An Overview In Diagnosis Of Dental Caries

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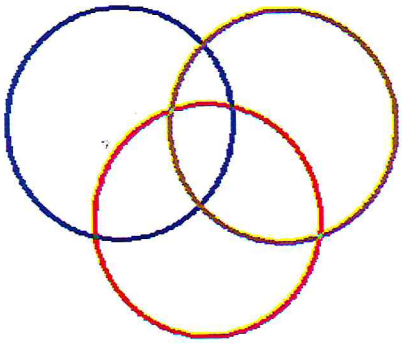
Introduction

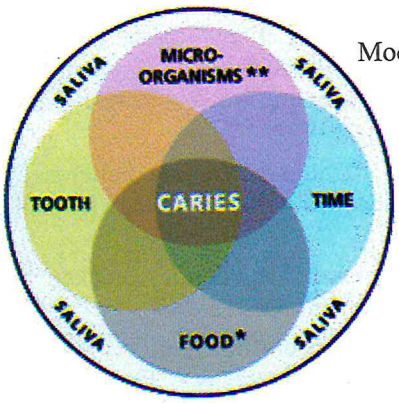
It is an infectious microbial disease of the teeth that results in localized dissolution and destruction of the calcified tissues. It is the most prevalent chronic disease affecting the human race. Once it occurs, its manifestations persist throughout life even though the lesion is treated. There are practically no geographic areas in the world whose inhabitants do not exhibit some evidence of dental caries. It affects persons of both sexes in all races, all social-economic straits and every age group. It usually begins soon after the teeth erupt in the oral cavity. Persons who never develop carious lesions are designated "caries free. No satisfactory explanation of their cario resistance has been found.

Hundreds of dental research investigators for more than centuries have studied various aspects of dental caries. Despite this extensive investigation, many aspects of etiology are still under observation and efforts at preventions have been partially successful.

Etiology Factors Of Dental Caries

Keys Diagram





Modified Keys Diagram

* Fermentable Carbohydrate
** Particularly *Strepococcus mutans*

- Micro flora: Acidogenic bacteria that colonize the tooth surface.
- Host: quantity and quality of saliva, the quality of the tooth, etc.
- Diet: intake of fermentable carbohydrates, especially sucrose, but also starch
- Time: Total exposure time to inorganic acids produced by the bacteria of the dental plaque.

Diagnosis Of Dental Caries

Methods of caries detection in vivo (clinically)

1. Visual examination
2. Tactile examination
3. Radiographs – conventional, digital and xeroradiography
4. Fibre optic transillumination
5. Optical methods – Fluorescence, light scattering
6. Electronic resistance measurements
7. Ultrasonics
8. Dyes
9. Visible luminescent spectroscopy
10. Optical caries monitor
11. Laser luminescence
12 Endoscopic methods
13. Diagnodent.

In vitro: (for research purposes)

1. Chemical analysis
2. Cross-sectional microhardness
3. Polarized light microscopy
4. Traditional transverse microradiography
5. Microphobe analysis
6. Iodine absorbitometry
7. Longitudinal microradiography
8. Surface microhardness

Visual examination:

This is called the European system of examination of diagnosing caries and requires about 10 minutes per subject.

The visual examination of caries encompasses the use of criteria such as detection of white spot, discolouration and frank cavitation. Visual examination on its own and without aids can be quite unreliable. An examiner detects caries by observing the change in translucency of enamel. This is done by observing a clean, dry and well-illuminated field.

Tactile examination:

The explorer and the floss to certain extent have been used for the tactile examination of the tooth.

The explorer can be of different varieties such as

1. Right angle probe [No.6]
2. Back action probe [No.17]
3. Shepherds crook [No.23]
4. Cow horn with curved ends [No.2]

Radiographs:

Though conventional radiographs [Bitewing and 10PA) are most frequently used for the detection of caries, they are associated with many drawbacks.

1. It presents a 2-D image of a three-dimensional object.
2. It may cause overlapping of the teeth due to faulty angulations.
3. The use of bisecting technique sometimes may also miss the initial lesion.
4. Another aspect is that net mineral loss must exceed at least 20-30% in order to be radiographically visible.

Direct digital radiography:

Currently, digital radiographic images may be obtained by video recording and digitization of a conventional film radiograph or by direct digital radiography. The first digital dental radiograph introduced in dentistry is called radiovisiography (RVG). According to Wenzel (1998), the sensitivities are relatively high for detection of occlusal lesions into dentin with a false-positive fraction to 5% to 10%.

CCD Technology:

The CCD is usually made of a chip of pure covalently bonded silicon atoms. When the chip is exposed to visible light or x-ray radiation, bonds are broken, and charged electron hole pairs are formed. The electrical charge created is captured, amplified, converted, and displayed as an image.

Storage phosphor screen technology:

This screen contains embedded phosphorus crystals that luminesce when stimulated by light at a specific wavelength. The energy released results in a latent image that is stored in the screen rather than on conventional film.

Xeroradiography:

Xeroradiography is a technique that uses modified xerographic copying techniques to record images produced by diagnostic x-rays. They have on additional feature called "edge enhancement" effect. Due to these small structures and areas of subtle density differences are made more visible. They contain uniformly charged selenium plates.

