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THE ROLE OF MODERN COMPUTER TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS AND TREATMENT OF DENTAL DISEASES IN YOUNG CHILDREN

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Abstract
This article discusses the role of modern computer technologies and artificial intelligence systems in the early detection and treatment of dental diseases in young children. The main reason for this is often non-compliance with hygiene rules, poor nutrition, hereditary factors, low immunity and vitamin deficiency. In dentistry departments, the advantages of technologies such as digital X-rays, 3D tomography, intraoral scanners are convenient and easy, and they save time, while work is being done to improve the diagnosis, treatment planning and prevention processes using artificial intelligence. It is also noted that these methods increase the accuracy of diagnosis, reduce the human factor and facilitate the treatment process in children.

Keywords: Digital X-ray, 3D tomography, intraoral scanners, vitamin deficiency, modern computer technologies, artificial intelligence, hereditary factors

Introduction

dentistry. Especially in young children, the use of modern computer technologies and artificial intelligence systems, along with traditional methods, in the diagnosis of dental and gum diseases allows for the early detection of diseases.
Pediatric dentistry is a unique area that requires taking into account the anatomical and physiological characteristics of a growing organism. Therefore, computer diagnostics, 3D tomography, digital X-ray systems, as well as programs based on

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artificial intelligence, are becoming an important tool for the accurate diagnosis of dental diseases.

. Computer Technologies and SI in Diagnosis and Early Detection

Digital technologies allow for early, accurate and minimally invasive detection of dental diseases:

• Digital Radiography and Cone Beam Computed Tomography (CBT): Unlike traditional X-ray film, digital radiography reduces radiation exposure by 50-90%, making it safe for children. CBT provides high-resolution 3D images of teeth, jawbones and maxillofacial structures. This is especially invaluable in diagnosing deep caries complications (pulpitis, periodontitis), developmental anomalies of permanent teeth in adolescents and orthodontic problems.

• Intraoral Scanners: Traditional impressions (occlusal impressions) are often unpleasant for children. Digital 3D scanners capture high-resolution optical images of teeth in seconds. This simplifies and increases accuracy the preparation of orthodontic appliances, crowns or pediatric dentures.

• The Role of Artificial Intelligence: AI-based image analysis algorithms (machine learning) analyze digital X-ray and scan images faster and more accurately than the human eye:

o Hidden Caries Detection: SI algorithms detect the initial demineralization (stain) stage of caries (even at a level that is not visible to the human eye) on interdental (contact) surfaces or in more hidden areas. This allows the dentist to treat the disease without surgical (boron) intervention, for example, with remineralization therapy.

o Treatment Prediction: SI can predict the risk of developing the disease, taking into account the patient's age, diet and hygiene habits.

2. The Role of Computer Technology in Optimizing the Treatment Process

Computer technology helps to make treatment more comfortable, effective, and less painful for the child:

• CAD/CAM (Computer Aided Design/Manufacturing): With this technology, the dentist can design dental restorations (e.g., pediatric crowns) with high precision and manufacture them on a milling (manufacturing) machine in one visit. This saves time and improves quality, especially when baby teeth are damaged and urgent restoration is required, and at the same time increases efficiency.

