

Advancements in Dental Radiology: Overcoming Limitations of Conventional Imaging

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Abstract: *Dental radiology has long played an exciting and critical diagnostic role in dentistry. However, there are some shortcomings with the conventional radiography. They depict two dimensionally, a three-dimensional structure. It is challenging to pin point the precise relationship of the perilous anatomic structures like neurovascular bundle and the maxillary sinus with the lesion. Dental radiology is evolving with large strides to keep pace with this fast-changing world and has been explained in this review.*

Keywords: CBCT; computed tomography; diagnosis; MRI; Radiology

1. Introduction

The history of dental imaging began in the late 1800's with the development of the x - ray by Wilhelm Conrad Roentgen. [1] After few weeks of Roentgen's discovery, Antoine Henri Becquerel began to experiment with known fluorescent or phosphorescent substances. He began his experiment with uranium compound, which is highly fluorescent after exposure to the sunlight. He noted that photographic plates were darkened by the uranium salt even if they had not been first exposed to sunlight. This activity was termed as radioactivity of that particular substance. The advances in dental radiography include the following -

1) Magnetic Resonance Micro imaging in Dentistry -

Magnetic resonance Micro imaging (MRM) is a non - invasive and non - destructive technique. With this technique, high-resolution three-dimensional images can be produced similar to histologic teeth sectioning process. Both internal and external tooth morphology can be determined with this technique. [2] Medical field is rapidly exploring this micro imaging but in dentistry it is still under development. This MRM can be implemented in both 2 dimensional and 3-dimensional mode. There are few hardware advances in MRM technique such as -

- Magnets - are one of the main components of MRM in Dentistry. The progress of magnetic resonance schemes calculated for professional niche submissions has sustained. Slighter, low - field, open resistant mechanisms still find extensive claims in, for example, edgy musculoskeletal imaging.
- Gradient coils - of magnetic field still continuing to develop day by day with maximum amplitudes of 30 - 40 mT/m.
- Image processing and computers - There are remarkable growths in computing control that have to be through in mandate to advantage from the numerous system inventions already been discussed. Fast capturing plan of action can effortlessly yield multiple images per study. Imaginative systems, for calculating k - space figures, have shaped notable image quality gain and new approaches for plummeting image accession epochs.
- Sequence advances: The hardware developments have mentioned sequence advances that are previously defined and have authorize a chain of new arrangements to be

smear to clinical training in day to day life. These series, in conjugation with phase array technology, have allowed enhancements to existing analysis types as well as the prospect for MRI to be used in pioneering and thrilling zones of diagnosing imaging and spectroscopy.

- Whole body screening: Extraordinary presentation inclines related to automatic table activities enable rapid imaging casing the whole of the body. The complete portion then can be skimmed in coronal or saggital planes giving complete body view.
- Comprehensive stroke examination: Rapid diffusion - weighted imaging and T2 - weighted, gadolinium - based perfusion imaging requires high specification gradients. Fast acquisitions minimize problems with patients' motion for diffusion, images and provide good temporal resolution for dynamic, first pass perfusion studies.

2) Micro - computed tomography in preventive and restorative dental research -

Micro - CT is a device that allows 3 - d imaging on a minor scale with a precise extraordinary resolution. [3] In this technique, there is no must for trial planning or slicing. Therefore, it is likely to scrutinize the center construction of tissue and the core variation of materials to surfaces without abolishing them. Due to these benefits, micro - CT is highly suggested in dental researches for many applications. Micro - CT is an evolving, accurate, non - invasive and non - critical tactic to detect caries. This can help in early detection of caries which will further lead to early treatment and better prognosis.

3) Optical coherence tomography (OCT) -

Optical coherence tomography is a non destructive and non-invasive technique which uses light. Hence, reduces the risk of radiation exposure. That is why, this technique is considered to be significant since this technology involved enables imaging using light around 2 - 3 mm in teeth and can, for example, allow the extent and progression of carious lesions to be determined. Thus, OCT is a self diagnostic method for dental diseases and can be used in pregnant and young children. Several studies have already demonstrated the application of optical coherence tomography (OCT) to detect the severity of dental caries which is helpful for the diagnosis. [4]

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4) 3-Dimensional enhanced truncated - correlation photo thermal coherence tomography imaging

eTC - PCT can perceive synthetic caries as soon as 2 days after commencement of simulated destruction and after 45s of surface loss, with a laser power correspondent to 64% of supreme allowable acquaintance. This advancement displays inordinate latent for additional progress as a dental imaging technology merging low recognition threshold, high sensitivity to graze development, 3D renovation competence, and absence of ionizing radiation. These sorts of eTC - PCT enable early diagnosis and helps in advancement of preventive dentistry.

