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# Artificial intelligence in periodontics: A review

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**ABSTRACT:**
Artificial intelligence (AI) has recently gained significant pace in practically every aspect of society. This article discusses the uses of AI in dentistry and further tries to emphasize the many applications particular to the discipline of Periodontics and Implant ology. As AI programs have developed over the years, they have made it feasible to analyses complicated datasets and logically interpret them. The possibilities are many, ranging from assisting the dentist in more effectively interpreting dental radiographs and clinically evaluating patients to assisting dental students in honing their manual dexterity.AI in clinical dentistry is still only a brilliant notion on paper right now, but with more funding and research, it may most definitely become a reality soon.This publication is open access (OA), and all articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License. This license permits others to remix, modify, and build upon the work in noncommercial ways as long as appropriate credit is given and the new works are licensed in accordance with the same terms as the originals.

**KEYWORDS :** Artificial intelligence , periodontics , review

## I. INTRODUCTION:

Have you ever thought about how technology may be utilized to make dentistry education both more enjoyable and more effective? How can dental x-ray interpretation be made simpler and free from inter- and intra-examiner variation? How may the upkeep of patient records be delegated to a machine rather than another person? Yes, artificial intelligence is the solution to the aforementioned problems as well as many more. Artificial intelligence (AI) is the term used to describe how computers that have been trained to think and behave like people simulate human intellect. A wide range of cutting-edge technologies, including those in healthcare and dentistry, are included in the umbrella term of artificial intelligence (AI). In this article, the many uses of AI in the discipline of periodontology will be particularly reviewed.

[1] The Turing test, initially known as the Imitation Game, was developed in the 1950s by English mathematician Alan Turing as a way of determining if a machine could exhibit intellectual behavior that was almost equal to that of a person. The 1956 Dartmouth Conference is credited with launching artificial intelligence. John McCarthy first used the term "artificial intelligence" during this meeting. Allen Newell and Herbert Simon published the first AI programme in 1955

Arthur Samuel coined the phrase "Machine Learning" in 1959. The decade from 1970 and 1980 was referred to as the First AI Winter because AI was the focus of criticism and financial challenges in the 1970s. The development of "expert systems" caused a surge in the years between 1980 and 1987. They are essentially artificial intelligence (AI) programmes that respond to queries or resolve issues pertaining to a particular field of expertise, guided by logical principles drawn from expert knowledge. The Second AI winter, which occurred in the late 1980s to early 1990s, was characterized by several financial disasters at this time. On May 11, 1997, DEEP BLUE defeated a current world chess champion, making it the first computer chess programme to accomplish this feat. Early in the twenty-first century, numerous issues throughout the world were effectively addressed thanks to the availability of vast amounts of data, more affordable and quick computers, and sophisticated machine learning techniques.

.[2,3]A rapidly expanding field, artificial intelligence (AI) in dentistry aims to help dentists provide high-quality patient care while also speeding up and streamlining procedures. Across the many dental specialties, several apps are being created. An artificial neural network for determining the need for orthodontic extraction (Jung and Kim et al., 2016), Bayesian networks for creating an AI Clinical decision support system (Thanathornwong et al., 2018), and Convolutional neural network-based Treatment outcome analysis (Patcas et al., 2018) in the field of orthodontics are a few of the recent studies that have been published.Speight et al. proposed an artificial neural network-based approach for determining the risk of oral cancer in the field of oral medicine in 1995. In 2018, Nam Y, Kim HG, and colleagues

released a study using natural language processing to translate the most common symptoms and past histories of TMJ problems into computer language. This led to the development of an AI-enabled system that might help dentists distinguish between different TMJ illnesses

## II. APPLICATIONS IN PERIODONTICS :

[4]The first haptics-based dental simulator created specifically for periodontics by Luciano et al. Students can learn the abilities they need to recognize and treat periodontal disorders using this simulator. You may "touch" a haptic device that displays 3D views of the upper and lower teeth as well as the gingiva. The haptic input that results simulates how a dental operator's hand feels when utilizing equipment in a professional setting. The performance of the student was also recorded and replayed by Steinberg et al in 2007. The simulator aimed to reduce the amount of time spent on lessons, accelerate learning, and provide limitless practice

