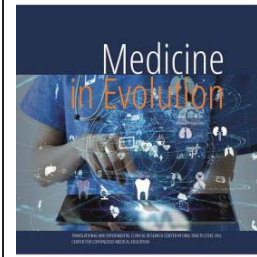


Artificial Intelligence in Paediatric Dentistry



Popa M.^{1,2}, Nikolajevic-Stoican A.N.^{1,2}, Luca M.^{1,2}, Dinu Ș.^{1,2}, Brăilă E.B.³, Dragoș B.¹, Indricean I.⁴, Matichescu A.M.⁵, Talpoș-Niculescu Ș.⁶

¹Department of Pediatric Dentistry, Faculty of Dental Medicine, "Victor Babeș" University of Medicine and Pharmacy, Timișoara

²Pediatric Dentistry Research Centre, PEDO-RESEARCH, "Victor Babeș" University of Medicine and Pharmacy, Timișoara

³Department of General Dentistry of Municipal Emergency Clinical Hospital, Timișoara

⁴Student, Faculty of Dental Medicine, "Victor Babeș" University of Medicine and Pharmacy, Timișoara

⁵Department of Preventive, Community and Oral Health Dentistry, Faculty of Dental Medicine, "Victor Babeș", University of Medicine and Pharmacy Timișoara, Translational and Experimental Clinical Research Center in Oral Health (TEXC-OH)

⁶Department of Maxillo-Facial Surgery, Faculty of Dental Medicine, "Victor Babeș" University of Medicine and Pharmacy, Timișoara

Correspondence to:

Name: Dinu Ștefania

Address: Bd. Revoluției, nr.9, Timișoara, România

Phone: +40 723224768

E-mail address: dinu.stefania@umft.ro

Abstract

Currently, new digital technologies for investigation, analysis or design and manufacturing are being implemented in more and more dental offices and clinics around the world. The purpose of this study is to show how the use of these digital technologies influences paedodontic practice, what are the advantages or disadvantages and what are the indications for their use. The motivation for choosing this research topic is that the medical act in this field requires a well-trained medical team and to increase its quality, new technologies put the premise of therapeutic procedures with a shorter duration, increased comfort and numerous other benefits.

With the help of artificial intelligence-assisted diagnostic software, dentists want to not only make it easier to read and report a large number of medical imaging investigations, but also to improve work efficiency and achieve more accurate results and the final diagnosis of various pathologies.

Keywords: artificial intelligence, DiagnoCat, software, CBCT

INTRODUCTION

In recent decades, technology has evolved a lot, bringing changes in many fields, from industry to the medical field and up to the way people communicate. An essential condition for innovation is creativity. Creativity involves taking ideas, concepts and materials from different fields to create something new and innovative. Dentistry takes from technique and engineering a series of new elements to always improve its diagnostic and treatment possibilities.

Digitization is the adoption or increase of the use of digital or computer technology by an organization, industry or country. This refers to how many areas are restructured in the context of digital communication and media infrastructure. Digitization is possible primarily due to digitization - the process of converting an analogue electrical signal into an equivalent digital one. The analogue electrical signal can have different voltage values, while the digital signal has only two distinct states zero and one [1].

Artificial intelligence (AI) is defined as the ability of a machine to mimic intelligent human behaviour to perform complex tasks, such as solving problems, recognizing objects, or making decisions. Human intelligence is the result of perception and interpretation as a biological result. Artificial intelligence cannot replace the human mind, but through multiple processes, it can arrive at interpretations and actions similar to those of the mind. AI comprises two categories:

- Machine learning - the instructions are initially processed by engineers and then learned; the program can make predictions on data that it has not analyzed before.

- Deep Learning - the relevant features are learned and arranged in categories in a single step, which makes it much more capable of processing complex data sets [2].

In medicine, IA has applications on two distinct levels, virtual and physical. It virtually analyzes data to control the health system by storing and manipulating medical documents and by guiding the doctor in the treatment decision. Nano-stomatology includes nanomaterials, bio-technology and dental nanorobotics to maintain oral health. These branches give new treatment possibilities in dentistry, orthodontics, periodontology and in oral pathology. Due to their small size, nanorobots can operate on a cellular and molecular scale [3].

In the field of clinical medicine, an increasing number of artificial intelligence models have been developed to make an automatic prediction of the risk of a particular disease, the detection of abnormalities, the diagnosis and the evaluation of the prognosis [4].

Artificial intelligence in the form of a virtual assistant can perform several tasks in the dental clinic with high accuracy and a small number of errors, for example:

- Assisting the diagnostic process and treatment planning;
- Warning the doctor before each appointment about any allergy of the patient;
- Warning in case of systemic pathologies that require additional precautions in the case of dental treatment (eg.: antibiotic prophylaxis in case of cardiovascular diseases) [5].

AI has many applications that may change Paediatric Dentistry practice in the future. Artificial intelligence that assists computer-aided design and fabrication systems for the manufacture of dental restorations will show its advantage in terms of time and aesthetics.

During mixed dentition, a neural network can predict the size of future unerupted premolars and canines, which is a great advantage in space analysis [6].

Radiology facilitates direct access to artificial intelligence in medicine due to its feature of creating digitally encoded images that can be easily transferred into computer language. Machine Learning is one of the main branches of artificial intelligence that allows a computational model to learn and make predictions by recognizing patterns. As radiologists are trained by repeatedly evaluating medical images, the main advantage of machine learning is that the designed AI model is able to improve and learn with experience by traversing large

data sets. With the help of artificial intelligence-assisted diagnostic software, radiologists want to not only make it easier to read and report a large number of medical imaging investigations, but also to improve work efficiency and achieve more accurate results, the final diagnosis of various pathologies. In the field of dental and maxillofacial radiology, pre-clinical studies have shown that AI models accurately located root canal orifices, detected vertical root fractures and proximal carious lesions [4].

