**BOOK CHAPTER**

**ARTIFICIAL INTELLIGENCE IN DENTAL PRACTICE**

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**Abstract**

The importance and presence of artificial intelligence (AI) has significantly increased across a variety of industries, including dentistry. It can make sophisticated predictions and decisions in the healthcare industry, especially in endodontics, by imitating human intelligence. Convolutional neural networks and/or artificial neural networks, two types of artificial intelligence models, have demonstrated a range of applications in endodontics, including studying the anatomy of the root canal system, predicting the viability of dental pulp stem cells, measuring working lengths, locating root fractures and periapical lesions, and forecasting the success of retreatment procedures.

By quickly understanding huge data, artificial intelligence (AI) technology is used in dentistry to deliver information that supports clinical decision-making. In areas where AI is now playing a substantial role in clinical dentistry, this study attempts to systematically review that role. Based on the key themes of artificial intelligence-assisted dentistry, documents spanning 1990 to 2022 were gathered. In dentistry, a rapidly developing technology like AI can undoubtedly take the role of physical skill. These technologies must also be used cautiously and under human supervision in order to decrease errors and oversight. Better outcomes for patients result from the earliest and most precise detection of oral disorders.

Keywords: artificial intelligence, AI algorithm, clinical information system

**Background**

Scientists and researchers have always been fascinated by the brain, one of the most interesting organs in the human body. The scientific community has never truly grasped how to build a perfect simulation of the human brain. The development of "artificial intelligence" (AI) has been the focus of intense scientific research for many years. In 1956, John McCarthy made the first mention of the discipline of applied computer science currently known as artificial intelligence. It is sometimes referred to as artificial intelligence. Artificial intelligence, also referred to as the "fourth industrial revolution," makes use of computer technology to mimic human-like reasoning, judgement, and intelligent behaviour.

Various AI models were used in the literature evaluation, and factors related to dental care were investigated. This work adds to the body of knowledge in two different ways. We applied the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) technique to map the literature on current trends in AI in dental care delivery systems. Additionally, it offers academics future perspectives by presenting various technological methods for foreseeing oral disorders. The focus of the remaining study is on obtaining answers to these three research objectives.

**Introduction**

A research into intelligent machines, or any machine that comprehends its environment and behaves in a way that maximises its chances of success, is known as Artificial Intelligence in computer science. The term "Artificial Intelligence" is used when a computer imitates analytical skills that people typically connect with other human brains, such as "learning and problem-solving". There has been a lot of experimentation with Artificial Intelligence techniques as clinical trial tools, specifically to help in decision-making for prognosis and projection, as well as each phase of diagnosis and subsequent therapy. Artificial Intelligence techniques have demonstrated excellent capabilities and capacities in recognising important data patterns. Artificial Intelligence has been shown to improve precision, accuracy, and efficiency to the level of medical specialists more quickly and economically.

It already has an impact on our daily life because of different office and practise management software. A few applications that have created intelligent conversational user interfaces for any device, application language, or environment utilising artificial intelligence are Siri, Alexa, and other voice command devices. Both virtual and physical (that is, robotics) Artificial intelligence have applications in the healthcare industry. The primary domain of the virtual type is the mathematical formulae for medicine dosage, diagnosis and prognosis, appointment scheduling, drug interactions, electronic health records, and imaging. Rehabilitation, telepresence, robotic assistance in surgery, and companionable robots for senior care are all part of the physical aspect.

The majority of dental applications use supervised learning, where the training data consists of many samples, each with a different characteristic or feature (such as pictures of the patient, their sex, age, how many cavities they have, and so on) and determination of ground truth (e.g., whether there was a prior endodontic visit or not). Artificial neural networks (ANNs) imitate the biological neuron system with many connections between neurons that is employed in "learning" and use it in its algorithm to understand the relationship between qualities and the truth.