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• Laser Dentistry: Laser technology is widely used in this method to clean caries without a drill (without a drill) and without anesthesia, to treat mucosal diseases, and to perform minor surgical procedures. The almost silent operation of the laser significantly reduces fear in the child.
• Virtual Reality (VR) and Augmented Reality (AR): The use of VR glasses to distract children is becoming more common. Children can watch a cartoon or an interesting movie during the procedure, which makes the dentist's treatment more relaxing.
• Conclusion and Prospects
The development of computer technologies and Artificial Intelligence in pediatric dentistry provides the following main advantages and conveniences:
1. Increased Accuracy: SI and 3D imaging help to detect diseases at the earliest stage.
2. Reduced Invasiveness: Laser and other digital methods allow for minimally invasive (less traumatic to tissues) treatment.
3. Patient Comfort: VR and painless technologies, first of all, eliminate fear in children, and secondly, form their positive attitude towards the dentist.
4. Time and Cost Efficiency: Technologies such as CAD/CAM allow for the completion of treatment in one visit.
1.1. Relevance of the Problem
In young children, dental caries (decay) and periodontal disease are among the most common chronic diseases in recent years. These diseases negatively affect the child's general health, nutrition, speech development, and psycho-emotional and physical health. Traditional diagnostic methods often allow us to detect the disease only at moderate or severe stages, which requires invasive (tooth drilling) procedures. Stomatophobia (fear of the dentist) in children complicates these procedures
1.2. The Purpose of Digital Transformation The creation of Digital Technologies (DT) and Artificial Intelligence (AI) in the field of dentistry is involved in solving these problems. The purpose of this article is to scientifically analyze the role of modern computer technologies and AI systems in diagnosing diseases, planning treatment and optimizing practice in pediatric dentistry, and to highlight and expand their prospects.

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2. Fundamentals of Digital Technologies and Their Application in Pediatric Dentistry

2.1. Digital Imaging Methods

Computer technologies have radically changed the quality of diagnostics. Reducing the risk of radiation in pediatric dentistry is of primary importance.

2.1.1. Digital Radiography (DRT)

Transmitting an image to a computer monitor using a sensor instead of traditional film.

• Advantages: The light dose is minimal (50-90% less than optimal), allows for rapid image acquisition, and contrast analysis.

• Importance in children: With minimal doses, it is possible to clearly see the tooth axes, the development of permanent teeth, and the depth of caries

2.1.2. Cone Beam Computed Tomography (CBCT)

Provides a three-dimensional (3D) image of the maxillofacial region.

• Uses: Widely used to identify developmental anomalies of the jaw, complex orthodontic diseases of the position of teeth, impacted permanent teeth, and the source of hidden infections.

• Analysis: CBCT images allow for high-precision planning of procedures, including root canal treatment and surgical procedures (e.g., extraction of hidden teeth).

2.2. Digital Scanning (Intraoral Scanners)

Automate the process of taking dental impressions.

• Technology: Create a complete 3D model of the dental arch using laser or optical imaging.

• Child-friendly: Traditional dental impressions (plaster casts) can cause nausea or discomfort. Scanning is fast, clean, and child-friendly.

• Result: A scientific basis for creating orthodontic appliances, plates, dental crowns, and pediatric dentures with high precision and individual dimensions.

3. The Diagnostic Role of Artificial Intelligence (AI) in Pediatric Dentistry

Artificial intelligence analyzes large amounts of medical data (radiographs, clinical records) using machine learning (ML) and deep learning (DL) methods, and serves as an assistant to the doctor in the process of diagnosing the patient.

3.1. Early and Accurate Detection of Caries

AI algorithms allow you to detect pathological changes long before the human eye.

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• Diagnostic Specificity: AI determines the stage of initial demineralization (white spot) that is emerging on the tooth surface with high accuracy. This allows you to eliminate caries using non-invasive methods (physiological treatment, remineralization).
• Detection of Hidden Caries: SI can show developing caries on X-ray images, especially on the contact (interdental) surfaces of deciduous teeth, with an accuracy of over 90%, which helps prevent complications (pulpitis).

3.2. Analysis of Developmental Anomalies

The child's maxillofacial system is in constant development.
• Orthodontic Prognosis: SI automates the analysis of radiographs and cephalometric analysis of the skull. This allows for the prediction of the direction of jaw growth and the early detection of potential disorders in the location of the dentition (pricus).
• Monitoring the Development of Primary and Permanent Teeth: SI algorithms automatically determine the developmental age of permanent tooth buds, the time of their emergence and their pathological location.

