



ProBots in Periodontics: Exploration of Present and Future Realities

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INTRODUCTION

Thanks to digitization, our modern lifestyle has become extremely convenient. For example, because they have a home automation system, we use tools like ALEXA and SIRI for voice interaction with the Internet (1). Artificial intelligence (AI) is a term used to describe machines that precisely perform activities that require human intelligence (2). Artificial intelligence is basically a branch of computer science that makes it possible to create software that can perform intelligent tasks (3). AI is further divided into machine learning (ML) and deep learning (DL) as sub-branches. ML is the process by which a machine solves problems using input data and algorithms. Whereas in DL, the computer detects a hierarchy of patterns, resulting in a stronger network (4). An artificial neural network (ANN) is the basic unit of artificial intelligence composed of many neural layers. An ANN consists of two layers: input and output, with a hidden layer in between (4,5). Artificial intelligence plays an important role in the field of medicine and dentistry by distinguishing diseased from normal structures, early detection of disease, predicting prognosis of treatment plan and so on. This is where a convolutional neural network (CNN) comes in, which can recognize images using mathematical operations (2,4,5).

In 1965, John Mc Carthy coined the phrase “artificial intelligence (AI)” (6). AI has a significant impact in the field of dentistry, such as tooth recognition and accurate caries diagnosis in oral radiology (3,7). ANN is used to estimate the location of the apical foramen and to diagnose a vertical root fracture. Oral cancer can be diagnosed using ANN, support vector machine (SMV), and logistic regression, among others (1,4). AI can be used in periodontology to distinguish normal from aberrant structures, detect disease and predict the effects of therapy. It is also useful in localizing soft and hard deposits (8), predicting the success of dental implant surgery (9), diagnosing periodontally damaged teeth for extraction (3,6), and differentiating periodontitis from aggressive periodontitis (10). As one of the advances in periodontology, it has the potential to be a promising tool as an adjunct to routine practice. Consequently, the current study seeks to evaluate the awareness of the application of artificial intelligence among dental professionals and postgraduate students in periodontology.

METHODOLOGY

A cross-sectional questionnaire study of dental professionals and postgraduate students was planned. The Ethics Committee of the Institute granted ethical approval (EC202091). The questions were self-prepared, validated & made reliable. The current study included both dental professionals and postgraduate students from different centres. Five questions were designed to assess participants' knowledge of AI. The following 10 questions were based on the knowledge and awareness of the application of artificial intelligence among dental professionals and postgraduate students in periodontology. The questionnaire was made available online using Google Forms and the generated link

was shared with a total of 273 participants via email / WhatsApp groups. Data collection was done using google form questionnaire and analysed using the SPSS v.28 software.

RESULTS:

Almost all of the participants (93.0%) were aware of artificial intelligence (AI) and around 85% had an opinion that AI can simplify the effort of dental professionals. The responses of to the questionnaire are represented the table1. 44.7 % agreed that AI applications should be part of undergraduate and postgraduate dental training and 100% of them presumed that AI can aid patient management and dental assistance in the near future.

