

REVIEW ARTICLE**DIAGNOSTIC AIDS IN ENDODONTICS: A REVIEW****¹Artika Gupta, ²Bharti Kataria, ³Himanshu Sood, ⁴Kunal Sethi**^{1,2,4}Senior Lecturer, ³Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh, Punjab, India**Correspondence:**

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ABSTRACT

In the modern world, there are so many recent advances in diagnosis in conservative dentistry Endodontics. It is enhanced by newer technologies. The style of this improvement is targeted towards increasing the objectivity sensitivity and reproducibility of the pulp tests while decreasing the patient's discomfort. Methods like Pulse Oximetry, Laser Doppler Flowmetry, Ultrasound Doppler, Dual Wavelength Spectroscopy, Photoplethysmography are being developed and evolved to get adapted to the current clinical setting which may be of great use to the modern endodontist. These new methods fulfill the necessity of choosing the best tools for a good diagnosis. The aim of this review therefore was to assess the utility of some devices and techniques utilized in endodontic therapy to make the correct diagnosis

Keywords: endodontic diagnosis, recent advances, magnification**INTRODUCTION**

The principle behind diagnosis is the determination of what kind of complication the patient has and why does he have that complication. In due course of time, this will lead to what treatment, the patient requires and if it's necessary. Providing the wrong treatment intensifies the patient's symptoms thereby increasing the difficulty of arriving at a correct diagnosis¹. To put it in simple terms, diagnosis is the process by which the dentist collects the information obtained from questioning, examining and testing the patient to identify the anomalies^{2,3}.

There are several methods used by the clinician for the diagnosis of dental disease, but the most common method is conventional method which includes visual, tactile and radiographic examinations. Although, the above mentioned methods serve as an important diagnostic aids for diagnosis, but also have some limitations.⁴ To overcome these shortcomings, there have been many recent diagnostic aids have been introduced which helps in detection of diseases in its initial stage. There are many recent adjunct aids used to sharpened the image and also to improve the illumination. The human naked eyes are capable of distinguishing fine details, but there is no match for what can be accomplished by improved illumination and magnification. The microscope and other forms of magnification fulfill that need, especially to perform the endodontic procedures. Enhanced magnification and illumination improved the visualization of the intricate and complex anatomy of root canal system.⁵

DIGITAL RADIOGRAPHY

The first system that was introduced in digital radiography in dentistry was radio-visiography by Trophy in France 1987. Digital radiography is a method of reproducing a radiographic image using a technology sensor of solid-state, which are broken into electronic pieces, and presented and stored as an image using a computer

A digital image is a collection of brighter and darker areas same as that of a film based image, but the nature of the digital image is totally different from that of film.⁵ There are two advanced technologies that create digital images without an analog precursor. Direct digital images and Semi direct digital images. Direct digital images are acquired using a solid-state sensor. The solid-state sensors are based on charge coupled device (CCD) and complementary metal oxide semiconductor (CMOS) and CMOS-active pixel sensor (CMOS-APS) based chips. Semi-direct digital images are obtained using a phosphor plate system.⁶

PULSE OXIMETRY

This technique is most commonly utilised for the measurement of oxygen concentration because of its ease and availability⁷. Squire, in 1940, perceived that the changes of red and infrared light transmission caused by pneumatic tissue compression permitted saturation to be computed⁸. In 1950, Wood⁹ used this principle to compute absolute saturation continuously from the ratios of optical density differences with the ear oximeter's pressure. Takuo Aoyagi, an electrical engineer in Tokyo, realized that, to compute saturation from the ratio of ratios of pulsating changes in the red and infrared light, the pulsating variations of oxygen saturation could be used^{10,11}. Schnettler and Wallace^{12,28} in 1991 have reported a correlation between pulp and systemic oxygen saturation readings using a modified pulse oximeter ear probe on a tooth. Gopikrishna. et al,¹³⁻¹⁴ developed a custom-made Pulse Oximeter sensor holder for an existing NellcorOxiMax Dura- Y D- YS. Pulse Oximetry also utilises the haemoglobin aspects in the red and infrared light. Oxy-haemoglobin absorbs more light in the red range than deoxy-haemoglobin and vice versa in the infrared range. The devices may further be 'reflectance' type or 'transmission' type. The difference is in the type of light incident on the detector. This sensitivity test can be an ideal chair-side screening test^{15-18,29}.

DIGITAL SUBTRACTION RADIOGRAPHY (DSR)

DSR is a more advanced image analysis tool. The procedure is based on the principle that two digital radiographic images obtained under different time intervals, with the same projection geometry, are spatially and densitometrically aligned using specific software.

