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A REVIEW OF INNOVATIVE TECHNOLOGIES FOR THE DIAGNOSIS AND TREATMENT OF CARIES

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Abstract: This work examines modern methods of diagnosing and treating dental caries: a review of innovative technologies is provided, with examples of instrumental diagnostic methods. A comparison between them is made, considering the advantages and disadvantages of each method.
Keywords: caries, diagnosis, efficacy, laser fluorescence, optical coherence tomography, electrical impedance spectroscopy.
Objective: To conduct a comparative characterization of methods for diagnosing dental caries.

Dental caries is widely recognized as one of the most prevalent disorders globally, affecting approximately 95% of the population. The diagnosis and prevention of caries remain significant and little understood issues in contemporary dentistry. Caries is a multi-stage process, requiring a combination of risk factors and time for cavity development. During a dental visit, it is often challenging to identify the carious process or assess the risk of caries. Typically, when a patient consults a physician, they already possess carious lesions, necessitating the preparation of dental tissues and subsequent restoration. Contemporary dentists aim to optimize the maintenance of natural tooth tissues and to avert the onset of pathological processes at an early stage. Numerous objective assessments exist to ascertain a cariogenic condition (e.g., CRT test), alongside numerous techniques for caries detection (both fundamental and supplementary); nonetheless, when used in isolation, they lack substantial

informativeness and are subject to skepticism. Identifying caries more efficiently and expeditiously in the first phases of its progression continues to be a pressing issue in contemporary dentistry.

Caries is a prevalent dental pathology impacting individuals across all age groups. Contemporary techniques for diagnosing and treating caries are advancing swiftly, facilitating early identification of the illness and enabling less invasive interventions. This article examines novel diagnostic techniques, including laser fluorescence, optical coherence tomography, and electrical impedance spectroscopy. Contemporary therapeutic approaches, including enamel infiltration, laser preparation, and remineralization therapy, are also examined.

Caries is a disease condition resulting in the demineralization and loss of dental hard tissues due to microbial activity. The World Health Organization (WHO) reports that over 90% of the adult population is affected by caries. Conventional diagnostic techniques (visual inspection, radiography) and therapeutic approaches (preparation and filling) include many drawbacks, including invasiveness and the need to excise a substantial amount of dental tissue. A pertinent focus in contemporary dentistry is the advancement of novel diagnostic and treatment methodologies that reduce intervention and conserve healthy tissues.

Diagnosis is a critical component of clinical medicine; without it, formulating a diagnosis is unfeasible, hence complicating the following prescription of treatment and preventative strategies. Early diagnosis, while the patient exhibits no symptoms, is of paramount significance in the detection of caries. Defects recognized early are more easily eliminated, hence preventing the advancement of the disease process. The premature onset of dental caries, along with a lack of diagnosis, may result in an escalation in caries severity from DMFT 2.7 (2004-2006) to DMFT 3.5 (2011) across all demographic age groups. The essential answer to this issue is the examination of

contemporary diagnostic methods and their subsequent use for the early detection of caries development.

Contemporary Techniques for Caries Diagnosis

1.1. Laser Fluorescence (DIAGNOdent)

The laser fluorescence technique using the DIAGNOdent diagnostic system (KaVo, Germany) enables the identification of structural alterations in dental tissues during demineralization, primarily on the occlusal surfaces of teeth. The device's laser photodiode generates light waves at a wavelength of 655 nm (red light) with a threshold power of 1 mW directed onto the tooth surface. The organic and inorganic compounds in hard tooth tissues absorb light, resulting in reflection within the infrared spectrum region. Consequently, the gadget displays numerical numbers and emits an auditory alarm. To enhance reading accuracy, it is advisable to clean and dry the teeth before to diagnosis. Inadequate oral hygiene and excessive dental plaque may result in inaccurate readings from the device. The primary benefits of this approach are user-friendliness, lack of detrimental ionizing radiation, identification of concealed carious lesions, and detection of fissure caries. Additionally, the severity of the condition may be visually assessed using digital and auditory identification. Nevertheless, the gadget is not designed for assessing the contact surfaces of teeth, since it is sometimes difficult to push the instrument's tip into the interdental area. This considerably limits the applicability of this technology [20-22]. The Quantitative Light-induced Fluorescence (QLF) approach is an alternative for diagnosing caries. The apparatus for quantifying light-induced fluorescence relies on the diminished capacity of demineralized dental hard tissues to fluoresce. The apparatus is a mobile system for intraoral examination using an incoherent light source and a filter system in lieu of a laser source. The light-emitting device produces blue light at a wavelength of 370 nm, which is conveyed via

a fluid-filled light path. During the test, the tooth absorbs the pulsed blue light, resulting in healthy teeth emitting a green luminescence, whereas carious teeth exhibit a red glow. The picture of the fluorescing tooth is sent to the display by a video camera with a high-frequency filter. A color picture depicting the state of the patient's oral cavity is shown on the screen. The apparatus is engineered for the prompt identification of carious lesions by assessing the loss of fluorescence in demineralized areas, therefore ascertaining the location, depth, and dimensions of the carious cavity, in addition to the severity of the pathological condition. The use of novel diagnostic procedures for caries in clinical practice will inhibit the progression of the carious process in its early phases and enable treatment by non-invasive approaches, therefore maintaining the tooth's natural tissues.

Laser fluorescence is among the most precise and non-invasive techniques for caries detection. The operational idea relies on the capacity of demineralized tissues to release fluorescent light when subjected to laser treatment. The DIAGNOdent gadget facilitates the early diagnosis of carious lesions, particularly in inaccessible areas like molar fissures.

