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RESEARCH ARTICLE

MACHINE LEARNING-- "A NEW TOOL IN DENTAL ARMAMENTARIUM

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ABSTRACT

One of the most revolutionary and quickly developing topics in modern science and technology is artificial intelligence (AI). The goal of artificial intelligence (AI) is to develop intelligent systems that can mimic, duplicate, or augment cognitive functions that are unique to humans. AI has evolved from theoretical ideas to real-world applications with wide-ranging effects. The goal of this multidisciplinary discipline is to develop computers that can learn, reason, solve problems, and adapt to changing surroundings. It draws influence from a variety of fields, including cognitive psychology, computer science, mathematics, neurology, and engineering. Natural language processing, computer vision, and autonomous decision-making are just a few of the impressive accomplishments that AI has shown because to the exponential expansion of computational power and the gathering of enormous datasets. This review describes the fundamental ideas, approaches, and uses of AI, shedding light on how it can find application in dentistry.

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INTRODUCTION

One of the most innovative and quickly developing aspects in the field of computer science and technology that is finding the extended application in health care is artificial intelligence (AI). AI is an umbrella term that includes a broad range of approaches, algorithms, and methodologies aimed at enabling machines to accomplish tasks that traditionally require human cognitive abilities. AI is rooted in the concept of constructing machines or systems capable of replicating human intellect. The diverse fields of machine learning, natural language processing, computer vision, and robotics are all combined in this field to make it easier to create intelligent systems that can reason, learn, adapt, and even show creativity. The development of AI has not only resulted in amazing technological advancements but has also had major effects on a variety of industries, including healthcare, banking, transportation, and entertainment.

Overview of Artificial Intelligence (AI) and its Relevance in Dentistry: Mankind has started growing rapidly over the fascination of the human brain over the past years it has been attempted several times to mimic the grey matrix until in 1956 John McCarthy developed the concept of AI.^{1,2} By offering cutting-edge tools and techniques to help dental practitioners with diagnosis, treatment planning, image analysis, patient management, and oral health monitoring, artificial intelligence (AI) has the potential to transform

the field of dentistry. Dentists can gain from increased precision, efficiency, and individualised treatment delivery by utilizing AI.^{3,4} In order to extract useful information and help clinical decision-making, AI algorithms in dentistry can process vast volumes of patient data, including medical records, radiographs, intraoral pictures, and clinical notes. These algorithms can gain knowledge from past cases and spot trends that may be challenging for human experts to spot, resulting in diagnoses that are more precise and effective.⁵ AI can also help with treatment planning by reviewing data particular to each patient and making tailored recommendations. To improve treatment outcomes, it may take into account elements like patient demographics, medical history, and clinical characteristics. This helps dentists create individualized treatment programs that address the needs of each patient, thereby increasing the effectiveness of the overall treatment.^{6,7} Additionally, wearable technology and sensor technologies are used by AI-driven oral health monitoring systems to gather real-time data on a variety of oral health factors. The status of oral health can be determined by regularly monitoring variables such as chewing behaviours, brushing practises, and saliva composition. In order to enable proactive and preventive dental care, AI systems can evaluate this data, spot trends, and notify clients and dentists about potential problems.⁸ Overall, AI has enormous relevance in dentistry since it offers creative ways to improve diagnosis, treatment planning, image analysis, patient management, and monitoring of oral health.

Dental professionals may provide more precise diagnoses, individualized treatment plans, and improved patient care by utilizing AI, which will ultimately result in better oral health results. AI encompasses several sub-branches that focus on specific aspects of intelligent systems. These sub-branches include Machine Learning (ML), Natural Language Processing (NLP), Computer Vision (CV), Robotics, and Expert Systems. A branch of artificial intelligence called machine learning (ML) focuses on creating algorithms and models that let computers learn from data and make predictions or judgments without having to be explicitly programmed. Large datasets can be analysed by ML algorithms, which can also find patterns and extract useful information to aid in decision-making. They cover a range of methods, including reinforcement learning, unsupervised learning, and supervised learning.⁹ Deep Learning is a focused branch of machine learning that entails building and training deep neural networks, which are artificial neural networks with several layers (DNNs). These networks can autonomously learn hierarchical data representations, which gives them the ability to tackle challenging issues like audio and picture recognition and natural language processing. Large labelled datasets and improvements in computing power have enabled deep learning to achieve amazing success across a variety of fields.⁹

Functional model of AI: An AI model is a mathematical representation of a real-world process. It is used to simulate the behavior of that process so that it can be better understood and predicted. There are many different types of AI models, but they all have one thing in common: they are based on data. The essential ideas and procedures that give the machines the ability to mimic human intelligence and carry out tasks without explicit programming are included in the working model of artificial intelligence (AI). In order to analyse, learn, and make defensible conclusions, AI fundamentally depends on data and algorithms. Data collection, the first step in the procedure, is gathering a sizable amount of information from diverse sources. Following that, this data is loaded into AI models, which employ algorithms for analysis, pattern recognition, and association building. The AI system improves its skills through a process known as training by iteratively altering its settings in response to input from its performance. The AI model can solve issues, forecast outcomes, comprehend natural language, and even execute difficult activities once it has been trained.