[5]The initial results of an ultrasonography periodontal probe at NASA Langley were reported in 1998 by Companion et al. The purpose of this probe was to lessen the discomfort and accuracy that come with hand probing. To couple the ultrasonic beam into the tissues, it includes a hollow conical tip that is filled with water. The complicated geometries of the periodontal tissues and ultrasonic propagation in the tip were both simulated by Kevin Rudd et al. in 2009 using the 3D parallel acoustic finite integration technique (3DPAFIT).Then, using a piece of software, the tip and the structures of the periodontal tissue are created in 2D and 3D, and simulations are run to get accurate data that echoes the depths of the periodontal pockets

[6]Numerous breath analyzers have been created to take the place of the olfactory evaluation that is subjective. The primary limitations of assessing volatile sulfuric compounds (VSCs) alone are that 1) the lack of VSCs does not signify that foul breath has disappeared and 2) non-sulfur volatile chemicals, which are indicators of systemic disorders and are present in up to 15% of halitosis cases, are disregarded. The whole spectrum of inhaled volatile chemicals is evaluated using artificial olfaction, a non-invasive approach (Barash et al., 2009; Haick et al., 2014; Nakhleh, Broza et al., 2014). With the help of analytic software and a database of breath patterns, it comprises of a set of sensors, many of which are based on nanomaterial's, that semi-selectively and/or collectively evaluate the composition of exhaled air before being processed towards a pattern-recognition application. The subject's halitosis is subsequently classified as extra-oral or oral using a decision tree classifier, the latter of which can also be linked to several systemic disorders. Nakhleh, Amal et al. (2017) announced the development of 20 functionalized nanomaterial's-based sensors with an overall accuracy of 86% that can discriminate between 17 distinct systemic disorders by analyzing exhaled breath

[7] Feres et al. investigated the theory in 2017 by effectively differentiating between GeneralizedAgP in younger people and GeneralizedChPutilizing 40 bacterial species of the sub gingival microbial complexes and a linear Support Vector Machine (SVM)-based classifier

[8]A machine learning classifier that could discriminate between inflamed and healthy gums was described by Rana, Yauney et al. in 2017. Using an oral imaging equipment, the matching fluorescence from the biomarker porphyrin was captured after exposure to light with a wavelength of 405–450 nm. Plaque was shown in yellow and orange hues, whereas irritated gums were shown in magenta and red hues. After then, the classifier generates a pixel-by-pixel segmentation of areas that may have gingivitis

[9]In order to link systemic and periodontal health, Rana, Yauney et al. published an automated procedure in 2019. It integrates the previously stated intra-oral fluorescent porphyrin biomarker imaging, clinical tests, and machine learning. Here, intra-oral images were gathered, segmentation was completed using the aforementioned classifier, and co-occurrence rates between the subject's Modified Gingival Index (MGIs) and three other sources of screenings, including a self-reported medical history questionnaire, Blood Pressure (BP), Body Mass Index (BMI), single-lead ECG, optic nerve disorders, etc., were analyzed.The findings demonstrated a substantial correlation between greater MGIs and male gender, advanced age, swollen joints, and a family history of eye illness. Significant correlations were found between gingivitis and optic nerve disorders. The authors emphasize the significance of oral health screening at the primary care level in light of the findings of their study

[10]In 2018, Lee and colleagues launched a computer-aided recognition method. In order to evaluate the diagnosis and prediction of periodontally compromised teeth (PCT), a prelabeled periapical radiograph dataset was provided. Premolars and molars had diagnostic accuracy for PCT of 81.0% and 76.7%,

respectively, while premolars and molars had diagnostic accuracy for extraction prediction of 82.8% and 73.4%, respectively. The findings of this investigation demonstrated diagnostic and predicative accuracy comparable to that attained by a periodontist with board certification

[11] In 2019, Krois et al. employed artificial intelligence to identify periodontal bone loss on panoramic dental radiographs. Results demonstrated that the trained AI programme has at least dentist-like discriminating capacity to evaluate PBL on panoramic radiographs despite the restricted dataset of radiographic image segments. The use of intra-oral periapical radiographs and other imaging data, as well as data sources like clinical records, will increase the usefulness and accuracy of CNNs, according to the scientists

