Artificial Intelligence and Early Childhood Caries in Dentistry – A Scooping Review

[1]Dr Ambreena Khurshid, MDS, Department of Pedodontics, Swami Devi Dyal Hospital and Dental College

[2]Dr Sakshi Khajuria, MDS, Department of Orthodontics, Himachal Institute of Dental Sciences, Poanta Sahib

[3]Dr Ubair Shafi, BDS, IGGDC, Jammu

Corresponding Author: Dr Ambreena Khurshid, MDS, Department of Pedodontics, Swami Devi Dyal Hospital and Dental College

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Abstract

Artificial intelligence is the simulation of intelligence exhibited by animals and humans processed by the machine. AI can perform tasks with greater precision and accuracy than humans. Artificial intelligence is playing significant role in dentistry, focussing on various aspects from diagnosis and treatment planning to patient care. This article describes the potiential role of AI in dentistry.

Keywords; Artificial intelligence, machine language, robotics, deep learning

Introduction

Artificial intelligence is potiential branch of computer science that emphasis on creating intelligent machines that can carry several tasks that would normally require human intelligence and as a method of programming a computer, robot, or other object to think like a smart human. [1] The origin of Artificial Intelligence is believed to be made by Alan Turing with his "Can Machine Think?" question devised the Turing test in the year 1950 to suggest that machines can use available information and reason to solve problems like humans. According to John Mc Carthy in 1956,"Artificial Intelligence" is defined as "the science and engineering of making intelligent machines" [3,4]

Discussion

Artificial intelligence (AI) over past decades is drawing attention in technological advancements throughtout the globe. Every field has intiated implementing AI in their work field and even medical field has embraced it's utility. There is huge spike in sophisticated means of documenting patient's data using computers, AI uses this data of patients, process it and then derive the information for diagnosis and treatment planning. It deals with developing computer programs that have the ability to perceive information, reason, and ultimately convert that information into intelligent actions.[5,6]. Various fields like reasoning, natural language

processing, planning, and machine learning (ML) are included in AI. A mong these machine learning is most commonly used AI application in medical and dental fields.

AI function is based on Learning, reasoning and self-correction.

Learning – refers to collection of data and formulation rules for turning it into meaningful information. Algorithms are rules that provides step by step instructions to the computer to carry out a task.

Reasoning or thinking deals with selecting the best algorithm to achieve a given result. Self-correction focuses to fine-tune algorithms so that they provide most precise and accurate information.

To understand the function, it is necessary to know about different categories of AI and the type of algorithm suitable for different applications.[10]
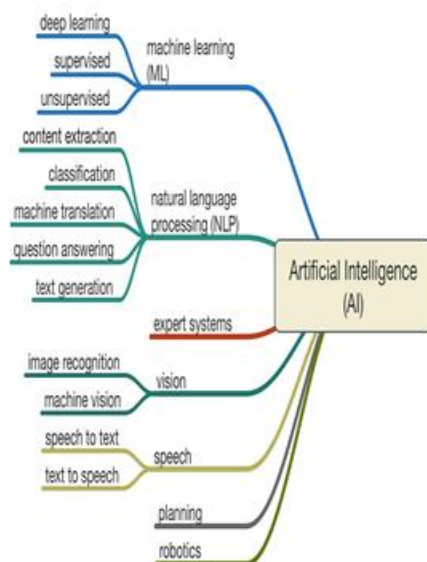

Figure 1: Representation of number of ways AI can be achieved [12]

Artificial Intelligence (AI) has paramount impact in dentistry by offering variable applications that enhance diagnostic precision, treatment planning, and overall patient care. Early Childhood Caries (ECC) represents a significant global health issue, disproportionately

affecting children in low- and middle-income countries[9]. Traditional detection methods rely heavily on visual-tactile examinations and radiographic imaging. However, these methods are often subjective and dependent on the clinician's expertise, which can lead to variability in diagnosis[5]. The emergence of Artificial Intelligence (AI) and Machine Learning (ML) technologies offered innovative solutions for improving the accuracy and consistency of ECC detection. Early detection and intervention are essential to prevent the progression of caries, which can lead to severe pain, infection, and negative impacts on a child's nutritional status, growth, and overall well-being[5]

A traditional detection method using the International Caries Detection and Assessment System (ICDAS) and radiographic imaging has been the standard in diagnosing ECC. Visual-tactile examination is a widely used technique but is subject to examiner variability, leading to potential inconsistencies in diagnosis[4]. Radiographic methods, while more objective, involve exposure to ionizing radiation and may not always detect early-stage carious lesions as they are not radiographically visible[6]. These challenges highlighted the need for more reliable, objective, and non-invasive methods for ECC detection, which is where AI-based approach has the potential to make a significant impact[5]

The Role of AI and Machine Learning in Healthcare

Artificial Intelligence (AI) has become an increasingly influential tool in various fields, including healthcare which encompasses a range of technologies that allow machines to perform tasks typically requiring human intelligence, such as visual perception, speech recognition, and decision-making. Machine Learning (ML) involves algorithms that learn from and make predictions based on data, making it particularly useful for tasks like disease diagnosis and treatment planning[7].

Deep Learning (DL), an advanced subset of ML, uses artificial neural networks with multiple layers to model complex data patterns. Convolutional Neural Networks (CNNs), a type of DL model, is particularly effective for image-based tasks like medical image analysis due to the ability to automatically learn and extract hierarchical features from raw image data[8]. CNNs have been instrumental in improving the accuracy and consistency of ECC detection by analyzing dental images such as intraoral photographs and radiographs[7].

Conclusion

Recent technologies are developed and adopted rapidly in the dental field. AI is among the most promising ones, with high efficiency and accuracy. Dentists can consider AI as a supplemental tool to reduce workload, improve diagnosis, decision – making, treatment planning and prediction of treatment outcomes and disease prognosis.

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