

Assessment and Evaluation of the Role, Application, and Uses of Artificial Intelligence in Periodontology among Dental Professionals

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Citation of this Article: Dr. Aparna Thakur, Dr. Sapna Gokul, Dr. Yugandhara Desurkar, “Assessment and Evaluation of the Role, Application, and Uses of Artificial Intelligence in Periodontology among Dental Professionals”, IJDSIR- November – 2025, Volume – 8, Issue – 6, P. No. 92 – 98.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. AI has been making waves in various fields, and dentistry is no exception. In recent years, AI has been increasingly used in periodontology and implant dentistry to improve patient outcomes and streamline dental procedures.

Aim: The study aimed to evaluate the role, application and uses of AI in periodontology among dental professionals.

Methodology: The present study is a descriptive cross-sectional online survey that was carried out among dental professionals in Maharashtra. A self-structured, close-ended questionnaire that was administered that consisted of 17 questions was included. The questions were circulated through Google Forms (Google LLC, Mountain View, California, United States), and it

was circulated among the study participants through online mode. The data were collected systematically, and SPSS Statistics was used for data analysis.

Results: 250 dental professionals participated in the study through Google Forms. Among these, 70% were females and 30% were males. 53% agreed that AI can assess percentage of bone loss and staging and grading of periodontitis more accurately. 62% agreed that AI can aid to create personalized Periodontics.

Conclusion: The present study showed that the dental professionals are very much aware of AI future in periodontics. Most participants emphasized that the basic working principles of A.I. such as data science and logical statistics, should be taught in dentistry as a part of the curriculum or as value-added courses during their clinical training.

Keywords: Artificial Intelligence, Dentistry Healthcare, Periodontology

Introduction

Artificial Intelligence (AI) has revolutionized various sectors, including healthcare, where it has shown tremendous potential in diagnosing, predicting, and managing diseases. In the field of dentistry, AI has been gaining traction for its capability to enhance clinical decision-making and improve patient outcomes. The integration of artificial intelligence (AI) into periodontology is an emerging area of interest among dental professionals, particularly as the discipline seeks to enhance diagnostic accuracy, patient management, and treatment outcomes. This study aims to evaluate the role, application, and uses of AI in periodontology among dental professionals. By focusing on their understanding and utilization of AI tools, the study provides insight into how AI can impact this specialized branch of dentistry.

Methodology

The study employed a descriptive cross-sectional online survey methodology to assess the awareness and perceptions of dental professionals regarding AI in periodontology. The survey was conducted among dental professionals in the state of Maharashtra, India. The participants were selected through an online platform, ensuring a broad reach across different geographical locations.

A self-structured, close-ended questionnaire consisting of 17 questions was developed to capture various aspects of AI in periodontology, such as its role, applications, and perceived benefits. The survey questions were distributed through Google Forms, a widely accessible platform, allowing dental professionals to respond at their convenience.

The questions ranged from general awareness of AI to its applications in patient management and treatment planning, thereby assessing how dental professionals

perceive AI technologies and their role within the clinical framework. Literature suggests that AI holds transformative potential for healthcare, including dentistry, as it addresses limitations associated with traditional practices and enhances the efficiency of patient care systems^{1,2}.

The collected data were analysed systematically using SPSS Statistics, which is a robust tool for performing statistical analyses and ensuring the reliability of the findings.

Results

A total of 250 dental professionals participated in the study, with a 70% female and 30% male respondent distribution. This reflects the general gender representation in the dental profession, with a majority of females in the field. The results of the survey provide valuable insights into how AI is perceived and utilized in the field of periodontology.

90% respondents were aware that AI can create complete virtual database for every patient (fig 1).