Artificial intelligence (AI) has the potential to revolutionise the fields of medicine and dentistry by creating answers to various clinical issues and thereby simplifying physicians' work. Artificial intelligence applications in the dental sector are still uncommon. However, the advancement of these technologies has had an effect on electronic recordkeeping, radiography and pathology, caries detection, robotic assistance, dental imaging diagnostics, and caries detection. Endodontic artificial intelligence research has increased in tandem with the development of other dental disciplines. Endodontists' knowledge has to be updated with regard to the application of artificial intelligence. Digital dentistry and superior visualization for diagnosis are used in dental practices and are becoming more efficient as a result of technological advances. In dentistry, dental informatics relates to [information management](https://www.sciencedirect.com/topics/social-sciences/information-management), communication, and the deployment of new technologies in clinical practice and research. Management of information in a dental office includes storing and using information generated while working directly with patients, arranging visits, and running dental practices.

Computers are used to record, store, and modify clinical data about patients in a clinical information system (CIS). These information systems may be utilised singly or throughout the entire healthcare system. CIS's role in supporting healthcare management and managing patient data includes integrating, gathering, and managing data from many sources. Information systems for dental departments are made to store a lot of data and make data processing easier. Other details concerning a patient's diagnosis and care can be immediately obtained with CIS. Such systems typically combine web-based technology with email communication, Internet search, and promotion practises, followed by instruction, practise, and more instruction in virtual reality. Modern tools including x-ray machines, intraoral cameras, and the retrieval of medical literature are used in clinical practise and research. Artificial intelligence (AI) adaptation, according to researchers, becomes more common and efficient over time.

AI can be utilized for Image analysis and interpretation as well. AI algorithms can analyze dental images, such as X-rays, panoramic radiographs, cone beam computed tomography (CBCT) scans, and intraoral photographs. By leveraging deep learning techniques, AI models can detect and classify various dental conditions, including dental caries, periodontal disease, bone loss, impacted teeth, and oral tumours. AI can assist dentists in identifying abnormalities, providing a valuable second opinion, and reducing the chances of human error.

AI-powered Computer aided detection (CAD) systems can automatically detect and highlight potential abnormalities in dental images, assisting dentists in their analysis. CAD systems can mark areas of concern, such as suspicious lesions or early signs of dental diseases. This helps dentists in early detection, leading to timely interventions and improved patient outcomes.

Robotic systems used in dentistry consist of robotic arms, tools, and sensors designed specifically for dental procedures. These systems are controlled by dentists, who guide and supervise the robot's actions throughout the treatment process. Robotic systems used in dentistry consist of robotic arms, tools, and sensors designed specifically for dental procedures. These systems are controlled by dentists, who guide and supervise the robot's actions throughout the treatment process. Robotics-assisted dentistry can be applied to a range of dental procedures, including dental implant placement, tooth preparations for crowns or veneers, root canal therapy, and orthodontic procedures. The robotic system assists in performing precise and repetitive tasks with a higher level of accuracy compared to traditional manual techniques. Robotic systems often incorporate advanced imaging technologies, such as cone beam computed tomography (CBCT) and intraoral cameras. These imaging systems provide real-time, high-resolution images that aid in the planning and guidance of dental procedures. Dentists can visualize the treatment area from different angles and perspectives, enhancing their decision-making process.

Robotics-assisted dentistry allows for minimally invasive procedures. The precise and controlled movements of the robotic system enable dentists to conserve healthy tooth structure while performing tooth preparations or other interventions. This can lead to less post-operative discomfort for patients and faster recovery times.It's important to note that robotics-assisted dentistry does not replace the role of dentists. Instead, it serves as a tool to augment their skills and provide additional precision and control during procedures. Dentists remain actively involved in treatment planning, patient interaction, and supervision of the robotic system to ensure optimal outcomes and patient safety.

With advancements in information systems and technology, the dental field has seen significant advancements. There have been specific information technologies (IT) developed for dental specialties, and dental-related applications continue to need special development. Medical information about patients will be available to dentists and doctors through harmonized dental software. Arguably, artificial intelligence is largely utilized in disease diagnosis with comparable accuracy to medical experts. Artificial intelligence has made substantial contributions to dentistry, primarily with dental radiography and Artificial intelligence oral imaged scans. Dental caries is the most commonly occurring disease afflicting humanity. Prevention, early diagnosis, and prompt treatment of dental caries remain the primary aim of the dental profession. Therefore, Artificial intelligence become an important tool in the diagnosis and predicts disease outcomes.

