in eliminating Strep mutans from a mixed-species environment without affecting closely related non- cariogenic oral streptococci (Eckert et al 2006)¹².

D. QUORUM SENSING TARGETS

Quorum sensing (QS) is a cell density dependent communication process that respond to the inter/intra-species signals and elicit responses to show behavioral changes in the bacteria to aggressive forms^{13,14}. Bacteria communicate with each other using hormone-like molecules known as pheromones, which increase in concentration as a function of bacterial cell density (Leung et al 2015).

E. NANOPARTICLES

Nanoparticles are classified as particles with a size no greater than 100nm. Silver and copper have received the most attention in dentistry¹⁵.

Nanoparticles of amorphous calcium phosphate (NACP) showed release of calcium/phosphate ions which remineralized tooth lesions and neutralized acids¹⁶. Silver ions have the following 3 main antibacterial effects: destruction of cell wall structure; denaturation of cytoplasmic enzyme and inhibition of microbic DNA replication (Peng et al 2012).

III. CONCLUSION

Dental caries remains an infectious disease and a public health burden worldwide. Almost 95% of the world population is affected by caries at different ages. While usually not life-threatening, the development of cavities is inversely related to quality of life and overall health. (Sullivan 2011) With the introduction of refined sugar into the modern diet and an improved understanding of the pathogenesis of dental caries, the need for novel approaches to caries prevention has become is a key undertaking for addressing the caries burden in the 21st century.

Currently, the most effective measures against caries development is the use of fluoride-containing products, such as varnishes, toothpastes and silver diamine products. Individual behaviours with regard to oral hygiene and diet is also key in the

While fluoride is able to reduce the incidence and prevalence of dental caries and should remain an important component of oral health regimen, it has limited efficacy in killing cariogenic bacteria residing in dental plaque (Hamilton 1990). This could explain the persistence of dental caries within populations, despite fluoride's well documented clinical efficacy (Milgrom et al 2009, Anderson and Shi 2006).

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