Fibre optic transillumination:

It has been designed for the detection of approximal caries. (Freidman and Marcus, 1970). The principle of transillumination is that there is a different index of light transmission for decayed and sound tooth structure. Illumination is delivered by means of fibre optics from the light source to the tooth structure. The resultant changes in light distribution as the light traverses the tooth are then recorded as an image for analysis.

The use of FOTI has been proved to be effective specially when used in the anterior region. The usage in the posterior region is associated with some difficulty. It has been thus advocated as an adjunct to visual and radiographic methods. Dyes have also been used for enhancement of visualization. Comparative studies of FOTI have led to mixed results in caries diagnosis because of high level of intra and inter-examiner variability.

Quantitative light induced fluorescence:

Light scattering is a measure of the observed whiteness of a carious lesion that can be correlated with the degree of mineral loss (Angmar-Mansson et al., 1987) and that the remaining small mineral particles in the lesion are embedded in water than in mineral-rich sound enamel. No threshold for the detection of white spot lesions using light scattering techniques has been determined, but lesions with a depth of only 25µm have been measured in vitro. The restriction of light scattering for caries diagnosis to smooth surfaces constitutes a significant drawback of this technique, although research is continuing to develop light-induced fluorescence to detect occlusal caries. (Angmar-Mansson et al., 1998).

Diagnodent:

A new method of caries detection is diagnodent introduced by KaVo, Germany in 1999, which is based on the principle of fluorescence. It enables to recognize at an early stage pathological changes that prove difficult or even impossible to detect, initial lesions, demineralization, changes affecting the tooth enamel. The incidence of fissure, approximal and residual caries can be identified. It is also useful in determining the amount of carious involvement / decalcification in different areas of the same tooth.

Manufactures selected cut-off points

Surface reading	
0-9	Sound/enamel caries
10-17	Enamel caries
18-99	Dentinal caries

Electrical conductance measurements:

The idea of an electrical method of caries detection dates back to 1878 when it is believed to have first proposed by Magitot. The theory behind the use of ERM is that sound surfaces should posses limited or no conductivity whereas carious or demineralized enamel s.hould have a measurable conductivity that will increase with increasing demineralization (Huysmans et al., 1997). At locations where the pore volume of the enamel is larger, the electrical conductance increases considerably.

When a potential of less than one volt is applied, the resistance of above 6,00,000 ohms indicates that tooth is caries free. A resistance below 2,50,000 ohms indicates that caries involving the dentin is present.

Visible luminescent spectroscopy:

The visible emission spectra and the fluorescent lifetimes for decayed and non-decayed regions of teeth differ. Quasi-monochromatic light from a tungsten source dispersed with a grating monochromator was focussed on the teeth. Although, how exactly it works is unknown, this is a non-radiological, non-invasive clinical method to detect dental caries.

Optical caries monitor:

This is an instrument, which quantifies incipient smooth surface lesions. It has been seen that in vitro lesions reflect much more light than sound enamel.

Endoscopic methods:

Endoscopic methods of caries detection are potentially sensitive diagnostic tools, which involve the use of endoscopic methods. These give a magnified image of the carious lesion to be viewed. Initial studies on the potential benefits of endoscopic examination, either with white light (VMV) or with filtered fluorescence excited by a blue curing light (VFF), have been performed by Longbottom and Pitts.

Ultrasonics:

Ultrasonics is the use of sound waves for detection and this offers considerable potential as a diagnostic instrument. Ultrasonic imaging was introduced by Ng et al. (1988) as a method for detecting early caries in smooth surfaces.

With the use of this instrumentation, sonic velocity and specific acoustic impedance can be determined for the dentin and enamel as well as for the soft tissue and bone. This method can be readily adapted to easily accessible areas but not for interproximal surfaces. Its main use, therefore, has remained invitro testing studies.

Dyes:

Dyes can facilitate caries detection and visualization. An absorbing dye can be introduced into lesions, enhancing the colour contrast between the lesions and the surrounding tooth structures. Calcein, Procion, Zyglo ZL-22, are used in the detection of enamel caries and Fuschin, Acid red system,9-aminoacrdine(disinfectant used in pulp canal treatment, less toxic and high bactericidal activity) and Povidine-Iodine detect dentinal caries.

Ultraviolet illumination:

Ultraviolet (UV) light has been used to increase the optical contrast between the carious region and the surrounding sound tissue. The natural fluorescence of tooth enamel, as seen under UV illumination, is decreased in areas of less mineral content, such as in caries lesions, artificial demineralization, or development defects (Alfano and Yao, 1981). The caries lesion appears as a dark spot against a fluorescent background.

Summary And Conclusion

The boundaries of caries diagnosis and caries intervention are changing .Dentist currently use visual, tactile and radiographic information to detect relatively advanced changes in the dental hard tissues .the clinical management of dental caries has been primarily directed at the treatment of the consequences of the disease process by placing restoration and not at curing the disease.

Using emerging technology, dentist will be able to detect incipient dental caries (demineralization) at an earlier stage than the clinically visible white spot .Dental caries is a dynamic process ,which in its early stages is reversible and even in its more advanced stages can be arrested.

The widespread use of fluorides has dramatically reduced the prevalence of dental caries and the rate of progression of the carious lesion. These changes permit dentist to adopt to more conservative management strategies directed at prevention and cure of dental caries.

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