

PRIMARY CARIES – AN OVERVIEW

Gaurav Solanki

Jodhpur National University, Jhanwar Road, Narnadi, Jodhpur-324003, (Rajasthan) India

Corresponding author*: drgauravsolanki@yahoo.com

Abstracts

Primary caries is an initial lesions produced by direct extension from an external surface. Dental caries is called as tooth decay or a cavity is a disease in which bacterial processes changes carbohydrate to acid which than dematerializes the hard tooth structure like enamel, dentin and cementum. Streptococcus mutans and Lactobacillus are the bacteria responsible for the dental caries by acid production. This article throws light on the dental caries disease, its sign and symptoms, treatment and prevention of it. A review of some patents on dental caries is also provided that summarizes the recent technical advancements taken place in this area.

Keywords: Caries, Causes, Signs and Symptoms, Treatment, Patent

1. Introduction

Cavities are like holes or structural damage in the teeth. Primary caries is an initial lesions produced by direct extension from an external surface. Dental caries also known as tooth decay or a cavity in which bacterial processes change carbohydrate present in food left on the teeth to an acid that dematerializes hard tooth structure. If demineralization exceeds saliva than it can lead to tissues break down resulting in the dental caries^{1, 2}. Two groups of bacteria are mainly found to be generally responsible for dental caries: *Streptococcus mutans* and *Lactobacillus*. Initially caries may appear as a small chalky area that may eventually develop into a large cavitation. Sometimes caries may be directly visible; however other methods of detection such as radiographs are used for less visible areas of teeth and to judge the extent of destruction. Disclosing solutions are also available that are used during tooth restoration to minimize the chance of the recurrence^{3, 4}.

2. Causes of tooth caries

Tooth decay usually occurs in children and young adults but can affect any person. It is a common cause of tooth loss in younger people. 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^{5, 6}. 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^{7, 8}. Plaque and tartar irritate the gums and results in gingivitis and can lead to periodontitis. 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. Untreated tooth decay can also destroy the internal structures of the tooth and ultimately causes the loss of the tooth^{9, 10}.

3. Signs and symptoms¹¹⁻¹⁵

A carious tooth may show signs and symptoms of tooth pain or achy feeling, mainly 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 caries¹⁶⁻¹⁹

Two main factors are responsible for tooth caries generally and 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.

5. Bacteria responsible for dental caries^{20, 21}

Mouth contains many types of oral bacteria but only a few specific species of bacteria like *Streptococcus mutans*, *Lactobacilli*, *Lactobacillus acidophilus*, *Actinomyces viscosus* and *Nocardia spp.* are found to be responsible for dental caries.

6. Diagnosis of caries^{22, 23}

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.

7. Treatment

Early treatment is less painful and less expensive than the treatment of extensive decay and goal of treatment is to preserve as much tooth structure as possible. Local anesthetics like nitrous oxide or other 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. A dental restoration is done to return the tooth to functionality and aesthetic condition after the decay is removed^{24, 25}. Ethedent, Fluoridex,

Dentagel, etc are some drugs used to treat caries. Treatment of dental caries may involve different procedures like cleaning, fillings, crowning, etc. 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^{26, 27}.

If the tooth decay is too extensive than a crown is needed for its correction. 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 or a root canal treatment can also be done for the restoration of a tooth. It is done 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^{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 may also be preferred by patients unable or unwilling to undergo the expense or difficulties in restoring the tooth³².

8. Prevention of caries

Having a good oral hygiene by use of toothbrushes to clean the teeth can prevent caries. 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. The tooth becomes more vulnerable to dental caries when carbohydrates in the food are left on teeth after every meal or snack. Dietary modification can be done to prevent the dental caries. In the presence of sugar and other carbohydrates, bacteria in the mouth produce acids which can demineralize enamel, dentin and cementum. 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 erupt^{33,34}.

9. Risk Factors³⁵

The risk for caries formation 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. 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 formation.

10. Some patents on dental caries

10.1 Synthetic peptide vaccines for dental caries: Vaccine compositions and immunogenic compositions are described which are glucosyltransferase subunit vaccines for dental caries and which contain at least one peptide which corresponds to a sequence of glucosyltransferase containing aspartate 413, an equivalent of aspartate 413, aspartate 451, an equivalent of aspartate 451, aspartate 562, and equivalent of aspartate 562, aspartate 567, an equivalent of aspartate 567, histidine 561, an equivalent of histidine 561, tryptophan 491, an equivalent of tryptophan 491, glutamate 489, an equivalent of glutamate 489, arginine 449, an equivalent of 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 described³⁶.

