

DENTAL CARIES- A WIDELY GROWING DISEASE OF TEETH

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Abstract

Dental caries called as tooth decay is basically a disease in which bacterial processes changes carbohydrate to acid. This acid then dematerializes the hard tooth structure. They are produced when demineralization amount exceeds the remineralization amount. Streptococcus mutans and Lactobacillus are the bacteria responsible for the dental caries. This article throws light on the dental caries disease, its sign and symptoms, treatment, prevention and risk factors associated with it. A review of some patents on dental caries is also provided that summarizes the recent technical advancements taken place in this area.

Keywords: Dental caries, causes, diagnosis, treatment, patents etc.

1. Introduction:

Cavities are like holes or structural damage in the teeth. Dental caries also known as tooth decay or a cavity in which bacterial processes change carbohydrate like sugar (such as sucrose, fructose, glucose etc) present in food left on the teeth to an acid that dematerializes hard tooth structure (enamel, dentin and cementum). If demineralization exceeds saliva than it can lead to tissues break down resulting in the dental caries. Two groups of bacteria are found to be generally responsible for dental caries: *Streptococcus mutans* and *Lactobacillus*. If this disease is not treated properly than it can lead to pain, tooth loss, tooth infection and in severe cases may also cause death of the patient^{1, 2, 3, 4}.

2. Incidence and Causes: After common cold, tooth decay is most common disorder. It usually occurs in children and young adults but can affect any person. It is a common cause of tooth loss in younger people. Different types of bacteria are normally present in the mouth. The bacteria convert all foods especially sugar and starch into acids. Carbohydrates increase the risk of tooth decay. Non-sticky foods are less harmful than sticky foods as they do not remain on the surface of the teeth. Bacteria, acid, food debris and saliva combine in the mouth to form a sticky substance called plaque that adheres to teeth mainly on the back molars, just above the gum

line on all teeth and also at the edges of fillings. Tartar is formed from the remineralized plaque. Plaque and tartar irritate the gums and results in gingivitis and can lead to periodontitis^{5, 6}.

Plaque begins to build up on teeth when most bacterial activity occurs. Tooth decay occurs if this plaque is not removed thoroughly and routinely. The acid in plaque dissolves the enamel surface of the tooth and creates cavities in the tooth which are usually painless until they grow very large and affect nerves or cause a tooth fracture and if they are left untreated, it may lead to a tooth abscess. Untreated tooth decay can also destroy the internal structures of the tooth (pulp) and ultimately causes the loss of the tooth^{7, 8, 9, 10}.

3. Signs and Symptoms^{11, 12, 13}: Sign and symptoms of tooth caries may include tooth pain or achy feeling, particularly after sweet, hot or cold foods and drinks, visible pits or holes in the teeth, appearance of a chalky white spot on the surface of the tooth which indicates an area of demineralization of enamel and is known as incipient decay, a brown spot on the surface of the tooth which indicates a sign of active caries, affected tooth area changes its color and become soft to the touch and may also cause bad breath and foul tastes.

4. Factors affecting dental caries:

Generally two main factors are responsible for tooth caries. They are food diet and oral hygiene. The major risk of tooth decay increases by carbohydrates (sugars and starches). Sticky foods are more harmful than non-sticky foods because they stick on to the surface of the teeth. Time of acid contact with the tooth surface also increases by frequent snacking habit. If the diet is rich in carbohydrates, the tooth caries can occur within few days of tooth erupting into the mouth. It almost takes four years for proximal caries to pass through the enamel in the permanent teeth. In cases, where oral hygiene is very poor and where the diet is very rich in carbohydrates, caries may cause cavities within months of tooth eruption^{14, 15, 16}.

5. Bacteria responsible for dental caries:

Mouth contains many types of oral bacterias but only a few specific species of bacteria like *Streptococcus mutans*, *Lactobacilli*, *Lactobacillus acidophilus*, *Actinomyces viscosus*, *Nocardia spp.*, etc are found to be responsible for dental caries^{17, 18, 19}.

