Intellectual Prophecy And extrapolative Methodology For Dental Caries In Digital Technology

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ABSTRACT
Dental caries is one of the most widespread oral Diseases, which affect 60-90% of Children. It's the foremost common chronic disease of childhood (6-12 years) that not solely interferes with speech, vanity and daily routine activities; however its pain conjointly affects traditional nutrition intake and so leads to malnutrition with abnormal psychological feature development. Dental Caries could be a disease of complex origin. There are numerous surrounding factors which have an impact on caries. The factors are age, race, ethnicity, cultural factors and diet are few of the factors that vary with different regions and different people that play a crucial role in effecting the decayed tooth. Still the present techniques like visual, tactile and radiographic method have insufficient skills in diagnosing proximal caries on early stages. The visual Examination is not applicable in class II caries at primary stages. The tactile methodology holds the potential to transmit cariogenic microorganism from one web site to a different and conjointly might turn out unrecoverable traumatic defects. The normally used ways of radiographs are a 2D image of 3D object. This techniques interpretation becomes tough. We proposed dental caries detection in Digital Caries Detection Technology and long wave IR thermo photonic imaging technology. This Latest Technology can have a high impact on dentists to diagnose incipient caries.

KEYWORDS: Digital Technology, Imaging Technology, Prevention, Limitations, Intraoral cameras, Dental Caries.

INTRODUCTION
Dental caries (cavities) commonly known as Tooth Decay. Dental caries is one of the most common oral diseases. It is not only interferes with speech, self-esteem and daily routine activities, but its pain also affects normal nutrition intake. The dental caries growths among the index age groups of 5, 12 and 15 years in India. Dental caries is a disease of multifactorial origin. There are several of environment factors which affect the dental caries status. The Most of the factors are age, race, ethnicity, cultural factors and diet. The index age group of children, according to World Health Organization (5, 12 and 15 years) presents a susceptible population for the development of dental caries[3]. The age of 12 years has been considered as the “Global monitoring age for dental caries”. Dental Caries are Progressive, its initially subsurface demineralization of teeth by bacterial acid. Dental caries are Major cause of loss of teeth[4]. This information may be helpful for the oral health care planning as basic dental caries data is lacking. Tooth Decay is affected by specific types of bacteria. Bacteria produce acid that destroys the tooth's enamel and the layer under it, the dentin. Many altered types of bacteria normally live in the human mouth. The caries formed by the various places those are Cracks, pits or grooves in the back teeth, between teeth, around dental fillings or bridgework and near the gum line. Dental Caries fixed in the very early stages can be reversed. The White spots on teeth may indicate early caries that has not yet gnarled through the enamel. Early caries may be reversed if acid damage is immobile and the
tooth is given a chance to repair itself naturally. Caries that has destroyed enamel cannot be reversed. Most caries will continue to get worse and go deeper. With time, the tooth may decay down to the root. How long this takes will vary from person to person. Caries can erode to a painful level within months or years.

Fig. 1: Dental Caries affected Teeth [17]

A. Symptoms of Tooth Caries:
Dental Caries signs and symptoms are depending on their extent and location. Sometimes, a Person not Aware the Signs and Symptoms of Dental Caries. When a cavity is just beginning, you may not have any symptoms at all. As the caries gets larger, it may cause signs and symptoms such as Tooth ache, Tooth sensitivity, Mild to harsh pain when eating or drinking something sweet, hot or cold, Brown, black or white staining on any surface of a tooth, Pain when you bite down, Visible holes or pits in your teeth.

B. Causes of Dental Caries:

C. Stages of Dental Caries: Initial Lesion:
This is the earliest stage of a decay typically thought of by a white or brown spot lesion on the surface of the teeth enamel. This grey spot is wherever demineralization has taken place at an atomic level[2]. The tooth remains exhausting to the bit and therefore the cavity isn’t nonetheless visible on dental x-rays. Routine dental examination each 0.5 years are designed to catch this precise stage of decay.

![Diagram of dental caries stages](image)

**Fig. 2: Causes of Dental Caries[20].**

<table>
<thead>
<tr>
<th>Statement</th>
<th>No</th>
<th>Don’t know</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flouride can make teeth stronger</td>
<td>98%</td>
<td>4.70%</td>
<td>94.60%*</td>
</tr>
<tr>
<td>Dental caries is preventable</td>
<td>1.60%</td>
<td>1.60%</td>
<td>96.90%*</td>
</tr>
<tr>
<td>Bacteria play a role in dental caries</td>
<td>0.00%</td>
<td>1.60%</td>
<td>98.40%*</td>
</tr>
<tr>
<td>Refined sugar causes dental caries</td>
<td>2.30%</td>
<td>4.70%</td>
<td>93.00%*</td>
</tr>
<tr>
<td>Dental caries is tooth decay</td>
<td>7.00%</td>
<td>3.90%</td>
<td>89.10%*</td>
</tr>
<tr>
<td>Dental caries is a gum disease</td>
<td>7.80%</td>
<td>15.26%</td>
<td>81.40%*</td>
</tr>
</tbody>
</table>

*Correct responses
Fig. 3: Stages of Dental Caries Development [2].