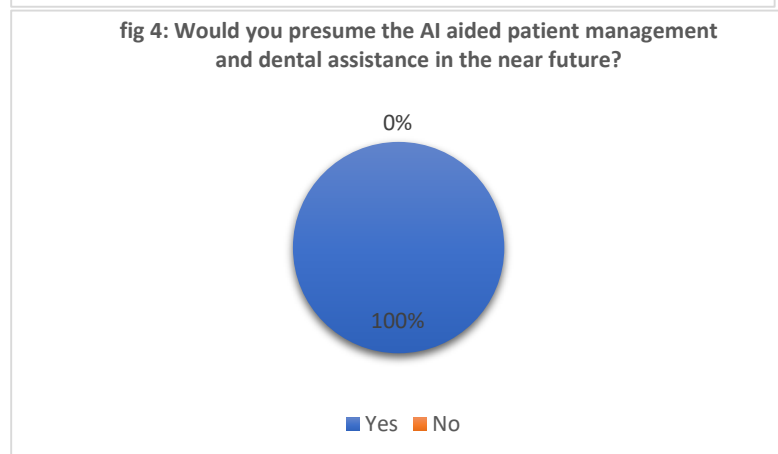
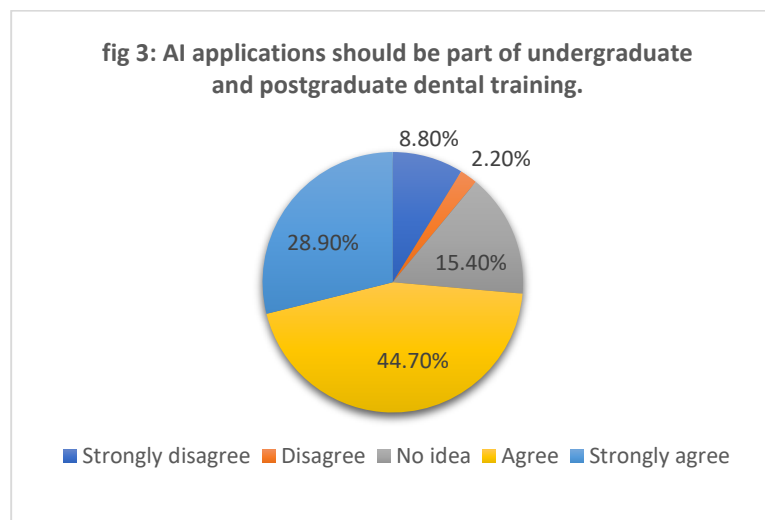
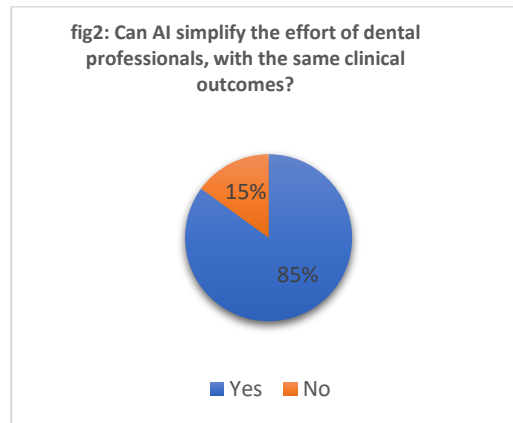
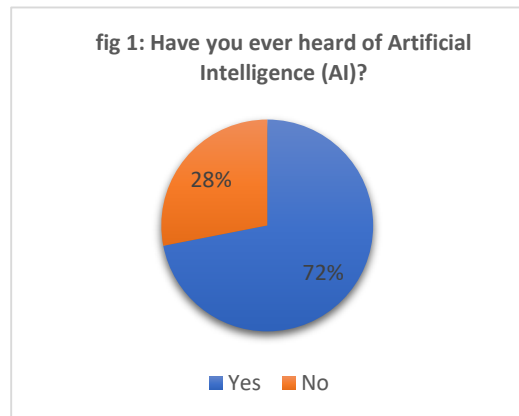


TABLE 1: REPONSES TO THE QUESTIONNAIRE

QUESTIONS	RESPONSES	NUMBER	PERCENTAGE	TOTAL
Have you ever heard of Artificial Intelligence (AI)?	Yes	254	93.0%	273
	No	19	7%	
What do you think Artificial Intelligence is?	Putting your intelligence in machine	75	27.5%	273
	Programming with your own intelligence	90	33%	
	Making a machine intelligence	108	39.5%	
	Playing a game	0	0%	
Can AI simplify the effort of dental professionals, with the same clinical outcomes?	Yes	232	85%	273
	No	41	15%	
The AI can be applied in which of the following forms in general health care?	Physical	12	4.4%	273
	Virtual	45	16.5%	
	Both	205	75.1%	
	None	11	4%	
What all methods of AI are applied in the field of Periodontics?	Decision tree & Deep learning	30	11%	273
	Neural networks & Machine learning	6	2.2%	
	Support vector machines	11	4%	
	All the above	226	82.8%	
Convolutional Neural Network (CNN) can be used as definitive diagnostic tool in the radiographic diagnosis of periodontal disease.	Strongly disagree	11	4%	273
	Disagree	6	2.2%	
	No idea	128	46.9%	
	Agree	78	28.6%	
	Strongly agree	50	18.3%	
AI can be used in 3-dimensional implant positioning and planning.	Strongly disagree	11	4%	273
	Disagree	6	2.2%	
	No idea	24	8.8%	
	Agree	170	62.3%	
	Strongly agree	62	22.7%	
Do you think application of Convolutional Neural Network (CNN) can ease diagnosis and prediction of periodontally compromised teeth?	Yes	235	86.1%	273
	No	38	13.9%	
Support Vector Machines (SVM) can be used for the following	Oral malodour	6	2.2%	273
	Gingivitis & Periodontitis	20	7.3%	
	Aggressive and Chronic periodontitis	30	11%	
	Microbial profile	6	2.2%	
	All of the above	211	77.3%	
Do you think electronic health records were analysed with natural language processing to convert chief	Yes	259	94.9%	273