The perceptions of Artificial intelligence in dentistry can depend on the social view and technology projection. It can be guaranteed that information systems coupled with Artificial intelligence will achieve accurate diagnoses of common oral diseases. Additionally, patient trust can enhance confidence in dental diagnosis, but it can also raise doubts and reservations about its use. Researchers and quality measures have made significant progress due to the development of health information systems, especially standardized clinical coding systems. There is limited research into [clinical decision support systems](https://www.sciencedirect.com/topics/computer-science/clinical-decision-support-system) that reuse [electronic](https://www.sciencedirect.com/topics/computer-science/electronics) dental data. Health information systems have also not been studied in depth about dental practitioners' working environments or their pedagogical value.

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**Discussion**

The purpose of this systematic review is to shed light on the developing function of artificial intelligence in dental disease detection and management. We discovered that Artificial intelligence is utilised extensively in dentistry and that dental doctors might profit from it at every level of diagnosis and treatment. Some data suggests that Artificial intelligence models could aid in dental diagnosis. Different methods were employed to gather and assess data as well as develop Artificial intelligence systems. So, it was challenging to compare the studies. Dentists can accurately diagnose dental flaws and reduce human error by doing this. Although Artificial intelligence makes it possible to access enormous databases and perform more in-depth analyses, its usage in everyday life is limited by sociological, technological, and ethical issues. There can be restrictions on the amount of data, the methods, or how the data is used in therapeutic settings.

**Conclusion**

Artificial intelligence technology has been widely applied in endodontics. According to research on the use of Artificial intelligence in endodontics, the neural networks performed similarly to the dental experts with more accuracy and precision. Artificial intelligence models have also outperformed the specialists in some studies. According to the studies, these applications might be more useful to novices and non-specialists as an expert opinion.

Artificial intelligence should be considered as an augmentation tool to help dentists carry out more beneficial duties, such integrating patient information and fostering professional connections, by complementing and, at times, relieving them. Modern artificial intelligence is excellent at making use of organised information and drawing conclusions from enormous volumes of data. However, unlike the human brain, it cannot make associations, and in a therapeutic setting, it is only partially competent to make complex decisions. Higher-level comprehension, which is dependent on dentists' experience, is specifically required in hazy scenarios to conduct physical examinations, incorporate medical histories, assess aesthetic results, and encourage discourse. It is essential to emphasise that effective patient-dentist communication necessitates an understanding of the patient's hopes, concerns, and expectations through nonverbal cues. This is true despite the heated arguments over whether or not empathy should be incorporated into the algorithms used by affective robots to simulate human emotions. These channels of communication are spontaneous and illogical.

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Dental professionals employ bitewing radiographs as part of their diagnostic procedure in addition to visual and tactical inspections of the oral cavity. Bitewing radiographs are not valid and dependable for the accurate diagnosis of tooth decay. In one investigation, it was discovered that bitewing X-rays had a low sensitivity of 0.24–0.42 in identifying dental caries. False positive and false negative results when using dental X-rays to diagnose caries are also frequent. According to a number of recent research, Artificial Intelligence-based technologies are more adept than dentists at spotting cavities on dental radiographs.

When it comes to spotting carious lesions inside the mouth, it has been discovered that near-infrared scans are more reliable than bitewing X-rays. Artificial Intelligence is frequently used in the building of algorithmic software systems that aid in dental diagnostics and data management. Dental Artificial Intelligence has made dental care more accessible, and systems built on Artificial Intelligence technology can provide healthcare professionals with expert advice during clinical assessments. Artificial Intelligence has made enormous strides in the healthcare sector, and several research have been published.

Practitioners continue to misinterpret Artificial Intelligence despite the fact that it has been demonstrated to be credible in dental analysis. Until it is generally embraced by the profession, some dentists may even see the technology as a danger. Dentists shouldn't worry about Artificial Intelligence replacing their work, despite widespread concerns in other industries. Since they are not licenced radiologists and viewing X-rays is only a minor part of their job, an Artificial Intelligence assistant can help them similarly to how a torch might. Dentists are required to continue providing patient care and treatment during the diagnostic phase. Dentists and students of dentistry must be educated, though, in order to foster faith in this cutting-edge technique.

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