## III. APPLICATION IN IMPLANTLOGY

Although there is a rapidly increasing demand for dental implants, several studies have revealed that many implants do not result in success. A hybrid technique to forecast dental implant success was established in 2016 by Sadat, Nazari, et al. A mixed predictive model using different classifiers, including neural networks, SVM, W-J48, and K-NN, was reported by the authors. With an improvement in sensitivity of up to 13.3%, the results demonstrated that the performance of the combined classifiers was superior to that of a single classifier. The authors think that this model can be a trustworthy tool for determining the implant's success before surgery.[12]A methodology for fabricating implant-supported monolithic zirconia crowns (MZCs) bonded to distinct hybrid abutments was presented by Lerner, Mouhyi, et al. in 2020. Here, the crown was created using CAD software and AI. The benefits were time savings, a decreased risk of mistakes, and a decrease in prosthetic rehabilitation expenditures.The 3-year survival and success rates of the 106 implant-supported MZCs were 99.0% and 91.3%, respectively, in a retrospective research. [14]The dentist may occasionally be unable to resolve a patient's implant-related problems because they are unfamiliar with the implant system. Consequently, it is necessary to identify implant systems without relying on the expertise or knowledge of the dentist. In order to distinguish implant systems from panoramic radiographs, Takahashi, Nozaki, et al. successfully conducted a research in 2020 utilising a deep learning-based object recognition programme. According to the authors, this approach may benefit both dentists and patients who are having problems with implants. [14]

## IV. ADVANTAGES AND DISADVANTAGES OF ARTIFICIAL INTEKKIGENCE

As has been demonstrated so far, AI offers tremendous advantages and has the potential to revolutionize any professional field. One of the many advantages of AI in the healthcare setting is the accuracy it brings to diagnosis, standardization of treatment protocols, ability to shorten treatment times by eliminating routine tasks, facilitation of more systematic and structured patient data collection, and reduction in human error. It also promises to increase patient involvement in healthcare.After all of that, it's important to keep in mind that every coin has two sides. AI itself also has a number of drawbacks. The setup fees are significant, which is the most important point. AI is upgraded frequently, therefore hardware and software must stay up to match the most recent standards. Regarding all the medical data that is utilized for training and testing AI programs, AI in healthcare also faces ethical problems. Artificial intelligence is performed by computer scientists who lack any medical expertise or background. This can result in a very analytical approach to healthcare AI applications. Interaction between doctors and patients, as well as professional expertise, are crucial components of modern healthcare.

## V. FUTURE OF ARTIFICIAL INTELLIGNECE IN DENTISTRY

[2]Yo-wei Chen et al. have forecasted an AI-Comprehensive Care System for the future, which wouldanalyses the planned treatment and take into account the patient's history and prior dental radiographs before each consultation. The AI Patient Manager helps the dentist comprehend each patient's features and preferences. The AI Problem Detector will help the dentist during the consultation to diagnose the issue and will also make treatment recommendations. Additionally, it will provide the dentist feedback as they are performing the process, minimizing human mistake. Next, a prognosis and outcome are projected

[2]Dental schools and practices will soon be able to create patient libraries with electronic patient records, digital x-ray pictures, and longitudinal monitoring data using AI. Additionally, distortion-free testing is made possible by 3D intraoral scanning. The patient may be scanned, and the AI can offer a fair evaluation, rather than having two faculty members evaluate

each student's case. This offers the learner unbiased feedback on how well they are studying.Yo-wei Chen et al. also suggested that dental insurance providers may employ AI to speed up the claim acceptance process. As a result, the procedure is transparent and patients may receive dental care more quickly without worrying about their insurance coverage.

## VI.CONCLSUSION:

Artificial intelligence is having a profound influence on people's lives and is here to stay. As this article has demonstrated, there are several ways in which artificial intelligence (AI) may be used in dentistry, and more specifically, periodontics, to improve the dentist's effectiveness. It remains to be seen if this becomes a regular practice and will rely on how different stakeholders, including dentists, researchers, and data scientists, work as well as the degree to which commercial and public organizations choose to financially support AI.

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