- Assess the healing process of periapical lesion
- Improvement in detection of dental and maxillofacial lesion
- Also used for evaluation of the progression, arrest, or regression of carious lesion.
- Helpful in temporo-mandibular joint especially with panoramics.

TUNED APERTURE COMPUTED TOMOGRAPHY

Tuned aperture computed tomography (TACT) is a simple, faster and noninvasive method for reconstructing tomographic images. Helpful in detection of radicular fracture or mandibular fracture, Assess the caries and extra canal more accurately than conventional techniques, Helpful in detection of degree of radiopacity of restorative material overlying or adjacent to it.^{19,30}

MAGNETIC RESONANCE IMAGING (MRI)

MRI is non-invasive method for the detection internal structure and certain aspects of human body. It employs radiofrequency radiation in the presence of magnetic field in order to produce high quality cross-sectional images of the body in any plane.^{20,31} it Helpful in detection of extent of carious lesions, Assess the status of pulpal tissue whether reversible

and irreversible pulpitis, For the diagnosis and evaluation of benign and malignant tumors of jaw, For the assessment of intracranial lesions involving particular posterior cranial fossa, the pituitary and spinal cord., For noninvasive evaluation of the integrity and position of articular disc within TMJ^{21,32}

ULTRASOUND IN ENDODONTIC DIAGNOSIS

It is of great convenience in conventional radiography as an imaging technique in clinical dentistry. Due to its high resolution, 3-D images of the innermost structure of the tooth can be viewed. Cotti²³ reported the differential diagnosis of periapical inflammations and cystic lesions using UltraSound imaging and they were confirmed by histopathological examinations. Rajendran and Sundaresan²² in 2007, have determined the efficiency of this tool for monitoring the reparation of periapical lesions treated by nonsurgical endodontics. UltraSound instrument has the aspect of penetrating hard tissues and can also identify anomalies and the disease condition even under existing radio-opaque restorations^{23,33}. Different biological tissues in our body possess different mechanical and acoustic properties. Henceforth, the UltraSound waves, at the interface between two tissues with different acoustic impedance, undergo the phenomena of reflection and refraction.

CONE BEAM COMPUTED TOMOGRAPHY

Cone beam computed tomography is recent technology initially developed for angiography in 1982 and subsequently applied to maxillofacial imaging. It uses divergent or cone shaped source of ionizing radiations and 2D area detector fixed on area gantry to acquire multiple sequential projection images in one complete scan.

- Helpful in detection of vertical root fractures.
- Helpful in detection of root morphology, number of root, accessory canals Detect the separated instrument into canal.
- Helpful in endodontic surgery planning and identification of root canal not seen in 2 D images.^{24,34}

DUAL WAVELENGTH SPECTROPHOTOMETRY

It is a class of studies in the field of dynamic light scattering related to the investigation of the dynamics of particles within very short time intervals. Diffusion wave spectroscopy was introduced by W.L. Butler in 1962 for the measurement of small absorption changes of highly dense biological materials in vivo.^{25,35} This method is independent of a pulsatile circulation because of the measurement of oxygenation variations in the capillary bed rather than in the supply vessels. Moreover, the presence of arterioles rather than arteries in the pulp and its hard covering by surrounding dentine and enamel make it difficult to detect a pulse in the pulp space. An in vitro study was done by Nissan et al.²⁶ for determining the utility of Dual Wavelength Spectrophotometry to identify teeth with pulpal chambers that are either hollow, filled with pulpal tissue or filled with oxygenated blood. Their studies suggested that continuous-wave spectrophotometry may be a better method for testing pulp vitality.

PHOTOPLETHYSMOGRAPHY

It is an optical measurement technique that is used for the detection of blood volume anomalies in the micro-vascular bed of tissue. Only a few opto-electronic components are required: a light source to illuminate the tissue (e.g., skin or tooth) and a photo-detector to measure the small changes in light intensity in relation with the changes in perfusion. This technique is also used to detect the circulatory anomalies in the human dental pulp. The specific wavelengths of light alone are absorbed by haemoglobin, while the remaining light passes through the tooth and is detected by a receptor. Cholesteric Liquid Crystals These

crystals have a helical structure, arranged in order along the long axis known as chiral-nematic liquid crystals. Due to their fluidity, these crystals are easily affected by temperature or pressure. Henceforth, they are thermochromic. These were studied by Howell et al.²⁷ in Lexington 1970.

CONCLUSION

These newer techniques gives more accurate and clear diagnosis about status of the dental disease. With the development of advanced system in traditional radiography three dimensional imaging technique introduced which gives a detail information about the internal structure of dental hard tissues in all the three planes. Based on scientific knowledge many more recent diagnostic modalities are under research, few of these system are in their infancy and many are based solely in laboratories, however such technologies may prove useful in future.

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