

Artificial Intelligence in Pediatric Dentistry

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ABSTRACT

Dentistry has evolved through a long journey. The incorporation of Artificial Intelligence (AI) is the present and future of dentistry. Artificial Intelligence is now gradually being used in various fields including medical healthcare and dentistry. Within the field of dentistry, Pediatric dentistry requires skills to perform procedures with proper patient behavior guidance skill. The present article aims to highlight the various AI innovations and its relation to pediatric dentistry with possible future supported with Robotics which might change the traditional way of clinical practice.

Keywords: Artificial intelligence, dentistry, pediatric dentistry.

INTRODUCTION

“Hey Siri, what is the weather condition today at Pokhara?” it is as simple as that to know answers to various questions nowadays. Technology has made our life much easier and more efficient. Recent advancement in technology is Artificial Intelligence (AI) that has experienced spectacular development and growth over the past two decades.¹ Our daily lives has been influencing through technologies such as Alexa, Siri, Tesla, Google, etc. AI is designed to act similarly to the human brains by learning from past experiences and applying in the future conditions.

Artificial Intelligence (AI)

Artificial Intelligence is termed as the capability of machines to exhibit a form of its own intelligence, which can imitate human knowledge and behavior.^{2,3} The most commonly used branches of AI are Machine Learning and Deep learning. Machine learning is a branch of AI in which systems learn to perform intelligent tasks without a prior knowledge or hand-crafted rules.¹ It uses algorithms to anticipate outcomes from a set of data. Deep learning with multiple computational layers builds a neural network that automatically recognizes patterns in order to improve

the feature detection.⁴ The combination and stacking of patterns create a deep system which is far more powerful.¹

Artificial Intelligence in Pediatric Dentistry

The application of AI is increasing gradually in various sectors and healthcare is no exception. The application of AI in Pediatric dentistry is quite relevant because it not only requires skill to perform procedures, but also requires proper behavior guidance skills.⁵ Various innovations are being introduced to Pediatric dentistry which help in the identification of behavioral pattern of a patient, anxiety management, data management, investigations, diagnosis, proper treatment planning, prediction of the prognosis and patient education.⁵ It benefits clinicians with high-quality patient care and simplifies complicated protocols by providing a predictable outcome.²

Patient and data management

Columbia University College of Dental Medicine is already incorporating radio frequency identification (RFID) into instruments to understand usage times as cameras into dental chairs to record procedures, and chair sensors to determine the time of patients' seating and departure.² With the incorporation of digital system and AI, the data of patients such as diagnoses, prescriptions, and previous interactions within various healthcare organizations will be readily available for the dentists. This will aid the dentist to know about the medical conditions such as allergies, specific disease requiring extra precautions, and drug interactions. Based on these records, modifications in the treatment plan can be done according to the patient's requirement, which will ultimately benefit the patient and assist the treating doctors in providing the best possible

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care.⁵

Most of the times, it is quite challenging to guide the behavior of the pediatric patients during initial visits because they are often fearful and anxious. Provision of the references of their anticipated treatment procedures via virtual reality (VR), movies and animation-based programs distract the attention of pediatric patients from the real-world processes which will lower their anxiety.⁶

In children, anesthetic nanorobots can be introduced in suspension form into the quadrant of interest. The nanorobots reaches the pulp via the gingival sulcus, lamina propria, and the dentinal tubules which ultimately blocks the action potentials in the sensory nerves. The activation or the duration of action of nanorobots can be controlled by the treating dentist.⁵ By the implication of this technology both the patient and clinician are benefited as the process becomes completely painless for the patients, and the clinicians are benefited as the pain management of the patient is completely under their control, which ultimately assist the dentist in the provision of quality dental care.

In this era of technology, institutions like 'Kolibree Artificial Intelligence' are incorporating AI technology in toothbrushes thus making a Smart one. A smart toothbrush is incorporated with three-dimensional (3D) motion sensors, a gyroscope, an accelerometer, and a magnetometer that detects the location and angle of the brush. The smart toothbrush then analyzes data to provide instant feedback to the user.⁷ The patient or the parents of the children gets to know the oral hygiene status via this technology.

Investigation and diagnosis

Dental diagnosis comprises of interpretation of patient information collected through observation, examination and investigation. Various oral pathologic conditions are investigated with microscopy, radiology and other imaging methods. For the diagnosis of specimens requiring histopathological examinations, the pathology specimens undergo multiple processes that include formalin fixation, grossing, paraffin embedding, tissue sectioning, and staining. When the processes are performed by a pathologist, the diagnosis may vary among the pathologists. This can be overcome by AI standardized system which can observe microscopic images and report the architectural variations with probable diagnosis.⁸

Deep Learning technology is used in analyzing the radiographs and imaging. AI-supported radiographic analysis does show a great potential of assisting clinician in making a diagnosis as an additional reference.² It has been integrated from 2-Dimensional to 3-Dimensional applications. AI supported with 3D imaging, such as Cone beam Computed Tomography (CBCT) is calibrated to identify the anatomical structures, nerves and pathological conditions automatically.⁸ CBCT can be used in pediatric patients having malocclusions and craniofacial anomalies, including cleft lip and palate.⁶ AI has been of great assistance in the proper assessment of the position of the unerupted teeth, and also in determining the extent of root resorption.⁶

Artificial Intelligence has also been used beyond the 3D imaging and is being expanded to intraoral scanning system as well. There are various AI incorporated softwares which can scan oral cavity and help the clinician in diagnosis of pathogenesis. These AI incorporated softwares also assist in verifying the cavity preparations and restorations and provides the instant feedback of the work done. Laboratories can also be benefited from this technology, as they can prepare the crowns or other appliances with computer-aided design and manufacturing, which would be a boon to pediatric restorations in terms of time and aesthetics with precision.⁹ AI-supported radiography in dentistry helps in the pixel-by-pixel analysis of the radiographs that provides the probable range of diagnoses. These imaging advancements aid in the detection carious lesions, periapical pathologies, oral cancer, and other oral pathologies.¹⁰

CONCLUSIONS

Artificial Intelligence in Pediatric dentistry is currently in the nascent stage, and it is rapidly evolving day by day. Advancements in every field of dentistry can be incorporated in Pediatric dentistry as Pediatric dentists are skilled for providing the comprehensive dental treatment of all kinds to the patients of certain age group. Hence, AI in pediatric dentistry benefits clinicians in the provision of high-quality patient care, patient education and simplification of complicated diagnosis and treatment protocols.

Conflicts of interest: None.

INAPD

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