5) Multi photon Imaging

Dental caries is one of the common diseases which holds one of the main interests in dentistry. Teeth are usually composed of crystals which can easily be detected with the help of autofluorescence (AF). Multi photon imaging technique uses this concept to detect the dental caries. Multi photon imaging provides a powerful means of visualizing dental tissues, in both healthy and carious samples.

6) Fibre optic confocal microscopy (FOCOM) -

By via conservative confocal microscopy methods, optical slices of materials can be gained, including fiber optics into system permits movability of the examination head. FOCOM has been confirmed formerly in the department as a thrilling technique of sensing dental caries. By skimming a micro - optic subsequently the fiber depth profiles over the tooth can be logged with the parting between peaks giving the complexity of the lesion. The work is developed a first-hand detained FOCOM device for in - vivo detection but the team moved on to go beyond point detection. It is one of the most reliable methods to detect dental caries in patients. The system utilizes a common fibre for both for the source and to detect the reflected confocal signal.

7) Ultrasound

Ultrasound has been cast - off as a method for examination of materials since the flinch of the last century, and as a non - invasive medical tool since 1950s. Though, it has not once mellowed as a expertise for dental diagnosis, smooth though there have been studies approved out into this later late 1960's. By expending novel top of the series high frequency transducers, the work approved out has broken through perseverance barriers formerly noted. Demineralization of natural enamel is assessed by ultrasound pulse - echo technique. Ultrasound interferes differently with different tissues. They have a frequency of >20, 000 Hz and have all the properties of waves. An ultrasound probe is used which sends and receives longitudinal waves to and from the surface of the tooth. It is also useful in diagnosis of proximal caries. [5]

8) Spatial Frequency Domain Imaging (SFDI) -

If near infrared is directly shown onto a tooth and one images in transmission one can clearly see the internal structure of the tooth and local areas where the optical properties have been altered by caries and other sub - surface structures. All the biological tissues are made up of variety of chromophores molecule that absorbs light of specific wavelengths. Spatial frequency domain imaging is a technique to separate the effects of scattering and absorption and consequently to

approximately quantify a set of chromophores. Every digital image can be deliberated to be collected of a number of pixel lines, with every line comprising a regularity of pixel gray values. The original image spectacles also known as spatial domain. Interestingly, a digital image may be interpreted by the computer into a rate image. Inside the so-called frequency domain, the sound which is known to fit in to convince frequencies can be effortlessly be removes by definitely eradicating the exacting frequency. Filters performance so is known as high or low pass filters. After re - transcription into the spatial domain, this kind of sound will be deleted. [6]

Uses of Micro Imaging in Dentistry

One of the main advantages of using micro imaging is that it produces high contrasting images which is better for diagnosing a particular condition. Early detection of caries is possible which makes micro imaging more advantageous. Micro imaging can also be implied on other dental tissues other than dentin. These techniques can be used in anyone regardless of their age that is in adults as well as in children. In the forthcoming days, MRM can compromise a gold average in the exploration for modest, unbiased, consistent and non - invasive method of caries recognition. Because MRM is non invasive, after checkup for caries the tooth remains accessible for further investigation. Teeth examined with MRM do not writhe the sectioning artifacts that can occur during predictable histologic examination. Another advantage of micro imaging which is of greater interest is that it exhibits low amount of radiation which prevents harm to the biological tissues thus, preventing further complications.

2. Conclusion

The application of micro imaging techniques in dentistry seems to progress each year with a persistent pace and it would be nearly silly for somebody to propose what its will be and when these will be touched. We continually see alterations and developments in prevailing methods, given that boosted analytic evidence. This goes day by day with the arrival of original tenders, which have been allowed by hardware progresses connected to the new order and gaining procedures, which in shot reproduce the growth of new disparity agents. There is always a temptation to suggest that the micro imaging techniques are becoming more advances and earlier, the likelihood of condensed inspection times may affect in higher patient amounts. However, it is repeatedly more truthful to receive these progresses, while giving some aids in shorter examination times, will in the main result in the ability to make additional measurements, producing more ample and improved quantity of diagnostic information.

Conflict of interest

NIL

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