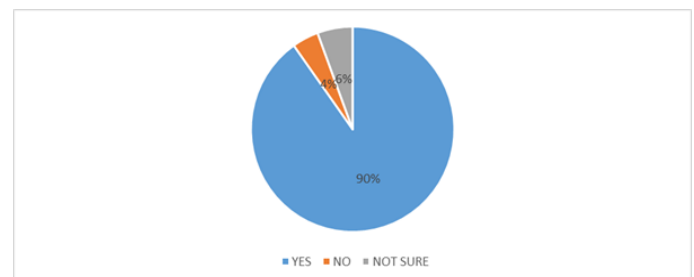


Figure 1: Participants responses on whether AI can create complete virtual database for every patient individually 55% participants expressed their knowledge about dental chairs working on AI based commands (fig.2)

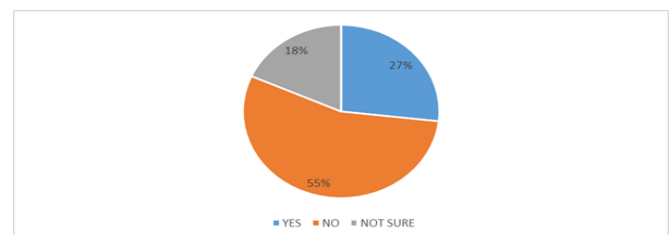


Figure 2: Participants responses on Knowledge about dental chairs working on AI based commands

39% of participants were aware that AI can predict genetic predisposition for periodontal diseases (fig-3)

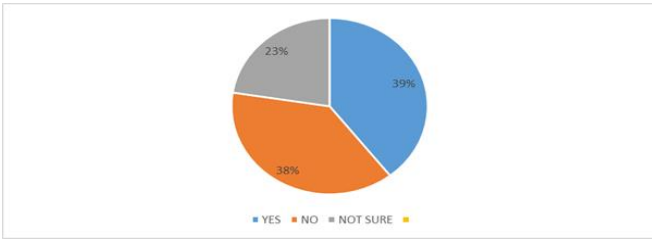


Figure 3: Participants responses on whether AI can predict genetic predisposition for periodontal diseases

52% of participants agreed that AI can assess the percentage of bone loss and the staging and grading of periodontitis more accurately compared to traditional methods.(fig 4) This reflects the increasing reliance on AI algorithms that can analyse radiographic images to detect subtle bone changes, thus facilitating early diagnosis and more effective treatment planning (fig-5)

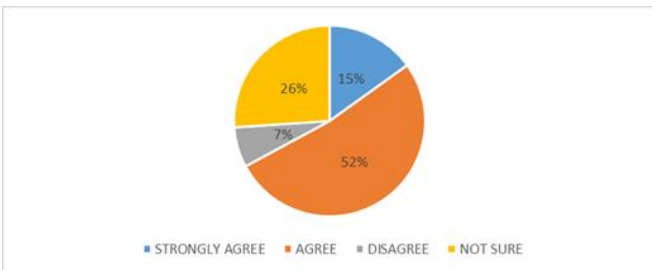


Figure 4: Participants responses on whether AI can assess percentage of bone loss and staging and grading of periodontitis more accurately.

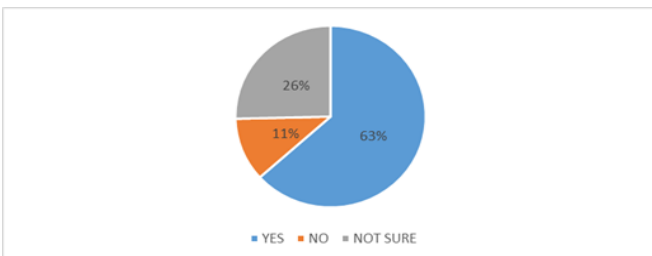


Figure 5: Participants responses on whether AI can be used in diagnosis and management of periodontal diseases.

60% of respondents acknowledged that AI has the potential to aid in creating personalized periodontal treatment plans. AI tools can analyse large datasets, including genetic, medical, and lifestyle factors, to tailor treatment approaches for individual patients, optimizing therapeutic outcomes and reducing treatment failures (fig 6)

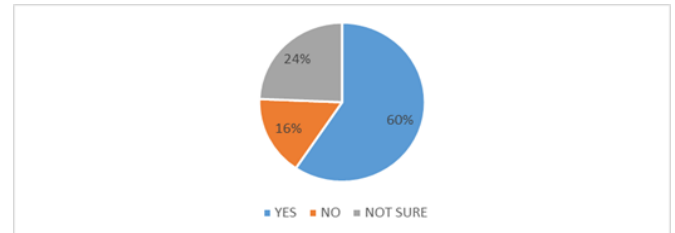


Figure 6: Participants responses on whether AI can aid to create individual treatment plan i.e. personalized treatment.