In the field of Dentistry, AI, although only at the beginning, makes remarkable progress. From the initial stage of recording the patient's medical history to processing data and extracting the information needed to establish a diagnosis, artificial intelligence has many applications in dentistry and medicine. However, artificial intelligence cannot take the place of the dentist, but it is necessary to take into account this tool given the technological evolution for an improvement of daily practice [7].

Aim and objectives

The purpose of this study is to determine the contribution that an artificial intelligence software can bring to the Paediatric Dentistry field.

MATERIAL AND METHODS

Correct diagnosis is the key to success in clinical practice. In this sense, properly trained neural networks, such as DiagnoCat (Moscow, Russia), can be an advantage for diagnosis, especially in pathologies with multifactorial aetiology. The software indicates the diagnosis and the differential diagnosis in its general description. DiagnoCat's artificial intelligence analyzes the purchased CBCT in DICOM format (a standard format in medical imaging) allowing seamless data transfer. The software allows the analysis of CBCT images obtained with any CBCT units without using the conventional software installed, specific to the unit (viewer). This increases the freedom of diagnosis and decreases the dependence on software imposed by the manufacturers.

In the first stage takes place the acquisition of data obtained from CBCT in DICOM format, then the neural network finds and segments the main anatomical regions, jaws, teeth, periapical lesions. Diagnosed identifies various diseases and disorders by evaluating 50 signs (normal-looking teeth, direct coronary restoration, dental crowns, endodontically treated root canals, implants, signs of periapical lesions, etc.) and selects dedicated images to support a plan of individualized treatment.

RESULTS

The following is an example of a diagnostic analysis of a 14-year-old female patient via DiagnoCat, Figure 1. Immediately after uploading files, you get access to DiagnoCat Viewer, which automatically produces: a panoramic view extracted from CBCT of different thicknesses, a set of three-plane sections for each tooth and a patient report to motivate him to continue and complete the treatment. Figure 2 presents attached images from the radiological report in which the artificial intelligence system identified pathological aspects, presenting very good accuracy.

Raport radiologic: Dinți 18 — 48

28.05.2021

Numele pacientului: P A
Data nașterii: 21/04/2007

ID Pacient: 202104221322414 73
Data scanării: 28/05/2021

Vârsta: 14
Sex: Feminin



Recomandări de trimitere:

Ortodont: 18, 28, 38, 48 Endodont: 17

Screening ortodontic

Discrepanțe dentare

Ingrămădiri dentare: 18-17, 17-16, 14-13, 12-11, 11-21, 21-22, 27-28

Spațieri dentare: 48-47, 37-38

Overbite: scăzut

Overjet: crescut

Discrepanțe scheletice

Nu s-au găsit discrepanțe

Acest raport a fost generat cu Diagnocat folosind Inteligența Artificială. Afecțiunile și patologile din acest raport nu pot fi considerate un diagnostic medical și trebuie interpretate de medicul stomatolog curant.

Diagnocat
28.05.2021 11:35

Figure 1. Extract from the Diagnocat radiological report



Figure 2. DiagnosticsCat radiological report of teeth 1.8.-2.2.

DISCUSSIONS

The aim of this study was to show the implications of the use of digital technology in daily paedodontic practice by combining representative information from current bibliographic sources.

The objective of this scientific paper was achieved by capturing the advantages and disadvantages of the AI technology, but also by reporting their clinical applications in paedodontic practice:

Advantages of using artificial intelligence

The use of AI leads to an increased degree of accuracy and precision by reducing human error. In this way the working time decreases and the quality of medical services increases. Past and present health problems of patients can be analyzed, because AI can accumulate and store data in one place and allows the doctor to make a more accurate diagnosis and to predict the potential health problems a person may have in the future. The management of the dental clinic can be improved based on predictive analyzes [8].

Disadvantages of using artificial intelligence

Creating such a system requires very high costs, because they are very complex machines, which require a lot of resources to be developed.

The use of AI can reduce human interaction, an essential criterion in developing a good doctor-patient relationship.

Software programs require frequent maintenance and updating, which also leads to an increase in maintenance costs. It can also be maintained only by programmers with a high level of training in the field) [9].

Computer-aided diagnostic programs are used to obtain a second opinion in the medical field. Creating a diagnostic protocol, documenting radiological examinations, selecting and adapting dedicated CBCT sections requires a lot of time and experience in image editing [10].

CONCLUSIONS

DiagnoCat allows you to record diagnostic protocols with just a few clicks. The advantages brought by these systems are related to the elimination of human error, the shortening of working hours, the possibility to make predictions on the evolution of health and last but not least it is a good tool for communication with patients. However, the accuracy of AI interpretations in dentistry still needs to be investigated through a variety of cases and types of imaging investigations, as there is a lack of standardization in dental radiology, which makes it difficult to learn the algorithm on correct diagnosis. Future directions of study augmented reality, nanostomatology and robotics in dentistry. New artificial intelligence systems lead to an increased degree of accuracy by reducing human error, shorten working time and give the possibility of large-scale studies.

Declaration of patient consent

The authors certify that they have obtained all the patient's consent forms. The patient, through his legal representative, consented for his clinical information to be reported under anonymity for medical and scientific research purposes.

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