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RESEARCH ARTICLE

RECENT ADVANCEMENTS IN DAIGNOSIS OF DENTAL CARIES: A REVIEW

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Abstract

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Introduction:-

Diagnosis is often derived from personal and cognitive experiences. Good diagnosticians use past experience, based on knowledge and diagnostic tools. To become a successful diagnostician, one must develop a number of assets. The most important of these are knowledge, interest, intuition, curiosity, and patience. The clinician must systematically gather all of the necessary information to make a “probable” diagnosis. When taking the medical and dental history, the clinician should already be formulating in his or her mind a preliminary but logical diagnosis, especially if there is a chief complaint. The clinical and radiographic examinations in combination with a thorough periodontal evaluation and clinical testing (pulp and periapical tests) are then used to confirm the preliminary diagnosis.

Recent advancements for diagnosis of dental caries.

1. Magnetic Resonance Imaging
2. Qualitative Laser Fluorescence
3. Dye Enhanced Laser Fluorescence (DELFI)
4. Laser fluorescence (LF)
5. Fiber-optic trans-illumination (FOTI)
6. Digital imaging fiber optic transillumination (DIFOTI)
7. Near-infrared digital imaging transillumination (NIDIT)
8. Ultrasound Imaging
9. CarieScan PRO
10. Orascopy or Endoscopy
11. LED fluorescence
12. Frequency-domain infrared photothermal radiometry and modulated luminescence (PTR/LUM)
13. Terahertz pulse imaging (TPI)

Magnetic Resonance Imaging

MRI combines the use of a magnetic field and some radio frequency antennas called coils. It involves the behaviour of hydrogen atoms (consisting of one proton and one electron) within a magnetic field which is used to create the

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MR image. No Ionizing Radiation: RF pulses used in MRI do not cause ionization and have no harmful effects of ionizing radiation. Hence can be used in child bearing ladies and children.

Qualitative Laser Fluorescence

This technique uses argon laser (488 nm) with a filtered blue light source. Fluorescence of tooth structure is due to the presence of chromophores within the enamel. Sound and carious enamel have differences in fluorescence due to the loss of chromophores. Carious enamel results in increase in light scattering and consequently the less fluorescence. In this technique, blue light is used to irradiate the surface of the tooth and the resultant fluorescent image is captured in a computer. QLF shows demineralization or incipient lesions as a dark spot. Caries and plaque appear red in color, indicating a bacterial presence. The images can be stored, measured and quantified in terms of shape of an area.

Dye Enhanced Laser Fluorescence (DELF)

DELF approach is based on the hypothesis that if a fluorescent dye penetrates an early carious lesion, detection of early mineral loss could be enhanced. One of the dyes used is Pyrromethene 556.

Laser fluorescence (LF) [DIAGNOdent]

LF caries detection (DIAGNOdent pen, KaVo) is based on the principle that when a red light (wavelength -655 nm) is applied to a tooth, the caries-related changes in the tooth tissues lead to an increase in fluorescence. It was suggested that these changes in fluorescence are due to protoporphyrin, a photosensitive pigment present in carious tissues as a result of bacterial metabolic activities. Clean and healthy teeth produce little or no fluorescence, while carious teeth produce fluorescence proportional to the degree of caries.

Fiber-optic trans-illumination (FOTI)

FOTI is a simple technique that uses a narrow beam white light to transilluminate the tooth. The principle of FOTI is that transillumination of areas with disrupted enamel crystals in demineralized tooth tissues results in dark shadows due to changes in the light scattering and absorption of light photons. The Sn of FOTI has been shown to vary between 0.50 and 0.85, with higher Sn values for dentin lesions than for enamel lesions.

Digital imaging fiber optic transillumination (DIFOTI)

DIFOTI is based on the same principle as FOTI, and uses visible light (wavelength range between 450 and 700 nm) to transilluminate the tooth along with a charge coupled device (CCD) camera. DIFOTI can capture real time images from the occlusal or buccal and lingual surfaces. DIFOTI was developed in an attempt to reduce the perceived shortcomings of FOTI by combining FOTI and a digital CCD camera. Images captured in camera are sent to a computer for analysis using dedicated algorithms.,

Near-infrared digital imaging transillumination (NIDIT)

This device uses a near infrared (wave length: -780 nm) light to transilluminate the tooth. The system consists of a CCD sensor to capture the images, connection to a computer, special software, and elastic arms containing a near infrared light source that transmits light through the gingiva, alveolar bone, root of the tooth, and up to the crown. The image displays from the occlusal surface.

Ultrasound Imaging

The technique is easy to perform and may show the presence, exact size, shape, content and vascular supply of endodontic lesions in the bone. The echographic probe, covered with a latex protection and topped with the echographic gel, should be moved in the buccal area of the mandible or the maxilla, corresponding to the root of the tooth of interest.

CarieScan PRO

The CarieScan PRO™ is a dental diagnostic device to use ACIST (AC Impedance Spectroscopy) technology to quantify dental caries measuring changes in tooth mineral density. This direct measurement is compared to a classification map of normal densities built up through six years of research

Orascopy or Endoscopy

Today's innovative and high-tech optical systems can deliver amazing depths-of-field and wide fields of view that enable the dentist to view a complete oral cavity in focus without having to move. The use of optical magnification

instruments such as endoscopes, oroscopes, loupes and microscopes enables the endodontist to magnify a specified treatment field beyond that perceived by the naked eye.

Endoscope

The flexible and semi-flexible endoscopes can be very valuable addition to the armamentarium. The endoscope is flexible due to special Nitinol coating. The optical part which is 0.9 mm of diameter, is a piece of equipment that enables the practitioner a magnification of up to 20X with clear picture with wide angle. A 2.7mm lens diameter, a 70° angulation, and a 3 cm long rod-lens are recommended for surgical endodontic visualization and a 4mm lens diameter, a 30° angulation, a 4 cm long rod-lens are recommended for non-surgical visualization through an occlusal access opening.

LED fluorescence

This method detects differences in the reflection and refraction of infrared energy from red light-emitting diode (LED) that is carried by a fiber optic cable to a tooth. The presence of a carious lesion will lead to changes in these properties. Another fiber optic cable serves as a photodetector that transmits the captured light to a microprocessor, which compares the signals to defined parameters.

Frequency-domain infrared photothermal radiometry and modulated luminescence (PTR/LUM)

The Canary System (Quantum Dental Technologies, Toronto, Canada) is based on photothermal radiometry and modulated luminescence technology (PTR/LUM). The manufacturer claims that this system can detect caries from 50 µm to 5 mm depth, including those under sealants and around the margins of restorations; is not affected by stains or calculus; and does not require a dry field.

Terahertz pulse imaging (TPI)

It is a relatively new imaging technique that has been demonstrated in both nonbiological [Hu and Nuss, 1995] and biological [Arnone and Ciesla, 1999] applications. The coherent detection scheme uses only micro-watts of radiation of a type that is non-ionising. Because the exposure levels from our system are orders of magnitude smaller than exposure levels that occur naturally, our system will be safer than ones employing X-rays.

Conclusion:-

It is clear from the above discussion that the differences in caries presentations and behavior in different anatomical sites make it unlikely that any one diagnostic modality will have adequate sensitivity and specificity of detection of carious lesions for all sites; a combination of diagnostic tools will help us diagnose lesions earlier and detect failing restorations sooner, all to avoid more costly, destructive dental procedures and truly take dentistry into the preventive rather than reactive mode.

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