Benefits of the method:

- Elevated diagnostic precision
- Lack of radiation exposure
- Potential for observing the dynamics of the process

1.2. Optical Coherence Tomography (OCT)

This technique resembles ultrasonic examination but utilizes light waves. OCT allows the acquisition of high-resolution pictures of dental structures in real time, identifying even the slightest enamel damage.

Benefits:

- Elevated resolution

• Lack of ionizing radiation

• Potential for early lesion identification

1.3. Electrical Impedance Spectroscopy (EIS) This technique involves quantifying the electrical resistance of dental tissues. Impaired regions have modified electrical conductivity, facilitating precise detection of demineralization. Contemporary Approaches to Caries Management

2.1. Enamel Infiltration (ICON Technology) Infiltration therapy aims to treat early stages of caries without the mechanical excision of tissues. The technique utilizes a polymer substance that infiltrates the porous enamel, thereby closing the compromised region. Benefits:

• Absence of pain throughout the process

• Conservation of healthy dental tissues

• Superior cosmetic appeal

2.2. Laser Preparation

Laser technologies are progressively supplanting conventional drills. Lasers (e.g., Er:YAG) facilitate the meticulous excision of carious tissues, minimizing patient pain. Benefits of the approach:

• Absence of pain

• Minimal collateral tissue damage

• Sterilizing properties of the laser

2.3. Remineralization Therapy Utilizing formulations that include fluoride, hydroxyapatite, and calcium-phosphate compounds fortifies enamel and inhibits demineralization. Final Assessment

The use of novel diagnostic tools for caries in clinical practice will inhibit the progression of the carious process in its early phases and enable treatment using non-invasive treatments that conserve the tooth's natural tissues. The use of contemporary techniques for diagnosing and treating caries facilitates early disease identification and enables treatment with little invasiveness. Laser technology, infiltration techniques, and biomimetic materials provide novel opportunities in dentistry, facilitating efficient caries management and extending tooth longevity.

Reference :

1. Abdullayeva N. DISTANCE EDUCATION: FROM EARLY TECHNOLOGIES TO ONLINE COURSES //INTERNATIONAL CONFERENCE ON MODERN DEVELOPMENT OF PEDAGOGY AND LINGUISTICS. – 2024. – Т. 1. – №. 11. – С. 75-78.

2. Amaechi, B. T., & Higham, S. M. (2005). *Quantitative Light-induced Fluorescence (QLF): A Potential Tool for the Early Detection and Prognosis of Dental Caries*. In G. K. Stookey (Ed.), *Early Detection of Dental Caries* (pp. 121-134). Indianapolis: Indiana University School of Dentistry.

3. Bader, J. D., & Shugars, D. A. (2004). A systematic review of the performance of a laser fluorescence device for detecting caries. *Journal of the American Dental Association*, 135(10), 1413-1426.

4. Boston, D. W., & Grabowsky, S. L. (2003). The use of optical coherence tomography in dentistry. *Journal of the American Dental Association*, 134(5), 575-583.

5. Gimenez, T., Piovesan, C., Braga, M. M., Raggio, D. P., Deery, C., Ricketts, D. N., & Ekstrand, K. R. (2014). Visual inspection for caries detection: a systematic review and meta-analysis. *Journal of Dental Research*, 93(7_suppl), 70S-78S.

6. Hall, A., & Girkin, J. M. (2004). A review of potential new diagnostic modalities for caries lesions. *Journal of Dental Research*, 83(1_suppl), 89-94.

7. Hibst, R., & Gall, R. (1998). Development of a diode laser-based fluorescence caries detector. *Caries Research*, 32(4), 294.

8. Karlsson, L. (2010). Caries detection methods based on changes in optical properties between healthy and carious tissue. *International Journal of Dentistry*, 2010, 270729.

9. Lennon, A. M., Buchalla, W., Switalski, L., & Stookey, G. K. (2002). The ability of selected oral microorganisms to emit red fluorescence. *Caries Research*, 36(2), 103-108.

10. Meyer-Lueckel, H., & Paris, S. (2008). Improved resin infiltration of natural caries lesions. *Journal of Dental Research*, 87(12), 1112-1116.

11. Mendes, F. M., Novaes, T. F., & Matos, R. (2010). The performance of a laser fluorescence device for the detection of occlusal caries in primary teeth. *Caries Research*, 44(3), 258-262.

12. Paris, S., & Meyer-Lueckel, H. (2010). Masking of labial enamel white spot lesions by resin infiltration—a clinical report. *Quintessence International*, 41(5), 371-374.

13. Pitts, N. B., & Stamm, J. W. (2004). International Consensus Workshop on Caries Clinical Trials (ICW-CCT)—final consensus statements: agreeing where the evidence leads. *Journal of Dental Research*, 83(Spec Iss C), C125-C128.

14. Pretty, I. A., & Maupomé, G. (2004). A closer look at diagnosis in clinical dental practice: part 5. Emerging technologies for caries detection. *Journal of the Canadian Dental Association*, 70(8), 540-544.

15. Rocha, R. O., Ardenghi, T. M., Oliveira, L. B., Rodrigues, C. R., & Ciamponi, A. L. (2003). In vivo effectiveness of laser fluorescence compared to visual inspection and radiography for the detection of occlusal caries in primary teeth. *Caries Research*, 37(6), 437-441.

16. Shi, X. Q., & Welander, U. (2008). Optical coherence tomography: a new imaging technology for in vitro caries diagnosis. *Caries Research*, 42(5), 332-338.