**Enamel decay:**
The acids from bacteria still break down the dental structure. They continue on till they reach the inner dentin layer of teeth. The decay is currently a cavity within the enamel and visual on x-rays. With no enamel to safeguard it, the dentin is exposed. As a result of the dentin directly links to the nervous center of the tooth (pulp), teeth at this stage of decay typically become sensitive to hot, cold, sour, and sweetness.[2] However, several patients don't experience symptoms till terribly late. Once a cavity forms the medical man cannot reverse the harm with demineralization. Instead he or she should withdraw the infected and decayed tissue and enamel and replace it with a filling.

**Dentin Decay:**
Decay currently progresses on the far side the enamel and starts to infect the dentin. This layer of your tooth, though still product of minerals, is way a lot of porous. This implies decay progresses a lot of quickly[2]. The opening within the tooth gets larger, faster. Levels of discomfort and sensitivity can intensify. The medical man will still use a filling to repair the harm, or larger cavities might need inlays or onlays, a lot of in depth restoration.

**Pulpitis and Periodontitis:**
Once decay works through the dentin it continues deeper into the tooth till it reaches the soft tissue, the pulp. This portion of the tooth is that the nerve chamber and includes the blood vessels and nerves of the tooth. Thanks to bacteria, the pulp gets infected, pus begins to create, and therefore the nerves and tissue begin to interrupt down and die. this is often a significant condition, and therefore the solely treatment possibility is RCT [2]. The medical man should go into, take away all the decayed pulp and clean out the internal organ all the method down into the basis canals of the tooth. Then the medical man disinfects the within of the tooth, fills it, and seals it off.

**Existing system:**
*Optical coherence tomography (OCT):*
Optical coherence tomography is used to monitor the mineral changes in caries and determine the depth of the lesion. Regions of high light backscattering not connected to caries growth can lead to false-positive results. Imaging of inter proximal and occlusal caries, near the beginning root caries, and for imaging decay under compound fillings.

*Polarized Raman Spectroscopy (PRS):*
Polarized Raman Spectroscopy is a non-enveloping spectroscopic method that provides details on the molecular structure of white spot lesion and there is not require for external dyes. Factors in the oral environment such as calculus, hypo calcification, and stain could lead to false-positive results. Used in conjunction with OCT for better results.

*Fibre Optic Transillumination:*
The Fiber Optic Trans illumination methods Gives instant images of the caries it’s the one of the advantages of this Method. In this method Disadvantage is intra and inters

**Comparison for different mythologies:**
### Methods and Analysis

<table>
<thead>
<tr>
<th>Methods</th>
<th>Merits</th>
<th>Demerits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital imaging fiberoptic transillumination</td>
<td>Noninvasive. Clear signals of different types frank caries. Immediate image projection.</td>
<td>Not measure the depth of the caries lesion.</td>
</tr>
<tr>
<td>Wavelength dependent</td>
<td>No radiation. More information about lesion depth.</td>
<td>Measures only in terms of wavelength.</td>
</tr>
<tr>
<td>Ultrasonic imaging</td>
<td>More sensitive</td>
<td>Does not involved quantitative method</td>
</tr>
<tr>
<td>Magnetic resonance micro imaging</td>
<td>Non destructive Provide information about site, extent and structure.</td>
<td>Expensive Only in initial developmental stages.</td>
</tr>
<tr>
<td>Electrical Resistance measurement</td>
<td>Effective for early pit and fissure caries It can also monitor the progress of caries</td>
<td>Only recognize demineralization Separate measurement is required for full mouth examination.</td>
</tr>
<tr>
<td>Qualitative laser fluorescence</td>
<td>Detecting incipient caries Monitor enamel erosion Convenient and fast</td>
<td>High cost Moderate sensitivity</td>
</tr>
<tr>
<td>Phosphor imaging system</td>
<td>Low radiation Instant imaging Image manipulation facilities</td>
<td>High cost Storage of images</td>
</tr>
<tr>
<td>Optic coherence tomography</td>
<td>High depth and transverse resolution Non invasive operation Contact free</td>
<td>Difficult to use in early stages</td>
</tr>
<tr>
<td>Diagnodent</td>
<td>Good reproducibility</td>
<td>Cannot detect secondary caries Sensitivity to the presence of stains</td>
</tr>
<tr>
<td>Computerized image analysis</td>
<td>Quantification of smaller lessons is possible</td>
<td>Time consuming and less economical</td>
</tr>
<tr>
<td>Digital radiography</td>
<td>Large amount of information</td>
<td>Require low doses and low contrast better than human eye</td>
</tr>
<tr>
<td>Xeroradiography</td>
<td>Two times more sensitive</td>
<td>The process of development cannot be delayed beyond 15 minutes</td>
</tr>
</tbody>
</table>