complaints and history of TMJ disorders into computer language?	No	14	5.1%	
Artificial Intelligence can be used as a “prognostic tool” to predict the course of a disease and determine whether there is a chance of recovery.	Strongly disagree	30	11%	273
	Disagree	0	0%	
	No idea	57	20.9%	
	Agree	152	55.7%	
	Strongly agree	34	12.4%	
Do you think in the dental insurance space, computer vision can also be used to prevent fraud, waste, and abuse and to streamline insurance claim processes?	Yes	223	81.7%	273
	No	50	18.3%	
	Maybe	0	0%	
Do you think AI system of data collection can aid in improving patient compliance by taking Pre-appointment, inter-appointment and post-appointment?	Yes	265	97.1%	273
	No	8	2.9%	
AI applications should be part of undergraduate and postgraduate dental training.	Strongly disagree	24	8.8%	273
	Disagree	6	2.2%	
	No idea	42	15.4%	
	Agree	122	44.7%	
	Strongly agree	79	28.9%	
Would you presume the AI aided patient management and dental assistance in the near future?	Yes	273	100%	273
	No	0	0%	

DISCUSSION:

Artificial intelligence improves our daily lives in various ways (1). AI is also a major advance in general dentistry. As we all become increasingly interested in simpler ways to diagnose and treat disease, artificial intelligence will be of immense benefit to the future practice of periodontics. Early diagnosis, prognosis of damaged teeth and accurate treatment planning will be able to save teeth from further development of the disease (6). Locating the deposits is a critical step in early diagnosis [8]. Dental implants are one of the most significant advances in periodontology. Navigational implant surgeries are challenging because we strive for perfection in implant placement [4,9]. All this will only be possible if artificial intelligence is used as a complement to traditional dental practice. For this goal, research in the field of artificial intelligence in dentistry has taken a million turns. The word AI was known by 229 out of 266 participants and its applications in periodontology were known by many of them, with PGs being the most numerous. One likely explanation is that AI, as a cutting-edge technology, has yet to be integrated into college curricula. Graduate students also gain knowledge through research publications. However, many of them were familiar with the concept of artificial intelligence. According to most of them, machine learning is key in periodontics. As many PG's were found to be knowledgeable about AI, its industries and applications, most were aware of the use of machine learning in periodontics. Almost all PG's responded positively to AI as an additional asset in periodontology, while only half of all DPs believed that AI could be an additional asset. Due to the competition in the field of dentistry, all doctors are more interested in non-invasive, less time-consuming treatment options. As a complement, AI has the potential to have a significant impact. Most of the periodontology artificial intelligence exercises were known by a