It is trained on past data so that it can make predictions about future events. There are many different types of AI models, but they all share a few common components: Inputs: These are the variables that the model uses to make predictions.

Outputs: These are the predictions that the model makes. A learning algorithm is how the model is trained on past data. The specific inputs, outputs, and learning algorithm will vary depending on the type of AI model.

This allows it to disrupt industries and change how people interact with technology. The working paradigm of artificial intelligence holds enormous potential for improving different parts of our daily lives and spurring innovation across a variety of disciplines as AI research and development continue to advance.¹⁰

APPLICATIONS OF AI

AI is rapidly evolving and finding its way in a variety of industries. The dental industry is no exception. AI is being used in dentistry from treatment planning to dental marketing.

Some of the main applications of AI in dentistry include:

- **Dental treatment planning:** AI can be used to create treatment plans for dental patients. This is done by taking into account the patient's personal history, current dental condition, and desired results.

- **Dental marketing:** AI can be used to target dental marketing campaigns. This is done by identifying potential patients and then tailoring marketing messages to them.
- **Dental diagnosis:** AI can be used to assist in the diagnosis of dental conditions. This is done by analyzing X-rays and other images to look for patterns that could indicate a particular condition.
- **AI in patient management:** AI-based virtual assistants can perform several tasks in the dental clinic with greater precision, fewer errors, and less manpower compared to humans.
- The applications have also been extended to surgical interventions like successful clinical application in image-guided surgery in the cranial area in oral implant surgery, removal of tumor and foreign bodies, biopsy, and TMJ surgery
- Another important application is in the field of CAD/CAM technology. CAD/CAM technique essentially creates two dimensional and three-dimensional models and their materialization by numerically controlled mechanics.
- The AI finds extended application is Orthodontics. Diagnosis and treatment planning by Analysis of radiographs and photographs.¹¹
- There might be some potential areas that might contra indicate the utilization of artificial intelligence (AI) in healthcare
- AI-based systems may not be able to identify all relevant patient data.
- AI-based systems may not be able to accurately interpret complex medical data.
- AI-based systems may not be able to provide personalized recommendations to patients.
- AI-based systems may not be able to keep up with the rapidly changing landscape of healthcare.
- AI technology is still evolving and may not be accurate enough for making important decisions about patient care.
- There is a risk that AI could be used to make decisions that are biased or discriminatory.
- AI systems may not be able to keep up with the changing landscape of healthcare, making them outdated quickly.¹²

IMPLICATION

Artificial intelligence has been increasingly applied to various areas in healthcare, including dentistry. AI can be used in a number of tasks in dentistry, such as providing diagnosis, treatment planning and even toothpaste recommendations. While AI holds a lot of promise for the future of dentistry, there are also some potential implications that need to be considered. For example, AI-assisted diagnosis could lead to more accurate diagnoses, but it could also lead to overdiagnosis and overtreatment. Additionally, AI-recommended treatments could be more effective than traditional treatments, but they could also be more expensive. Overall, AI has the potential to greatly improve the field of dentistry. However, it is important to consider the implications of AI before fully implementing it into practice.

CHALLENGES: Artificial intelligence is one of the most transformative technologies of our time. With AI we can create smart systems that can automate tasks, make decisions, and even learn and improve over time. However, AI is not without challenges. One of the biggest challenges is creating systems that are both effective and safe. Another challenging is ensuring that AI technologies are accessible to everyone and that they are used to benefit all of humanity. One of the challenges of artificial intelligence is creating algorithms that are able to learn and adapt as new data is introduced. Another challenge is dealing with the enormous amount of data that is required for artificial intelligence systems to function properly. Despite these challenges AI holds immense potential and we are already seeing its positive impact in many areas of our life. Artificial intelligence has the potential to revolutionize many industries and make our lives easier. With continued development of new and improved algorithms, artificial intelligence will become more and more prevalent in our world.^{13,14}

CONCLUSION

In conclusion, artificial intelligence is a powerful tool that can be used to achieve a variety of tasks. With the proper training, AI can be used to create accurate models and make predictions. Additionally, AI can be used to automate processes and make decisions. However, it is important to note that AI is not a silver bullet and it should not be used as a replacement for human judgment. When used correctly, AI can be a powerful tool for businesses and organizations. Artificial intelligence is a powerful tool that can be used to complement the skills and knowledge of dental and specialist staff. While AI can never replace the human touch, it can be used to streamline processes and improve efficiency. When used correctly, AI can be a huge asset to dental and specialist practices. AI technology is rapidly evolving and offers great potential for improving dental and specialist care. However, AI should be used as a complimentary asset to human skill and knowledge, not as a replacement. AI technology is not yet advanced enough to match the human ability to diagnose and treat dental and specialist conditions.

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