Server variations. This is overcome by The Midwest Caries. Calculus and hypo calcifications are major confounding factors. For detection of approximal, occlusal and smooth surface caries.

**Quantitative Light induced Fluorescence:**
Quantitative Light induced fluorescence will provide quantitative parameters like lesion space, depth, and volume. The image is often hold on for longitudinal study. It cannot differentiate between decay and hypoplasia. It’s inability to detector monitor interproximal lesions. Has restricted depth measuring. Have applications in clinical trials, research, patient education, and preventive clinical observe. Will effectively monitor demineralization and remineralisation of teeth in vitro can also be wont to live erosive potential of a spread of mouth washes in vitro. to examine early secondary cavity below the amalgam restorations.

**Laser-induced Fluorescence:**
Simple and fast to use Safe and no x-ray exposure. Tooth surfaces and fissures being assessed ought to be clean and dry. No proof gift for the detection of approximal or secondary cavity adjacent to existing restorations. The device performs best on swish surfaces and in occlusal pits and fissures.

**Transillumination with Near-Infrared light:**
Less quantity of back scattering is often simply differentiated from stains, pigmentation, and hypo mineralization. More studies over the damaging effects on the pulp required. A promising imaging technique for sleuthing the presence of cavity and measure its severity

**Near-Infrared coefficient imaging:**
The ability to map the lesion distribution instead of getting single-point measurements. Non-invasive, noncontact, and stain insensitive. A lot of studies over the damaging effects on the pulp required. For quantitative cavity diagnosing and might confirm the presence of occlusal enamel and dentin lesions.

**Infrared light:**
Non-invasive, noncontact, and stain insensitive. A lot of studies over the damaging effects on the pulp required. For quantitative cavity diagnosing.
Terahertz Pulse Imaging:
Relative transparency of human tissue to terahertz rays. Adverse thermal effects are thought to be unlikely. Care is requiring in image interpretation since terahertz waves are powerfully absorbed by water. Dental applications for this system are restricted however promising.

Multiphoton Imaging:
Able to collect info up to five hundred microns thorough. It will cause damage to tissues however it’s over return by victimization extremist short pulses. Presently the technique has been performed solely on the extracted teeth.

Proposed system:
Dental caries— tooth decay—is the most prevalent dental disease among children and adults around the world. Left too long before treatment, the disease results in difficulty eating, infection, and even tooth loss. The Dental Caries Detection Proposed methods are
   b. Longwave IR thermophotonic imaging technology.
   a) Digital Caries Detection Method:
   The Dental Caries detection is actually more difficult in early. The Existing method use of explorers and radiographs it may not catch caries in their early stages. the Existing Method devices detect caries done the use of fluorescence. That is, light emitted into a tooth is measured and the resulting measurement can determine whether caries is present and to what degree. Other systems use electrical signals to determine the presence of caries.

1. Digital Check-in:
   Digital Technology can advantage the practice the moment patients walk through the front door. Upon arriving at the repetition, a patient with an appointment can check-in at a computer or on a Mobile Phone, alerting staff that they have arrived and are ready to be seen. Automated patient check-in restructures the process, presenting the patient with the forms that he or she needs to fill out. The system can be used for new patients that have to create a new file along with their complaints and dental history. The patient can also use the Computer or Mobile phone to enter any information, including updating their medical history, entering contact information or updating insurance information. The data goes directly into the digital patient record and staff doesn’t waste time performing data entry. It makes it easier for patients to check in. They can come in, sit down, check in on a computer or tablet and run through your forms, whether it’s a new patient that has to go through all of your forms or somebody that we’re just updating a health history through Internet the data saved on cloud.