10.2 Agent for dissolving dental calculi and dental caries: An agent for dissolving dental calculus and/or dental caries, which comprises one or more kinds of substances selected from the group consisting of inositol phosphoric acid esters (e.g., phytic acid), polyphenols (e.g., Perilla frutescens var. crispa polyphenols), phosphoric acids, edetic acid salts, tartaric acid, malic acid, citric acid, and glycolic acid as an active ingredient. Dental calculus and/or dental caries can be conveniently dissolved in a short period of time³⁷.

10.3 Non-fluorine anti-caries safety toothpaste of double cavity tube and its process: The invention discloses a fluorine-free caries resistant safety toothpaste which comprises IgY electuary and an electuary of the common components, wherein the IgY electuary is prepared from IgY preparation, caborpl, cellulose glycollic ether, carrageenan, xanthan gum, glycerin, sorbitol, Aspartame, Saccharin Sodium, polyethylene glycol PEG600, polyethylene glycol PEG1200, hydrogenation fatty acid ester polyoxyethylene, peppermint essence, spearmint essence, wintergreen essence, fresh fruits essence, cola essence and chocolate essence³⁸.

10.4 Device for the detection of non-cavitated early dental caries lesions: The invention provides a device for detecting non-cavitated caries lesions, including a measuring electrode having an electrically conductive tip. The tip is dimensionally configured to fit within a fissure and provide electrical contact with a patient's tooth. A reference electrode is also included, the reference electrode being configured for electrical contact with the patient's body. A measuring means is also provided for determining electrical conductance between the measuring electrode and the reference electrode, wherein the device is further configured to receive a current source for providing electrical current between the measuring electrode and the reference electrode³⁹.

10.5 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 medium⁴⁰.

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.

References

1. Kidd, E.A.M. Essentials of Dental Caries. Oxford: Oxford University Press; 2005 ISBN 0198529783.
2. D. Birkhed, B. Sundin, and S Westin. Per capita consumption of sugar containing products and dental caries in Sweden from 1960 to 1985. *Comm. Dent. Oral Epid.* 1989; pp 41-43.
3. Summit, B. J, Robbins J., and Richard S. Schwartz. Fundamentals of Operative Dentistry: A Contemporary Approach. 2nd edition. Carol Stream, Illinois, Quintessence Publishing Co, Inc.; 2001. ISBN 0-86715-382-2. Forsyth conference. The first international conference on the declining incidence of dental caries. *J. Dent Res.* 1982; 61, pp 1301-1383.
4. Oral Health Topics: Anesthesia Frequently Asked Questions, hosted on the American Dental Association website. Page accessed August 16, 2006.
5. J.J. hefferenn. Proceedings: scientific consensus conference on methods for assessment of the cariogenic potential of foods, San Antonio. *J. Dent.* 1985; Re. 65.
6. M.E. Jensen and C.F. Schachtele. The acidogenic potential of reference foods and snacks at interproximal sites in the human dentition. *J. Dent. Res.* 1983; 62, (8), pp 889-892.
7. Cate, A.R. Ten. Oral Histology: development, structure, and function. 5th edition; 1998. ISBN 0-8151-2952-1.
8. Cavities/tooth decay, hosted on the Mayo Clinic website. Page accessed May 25, 2008.
9. Holloway PJ; Moore, W.J. The role of sugar in the etiology of dental caries. *J Dent;* 1983 11 (3): 189–213. doi:10.1016/0300-5712 (83) 90182-3. PMID 6358295.
10. Dental caries, from the Disease Control Priorities Project. Page accessed August 15, 2006. Ash & Nelson, Wheeler's Dental Anatomy, Physiology, and Occlusion. 8th edition. Saunders; 2003. ISBN 0-7216-9382-2.
11. FAQs about Root Canal Treatment, hosted on the American Association of Endodontists website. Page accessed August 16, 2006.
12. Fejerskov, Ole Dental Caries: The Disease and Its Clinical Management. Oxford: Blackwell Munksgaard; 2008. ISBN 1405138890.
13. Dental Caries, hosted on the University of California Los Angeles School of Dentistry website. Page accessed August 14, 2006.
14. Introduction to Dental Plaque. Hosted on the Leeds Dental Institute Website. Page accessed August 14, 2006.
15. Frequently Asked Questions, hosted on the American Dental Hygiene Association website. Page accessed August 15, 2006.
16. Health Promotion Board: Dental Caries, affiliated with the Singapore government. Page accessed August 14, 2006.
17. Oral Health Resources - Dental Caries Fact Sheet. Hosted on the Centers for Disease Control and Prevention website. Page accessed August 13, 2006
18. Dental Health, hosted on the British Nutrition Foundation website; 2004. Page accessed August 13, 2006.
19. Neville, B.W., Damm D, Allen C, Bouquot J. Oral & Maxillofacial Pathology. 2nd edition; 2002. ISBN 0-7216-9003-3.
20. The World Oral Health Report 2003: Continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme, released by the World Health Organization. (File in pdf format.) Page accessed August 15, 2006.
21. ADA Early Childhood Tooth Decay (Baby Bottle Tooth Decay). Hosted on the