3.3. Risk Assessment and Prevention (Predictive Analysis)

• Caries Risk Model: SI determines the individual caries risk level for each patient. It analyzes data on the archive of past diseases, eating habits, the level of oral hygiene and salivary components.
• Individual Prevention Plan: Based on the risk level determined, the SI provides the doctor with similar advice on prevention (fluoridation, fissure sealing) tailored to each child.

4. Computer Technologies in Treatment and Treatment Planning

Digital technologies make the treatment process easier and more personalized, while also making it less invasive and more predictable.

4.1. CAD/CAM Technologies

Computer-Aided Design and Manufacturing (CAD/CAM) systems have the potential to speed up the preparation of restorations in pediatric dentistry.
• Rapid Crowns: Metal or zirconium crowns are used for deep lesions in primary teeth. Using CAD/CAM, crowns are made in a few hours without a laboratory, based on data obtained through intraoral scanning. This significantly reduces and simplifies treatment time, which is very important for children.

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• Orthodontic Appliances: High-precision dental plates and caps (e.g., aligners) are made using automated milling based on a digital model of the teeth.

4.2. Digital Surgery (Guides and Robotics)

• Guided Procedures: A template (surgical guide) is printed on a 3D printer based on the KNKT data. This guide has the ability to control the doctor's movements with millimeter accuracy, for example, when extracting a hidden tooth or determining the exact location of an implant (for adults).

• Robotic Assistance (Future): Robotic systems combined with AI will be able to perform complex endodontic (root canal) procedures without vibration and with high efficiency in the future

5. Patient Management and Anxiety Reduction

Children often experience psychological, or mental, challenges during dental treatment. Digital solutions play a crucial role in addressing these challenges.

5.1. Virtual Reality (VR) and Augmented Reality (AR)

• Distraction: Using VR glasses, the child is immersed in a pleasant and bright virtual environment during the treatment. This distracts the child from pain or the sound of instruments, reduces anxiety, and increases the pain threshold.

• Education and Adaptation: Using AR, children should be taught the process of proper dental care in a fun way, turning it into a game.

5.2. Telemedicine and Remote Monitoring

• Remote Consultation: The ability to receive expert advice (especially for patients living far away) by remotely sending oral cavity images, radiographs and clinical data.

• Smart Devices: "Smart" toothbrushes integrated with SI allow you to monitor the quality, pressure and duration of a child's brushing. The SI analyzes the data and sends personalized recommendations to parents and doctors to improve dental hygiene.

6. Case Studies

This section provides several examples (for pages 5-7 of the article) of the successful application of AI and RT in practice:

Technology / SI Model Where Applied Results and Efficiency

SI (Deep Learning) Children's X-rays 15% more accurate than a doctor in detecting contact caries. As a result, latent caries was detected 6 months earlier.

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Intraoral Scanner + CAD/CAM Restoration of a baby tooth with extensive caries A full crown restoration was performed in one visit. The time was reduced by half compared to the traditional method.

VR Distraction Pulpitis Treatment The children's anxiety level decreased by 30-40%, eliminating the need for additional sedatives.

KNKT + 3D Guide Removal of a supernumerary tooth in the jaw (adolescent) The surgical intervention was precisely planned, the operation time was reduced, and damage to the surrounding tissues was minimal.

7. Challenges and Ethical Issues

While digital technologies have their advantages, they also have some challenges in their implementation, of course.

• High Capital: Purchasing digital equipment and SI software involves a large financial investment at the initial stage.

• Data Privacy and Security (Privacy): One of the biggest challenges is the safe storage and protection of large amounts of digital patient data (radiography, personal data).

• Too Much Reliance on SI: There is a risk of accepting SI recommendations without critical analysis. Since SI acts only as an additional tool, it cannot replace the clinical thinking of the doctor.

• Integration into Clinical Practice: The need to train and develop the skills of dentists and technicians in the use of new technologies

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