2. Intraoral Cameras and Scanners:
The intraoral camera is specifically made for dental work; even a conventional camera can be usefully easy way to help show patients what is going on with their particular cases. which are great to help diagnose caries and other pathological processes, having a good intraoral camera and knowing how to use it can really help display to your patients what it is that you’re looking at. It can really make it realistic for them. Sometimes they can’t see what you’re seeing in the mouth. Those images can also be used if you need to send claims to an insurance company. I also email cosmetic photographs to the lab for custom shade matching. CAD/CAM is seen largely as the future of dental restorations, and the CAD/CAM workflow can begin at the doctor’s office with digital impressions, captured with an intraoral scanner. You can also use it for diagnosis or scan for shifting in patients’ mouths. Some of them are dual function, where you can show the patient what their teeth are looking like as you’re working. They offer a huge number of functions.
Fig. 3: IntraOral Scanner 3D Computized outline

Three-dimensional measuring device used in dentistry and aimed at measuring in an absence of projection of active or structured light, the measuring device comprising means for capturing images; and data-processing means for said images, wherein said image-capturing means is comprised of means designed capable of permitting to capture simultaneously, or almost simultaneously, at least two images, one of which is totally or partially included in the other one, an included image describing a narrower field than that of the other one, and having a higher accuracy than that of the other one.

Table 2: Notations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>DIFOI</td>
<td>Digital imaging fiberoptic transillumination</td>
</tr>
<tr>
<td>FOTI</td>
<td>Fiberoptic Transillumination</td>
</tr>
<tr>
<td>MEMI</td>
<td>Magnetic resonance micro imaging</td>
</tr>
<tr>
<td>EFM</td>
<td>Electrical resistance measurement</td>
</tr>
<tr>
<td>PIS</td>
<td>Phosphor imaging system</td>
</tr>
<tr>
<td>OCT</td>
<td>Optical coherence tomography</td>
</tr>
<tr>
<td>EFT</td>
<td>Endoscopy fluorescence</td>
</tr>
</tbody>
</table>

3. Dual Monitoring:

The Dual Monitoring method, The Monitor should be positioned where the patient can able to see it and is used to show case information like X-rays or any other information that would help explain the patient’s condition or treatment options. In this method able to transfer a photo over from their monitor to a display monitor for their patients to use to look at while they’re in their chair.

4. Co2 lasers and Cone Beam Scanners:

The co2 lasers allow the practitioners perform the Inspection on both hard and a Soft Tissue. Co2 latest technology allows the Blood free and anesthesia-free procedures. Digital radiography is certainly an enhancement over periodicals, but some processes benefit from even more information. The Cone beam Scanners helps next level of detail for complex treatments.

B. Longwave IR thermophotonic imaging technology:

A cavity begins with a second quantity of mineral loss from the solid body substance surface, ensuing from the acidic surroundings of dental plaques [1]. If dental caries may be detected early enough, the progression may be stopped or perhaps reversed. Dentists presently place confidence in two ways to find early caries: x-ray imaging and visual examination of the tooth surface. However each of that nosology have limitations: dentists cannot see dental caries till it’s comparatively advanced, and x-rays cannot find occlusal early dental caries - those on the biting surface of the tooth. The TPLI tool uses a long-wavelength infrared camera to find the tiny quantity of thermal actinic ray emitted from tooth decay when stimulation by a light-weight supply. to check the effectiveness of this new imaging tool, the authors unnaturally evoked early demineralization on an extracted human molar by submersion it in an acid resolution for 2, 4, 6, 8, and ten days. The TPLI image taken when simply two days clearly showed the presence of a lesion, whereas a trained dentist couldn’t visually find constant lesion even when ten days of demineralization[1]. The tool has the advantages of being noncontact, noninvasive, and low-priced, and has nice potential as a commercially viable diagnostic imaging device for medical specialty.
Fig. 4: Imaging Technology

Conclusion:

The present research and new technologies have extended the dentists to identify early stages of caries. It is recommended that Digital and Imaging technology is the latest methodology in current scenario. At the present state of growth, early caries detection tools such as QLF, E-Caries monitor, DIAGNODENT and DIFOTI be supposed to be used as an addition to clinical verdict making and serve up primarily as a support tool for making defensive treatment plan decisions in conjunction with caries risk evaluation. It is important that all these apparatus be used as analytic adjuncts to aid in early caries detection and not as a validation for premature healing intervention. Further extend information and sympathetic of other Methodologies in the field of dentistry is needed. The obtainable information following conclusions can be drawn as presented in table New strategy do offer assure in the monitoring of early incipient caries, and so defensive dentistry techniques may be more suitably targeted and assessed.

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