6. Diagnosis:

For primary diagnosis we use a good light source, dental mirror and explorer for inspection of all visible tooth surfaces. X-rays are used to detect dental caries which is not visible like caries between the teeth. Visual and tactile inspections are used to diagnose pit and fissure caries. At times, pit and fissure caries may be difficult to detect when bacteria penetrates into the enamel and reaches the dentin part of the tooth, but then the outer surface may get remineralize. Therefore such types of caries are known as hidden caries. Hidden caries can be detected by method called as radiographs, which are used to detect and judge the extent of destruction of such caries^{20, 21, 22}.

7. Treatment:

The goal of treatment is to preserve tooth structures and prevent further destruction of the tooth^{23, 24}. Early treatment is less painful and less expensive than the treatment of extensive decay. Local anesthetics like nitrous oxide known as laughing gas, or other prescription medications may be required in some cases to relieve pain during treatment or

to relieve anxiety during treatment. A large portion of decayed material from a tooth is removed by a dental handpiece drill. If the decay in dentin reaches near the pulp then spoon is used to remove tooth decay. A dental restoration is done to return the tooth to functionality and aesthetic condition after the decay is removed^{25, 26, 27}.

Treatment of dental caries may involve cleaning, fillings, crowning, endodontic therapy etc. An amalgam is generally used as a restorative material in a tooth. A tooth structure if destroyed doesn't regenerate fully but remineralization of very small carious lesions may occur if oral hygiene is kept at optimal level.

Restorative materials like dental amalgam, composite resin, porcelain, [gold](#) etc are used as filling materials. Composite resin and porcelain matches the color of a patient's natural teeth and are thus used more frequently where aesthetics is needed but composite restorations are not as strong as dental amalgam and gold.

A crown is needed when the decay is too extensive and there is not enough tooth structure remaining to allow a restorative material to be placed within the tooth. Crowns are often made of gold, porcelain or porcelain fused to metal. This restoration appears similar to a cap and is fitted over the remainder of the natural crown of the tooth^{28, 29}.

Endodontic therapy can also be done for the restoration of a tooth which is also known as a root canal treatment. It is recommended when pulp in the tooth dies from infection by decay-causing bacteria or from trauma. During the treatment, pulp of the tooth, including the nerve and vascular tissues are removed along with decayed portions of the tooth. The canals are cleaned with files to clean and shape them and then they are filled with a rubber-like material called gutta percha and then a crown is placed. After completion of a root canal, the tooth becomes non-vital as it does not contain any living tissue^{30, 31}.

An extraction can also be done for treating dental caries if the tooth is too far destroyed from the decay process to effectively restore the tooth. Extractions are also sometimes

considered if the tooth lacks an opposing tooth or may probably cause further problems in the future. Extractions may also be preferred by patients unable or unwilling to undergo the expense or difficulties in restoring the tooth³².

8. Possible Complications^{33, 34}:

Possible complications which may arise in treatment of dental caries includes discomfort or pain in tooth, fracture in tooth, inability to bite down on tooth, tooth abscess and tooth sensitivity.

9. Prevention:

Dental caries can be prevented by use of toothbrushes to clean the teeth. The purpose of oral hygiene is to minimize any etiologic agents of disease in the mouth. The brushing and flossing removes and prevent the formation of plaque. Plaque consists mostly of bacteria and as the amount of bacterial plaque increases, the tooth becomes more vulnerable to dental caries when carbohydrates in the food are left on teeth after every meal or snack³⁵.

Dietary modification can also be done to prevent the dental caries. The frequency of sugar intake is more important than the amount of sugar consumed. In the presence of sugar and other carbohydrates, bacteria in the mouth produce acids which can demineralize enamel, dentin and cementum. The more likely dental caries are to occur if more frequently teeth are exposed to this environment³⁶.