A significant portion of dental professionals noted that AI can improve the diagnosis of periodontal diseases, predict disease progression, and help in monitoring the effectiveness of treatment over time.(fig 7) AI-powered diagnostic systems, such as image recognition and machine learning models, are becoming integral in assessing clinical data with higher precision and efficiency (fig 8)

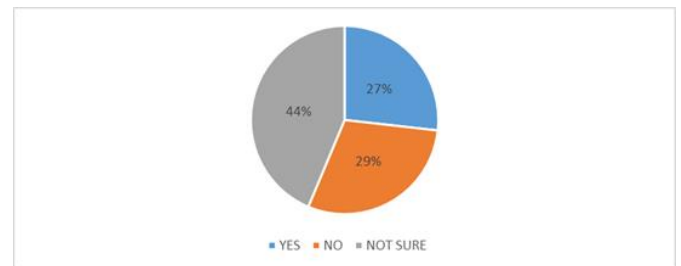


Figure 7: Participants responses on whether periodontal health will be better managed by AI

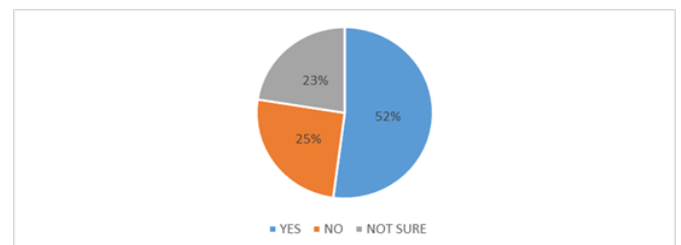


Figure 8: Participants responses on Machine learning algorithm predicting the outcome of periodontal therapy. Despite the perceived benefits, some participants raised concerns about the high cost of AI technologies, the need for specialized training, and resistance to new technologies among practitioners. Several respondents also expressed skepticism about the reliability of AI in complex cases where human intuition and experience are crucial (fig 9)

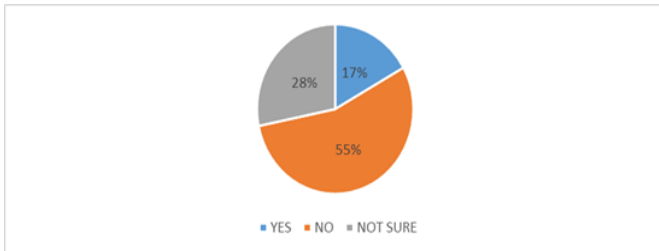


Figure 9: Participants responses on AI will be threat to periodontist in future

Discussion

250 dental professionals participated in the study. Across a cohort of 250 dental professionals, the demographic results indicated a predominance of females (70%) compared to males (30%). This distribution reflects findings in related fields, where women are increasingly represented in health professions³. The results indicate that the majority of the participants agreed that artificial intelligence would have a real and positive impact on dental practice. It is possible to create complete virtual database to all the patients with the help of AI software and many dentists are using it. Present research results were also in line with previous studies. AI incorporated voice command dental chairs are available.

Present survey 55% of participants expressed their knowledge about dental chairs working on AI based commands.

It was observed that 76.5% of the participants in this research had an acceptance position regarding the use of artificial intelligence as a planning tool for dental

diagnosis and treatment. A similar study conducted in Saudi Arabia by Sanjeev Khanagar in 2021 established that 67.6% of the participants indicated that they agreed with the aforementioned statement⁴. Artificial intelligence in the field of health has revolutionized accuracy in diagnosis and dental treatment planning, since these systems have the ability to simplify tasks and provide results in less time, which allows the dentist to save on resources and be more efficient in their dental practices.

In present study 17% dental professionals expressed their opinion regarding application of AI in dentistry may pose threat for periodontists in future.

Moreover, there is an increasing recognition of the ethical implications surrounding the use of AI technologies in clinical settings. Schwendicke et al. highlighted the importance of establishing ethical guidelines to ensure patient privacy and consent as AI systems become more integrated into healthcare practices (Schwendicke et al., 2020). Furthermore, the work of Roganović and Radenković emphasized the significance of a collaborative human-machine interface, affirming that AI should enhance, rather than replace, clinical judgment in dental care⁵. This notion is crucial, especially considering the concerns some practitioners have about AI encroaching upon their professional roles and responsibilities⁶.