- American Dental Association website. Page accessed August 14, 2006
22. Rogers, Anthony H. *Molecular Oral Microbiology* Caister Academic Press; 2008. ISBN 978-1-904455-24-0.
 23. Soames, J.V. and Southam, J.C. *Oral Pathology*, 2nd edition, chapter 2 - Dental Caries; 1993.
 24. Gerabek WE. The tooth-worm: historical aspects of a popular medical belief. *Clin Oral Investing*; 1999. 3 (1): 1-6. doi:10.1007/s007840050070. PMID 10522185
 25. <http://www.vab.com/>.
 26. Executive Summary of U.S. Surgeon General's report titled, *The Health Consequences of Smoking: A Report of the Surgeon General*, hosted on the CDC website. Page accessed January 9, 2007.
 27. Banting, D.W. *The Diagnosis of Root Caries. Presentation to the National Institute of Health Consensus Development Conference on Diagnosis and Management of Dental Caries Throughout Life*, in pdf format, hosted on the National Institute of Dental and Craniofacial Research, p. 19. Page accessed August 15, 2006.
 28. *Epidemiology of Dental Disease*, hosted on the University of Illinois at Chicago website. Page accessed January 9, 2007.
 29. Kidd, E.A.M. and Smith B. (1990). *Pickard's Manual of Operative Dentistry*, 6th Edition. Chapter 1 - Why restore teeth?
 30. Sonis, Stephen T. *Dental Secrets: Questions and Answers Reveal the Secrets to the Principles and Practice of Dentistry*. 3rd edition. Hanley & Belfus, Inc.; 2003. ISBN 1-56053-573-3.
 31. *Oral Health Topics: Anesthesia Frequently Asked Questions*, hosted on the American Dental Association website. Page accessed August 16, 2006
 32. *Aspects of Treatment of Cavities and of Caries Disease from the Disease Control Priorities Project*. Page accessed August 15, 2006.
 33. Doniger, Sheri, B. *Sealed: Dental Economics*; 2003. Page accessed August 13, 2006.
 34. <http://www.toothtalk.com/>.
 35. *A Guide to Oral Health to Prospective Mothers and their Infants*, hosted on the European Academy of Paediatric Dentistry website. Page accessed August 14, 2006.
 36. Smith, Daniel J, Taubman, Martin A inventors. Synthetic peptide vaccines for dental caries. Forsyth Dental Infirmary for Children (Boston, MA). US patent 6,827,936; 2004 Dec 7.
 37. Ono, Kazuhiro, Nagata, Yuuki, Yoshiko inventors. Agent for dissolving dental calculi and dental caries. Showa Yakuhin Kako Co. Ltd. (Tokyo, JP). US patent 7,879,315; 2011 Feb 1.
 38. Jianfen C, Jingwu Y, Nengyi Z inventors. Non-fluorine anti-caries safety toothpaste of double cavity tube and its process. Shanghai Whitecat Shareholding Co. Ltd. US patent 1,239,148; 2006 Feb 1.
 39. Kleinberg I, Confessore F, Chatterjee R inventors. Device for the detection of non-cavitated early dental caries lesions. US patent 2,011,051.
 40. Baysan, Gregory R, Irvine Weisel, Tom Mc, Pherson Roger inventors. Dental apparatus and method using ozone and an aqueous medium. CurOzone Ireland Ltd. 03 Dublin IE. US patent: 6,454,566; 2000 Nov 13.