The use of dental sealants can also be done to prevent dental caries. A sealant is a thin plastic-like coating applied to the chewing surfaces of the molars which prevents food being trapped inside pits and fissures in grooves under chewing pressure so resident plaque bacteria are made deprived of carbohydrate and thus prevents the formation of pit and fissure caries which is the most common form of dental caries. Sealants can be applied on the teeth of children shortly after the molars erupt³⁷.

10. Risk factors:

Reduced saliva leads to dental caries since the buffering capability of saliva is not sufficient enough to counterbalance the acidic environment created by certain foods.

Conditions like Sjogren's syndrome, diabetes mellitus and sarcoidosis reduces the amount of saliva produced by salivary glands and thus leads to tooth decay. Drugs such as antihistaminic drugs and antidepressant drugs can also disturb the salivary flow. The cells in salivary glands can also be damaged by radiation therapy of the head and neck which also increases the chances of dental caries formation³⁸.

The risk for caries formation also increases by use of tobacco as some brands of smokeless tobacco contain high sugar content. Tobacco can cause the gingiva to recede and as the gingiva loses attachment to the teeth, the root surface becomes more visible in the mouth and chances of root caries increases more prominently as compared to other risk factors³⁹.

Lead exposure at intrauterine and neonatal levels also promotes dental caries. Other atoms with similar electrical charge and ionic radius as of bivalent calcium like cadmium, mimic the calcium ion and their exposure may also promote tooth decay⁴⁰.

11. Some patents on dental caries:

11.1 Device for detecting dental caries:A device for detecting dental caries has an illumination device which emits radiation of a pre-determined wavelength towards a tooth. A filter accepts radiation returned by the tooth in a pre-determined spectral range. The accepted radiation is evaluated for caries detection. The illumination device has at least one light guide, by means of which the radiation can be supplied to the tooth. The illumination device emits radiation in the spectral range from 360 to 580 nm. The filter accepts the returned radiation in the spectral range above 620 nm. The device can be used in a flexible manner and enables a low level of caries to be identified⁴¹.

11.2 Method of reducing dental caries: A method for reducing dental caries is provided wherein the teeth are contacted with a hydrogenated starch hydrolysate in the presence of a sugar as contained in a chewing gum or toothpaste or powder composition⁴².

11.3 Synthetic peptide vaccines for dental caries:Synthetic peptide vaccines for dental

caries is provided wherein glucosyltransferase contain at least one peptide corresponding to the sequence of glucosyltransferase containing aspartate 413, aspartate 451, aspartate 562, aspartate 567, histidine 561, tryptophan 491, glutamate 489, arginine 449, or combinations thereof. These subunit vaccines elicit antibodies which protect an immunized mammal from dental caries. Methods of provoking an immune response to intact glucosyltransferase are also reported⁴³.

11.4 Prevention of dental caries: Prevention of dental caries is provided by contacting teeth with an edible composition containing micellar casein which has been isolated from animal milk and has been incorporated in the composition in an amount sufficient to inhibit oral colonization by *Streptococcus sobrinus*⁴⁴.

11.5 Dental apparatus and method using ozone and an aqueous medium: Dental apparatus and method for the treatment of dental caries is reported wherein it includes a source of oxidizing gas, an aqueous medium and a handpiece for delivering the gas and aqueous medium to the infected tooth. A cup attached to the handpiece is provided for receiving the gas and exposing the selected infected area of the tooth to the gas and the aqueous medium⁴⁵.

Conclusion:

Dental caries treatment not only corrects the damaged tooth but also restores the esthetics, phonetics and functions of the tooth. Proper treatment should be done to avoid any complications and to make tooth appear more natural. Every treatment should be done according to the particular patient's condition and work should be done in such a way that most portion of natural tooth is protected from damage. Hope this review will be helpful in providing some useful information related to dental caries to dental students.

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