Whereas a similar study conducted by Aboalshamat KT among dental professionals a more percentage (49%) compared with the present study agreed or strongly agreed that AI could replace dentist⁷.

But same time almost all the participants from the present study expressed their opinion on AI based treatment which will be accepted by patients.

While the use of AI and CNN technology may not be able to replace the gold standards of periodontal

assessments, it is showing promising results in healthcare by growing and learning as a human does to help aid in these assessments.

63% of participants strongly agreed AI can be used in diagnosis and management of periodontal diseases. AI-powered tools can help doctors and researchers analyze patient data, identify potential health risks, and develop personalized treatment plans. Patel et al. analysed the impact of AI on improving diagnostic capabilities in periodontology, asserting that AI-driven solutions lead to more efficient and effective management of periodontal diseases⁸.

60 % participants were of opinion that AI can aid to create individual treatment plan i. e. personalized periodontics.

Machine algorithms will measure and analyze radiographs, photographs, clinical assessments and chart notes with dentist level accuracy and understanding. This can result in a highly accurate output and clinically relevant results improving patient care enhancing diagnostics and reducing errors. In the present study 52% participant were of the opinion that machine learning algorithm could predict the outcome of periodontal therapy.

The findings of this study demonstrate that AI holds significant promise for advancing periodontology, particularly in areas such as diagnostics, treatment planning, and monitoring. AI-based tools, such as deep learning algorithms for image analysis, can significantly enhance the accuracy of periodontal disease detection, allowing for earlier intervention and better patient outcomes. Furthermore, the ability of AI to tailor treatments to individual patients based on a wide range of factors underscores its potential for personalized medicine in periodontology. Consequently, as AI continues to evolve, its implementation in

periodontology is likely to enhance treatment precision and individualization further^{9,10}.

One of the main limitations of our study is in relation to the method of data collection. When using a self-report questionnaire there is the possibility of social desirability bias on the part of the respondents, in which they complete the survey in a socially accepted manner rather than according to their own criteria.

Limitations of the present study included a smaller sample size. These studies should be carried out in association with the government authorities aiming a larger sample size in order to attain a perception and attitudes of all the working dental professionals. Another limitation is that the dental curriculum does not include AI content, thereby; this basic questionnaire might be insufficient to generalize the theory.

However, while the benefits are clear, the integration of AI into routine dental practice faces several challenges. The high cost of advanced AI tools, alongside the need for continuous professional training and education, remains a barrier for many practitioners. The study also highlights the importance of ongoing research and development to refine AI technologies and ensure they align with the clinical needs and expertise of dental professionals.

AI also carries its own limitations. The foremost concern revolves around the significant initial setup costs. Given that AI systems require constant updates, both in terms of hardware and software, to align with the latest requisites, this incurs ongoing expenses. Uncertainty in the realm of ethical considerations also looms over AI's application, as it involves sensitive medical data used for both training and testing purposes.

Conclusion

AI is poised to have a significant impact on future healthcare options, particularly in the realm of precision

medicine, which is widely recognized as a crucial asset in healthcare. Automatic segmentation powered by AI assists operators in expediting analysis, particularly for those not accustomed to visual analysis, enabling clinicians to provide meticulous patient care. AI technologies cannot completely replace physicians; rather, they will augment healthcare providers in delivering patient care and clinical practitioners may shift towards roles and work schedules that maximize the utilization of unique human abilities such as compassion, motivation, comprehensive assimilation and overall a patient-centric healthcare system.

From the perspective of periodontal diagnosis, AI is currently in its early stages of development and the lack of comparative studies for cost analysis, with and without AI, hinders further assessment.

As AI technology continues to evolve, it is crucial for dental professionals to stay informed and engaged with these advancements to ensure they are using the most effective tools available for periodontal diagnosis and treatment. Moving forward, the collaboration between AI developers and dental professionals will play a key role in shaping the future of periodontics and dental healthcare at large.

Recommendations for Future Research

Further studies should explore the long-term effectiveness of AI applications in clinical practice, particularly in improving patient outcomes. Research focusing on the cost-effectiveness of AI tools for periodontics will be crucial for widespread adoption in dental practices. There is also a need for educational programs that focus on training dental professionals to efficiently integrate AI into their practices. By addressing these aspects, AI can become an indispensable tool in the arsenal of dental professionals, revolutionizing how periodontology is practiced worldwide.

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