large percentage of students with almost equal numbers of PG's and DPs. Only a small percentage of our survey participants were unfamiliar with 3D-guided dental implants, while others were well versed in the subject. The most important source of information was articles, followed by media, seminars and other sources. This is because professional articles are required to be read as part of the study material for graduate studies. Half of dental professionals said the media and other sources were equally helpful in learning about AI. Many participants in the current study were aware of the advantages and disadvantages of AI. According to our findings, many participants believe that artificial intelligence can improve clinical diagnosis, while only a minority believe that software tools cannot help in the detection of periodontal disease. In the current survey, more than half of the population believes that both digital and physical charting methods should be used, while only a few prefer purely digital historical records and only a few accept handwritten maps as the gold standard for treatment records. In the grand scheme of things, both computerized and handwritten mapping methods must be used in periodontal clinical practice. A majority of the 273 experts and students agreed that AI has a bright future in Indian dental practice in the coming years. Moreover, many practitioners and students agree that the use of artificial intelligence in dentistry is ethical. Many participants agreed that the future of implantation will be simple and automated. Almost everyone agrees to learn AI-related tools and ethical practices with AI. More than half of the women and men in our survey agreed that AI improves the clinical diagnosis of periodontal disorders. All PGs were eager to learn AI related tools for future use. Seram T. and colleagues (11) surveyed dental students and found comparable attitudes and perceptions of AI. Half of the participants believe that artificial intelligence will improve treatment planning and diagnosis, according to Samyuktha P.S. and colleagues (12). They chose healthcare and healthcare workers as research subjects. Furthermore, in Samyuktha P.S. and peer studies, many respondents chose digital data over physical data, which contradicts our findings. In a survey of dental students, Ranjana and colleagues (13) found that equal numbers of girls and boys believed that AI could improve clinical diagnosis. An investigation by Riesha V and colleagues (14) yielded inconsistent results. Few study participants believed that artificial intelligence could pose a threat to dental practices in terms of data confidentiality and security. Our findings on the source of information about AI contradict the results of a patient survey conducted by Jaiswal M and colleagues (15) who observed a better connection between dentists and patients through a mass media platform. According to Mupparap and colleagues (16). Artificial intelligence technologies will only benefit dentists by providing second perspectives to augment their own. However, no technology will ever replace the dentist. Hwang and colleagues (17) take roughly the same point of view. As a result, we find that most of the conclusions from the previous literature are consistent with the findings of our survey in the aforementioned studies. Our study was scalable, cost-effective and delivered results quickly. It also made it easier to contact individuals and get quick responses from them. The anonymity of the participants was protected throughout. The online format of the questionnaire provided sufficient flexibility in terms of when and where respondents could complete our survey. One of the advantages of online questionnaire surveys was the flexibility of design. Only dental professionals and postgraduate students of the Institute of Periodontology participate in this study. Since the sample size is smaller, the results may change compared to a large population study. One of the disadvantages of selection bias is the exclusion of dental trainees. To avoid sample bias, random sampling would be a better alternative. Disadvantages can be differences in understanding and interpretation, questionnaire fatigue and accessibility issues. Extensive investigation with other specialists should be done to overcome the limitations.

CONCLUSION:

The current study analyzed the awareness, knowledge and future application of AI in dental professionals and post-graduate students in periodontology towards the potential use of artificial intelligence. Most of the study participants were aware of the use of artificial intelligence in the field of dentistry. Since many students will be future academics, they should try to raise awareness about it. As artificial intelligence can be a useful addition in dentistry, the final diagnosis should be made by professionals. As a supplement to traditional dental practice, AI will be a promising tool. As a result, it seems necessary to incorporate the basic principles of artificial intelligence into the dental curriculum through lectures and seminars. Together with the implementation of AI, this could lead to the improvement of clinical practice and the expansion of dentistry.

REFERENCES:

1. Meghil, M.M., Rajpurohi, P., Awad, M.E., McKee, J., Shahoumi, L.A., Ghaly, M. Artificial intelligence in dentistry. *Dentistry Rev* 2022; 2(100009):1-11.
2. Khanagar, S.B., Al-Ehaideb, A., Maganur, P.C., Vishwanathaiah, S., Patil, S., Baeshen, H.A., et al. Developments, application, and performance of artificial intelligence in dentistry—A systematic review. *J Dent Sci* 2021;16(1):508-22.
3. Shan, T, Tay, F.R., Gu, L. Application of artificial intelligence in dentistry. *J Dent Res* 2021;100(3):232-44.
4. Nguyen, T.T., Larrivée, N., Lee, A., Bilaniuk, O., Durand, R. Use of artificial intelligence in dentistry. Current clinical trends and research advances. *J Can Dent Assoc* 2021; 87:17.
5. Schwendicke, F.A., Samek, W., Krois, J. Artificial intelligence in dentistry: chances and challenges. *J Dent Res* 2020; 99(7):769-74.
6. Sachdeva, S., Mani, A., Vora, H., Saluja, H., Mani, S., Manka, N. Artificial intelligence in periodontics—A dip in the future. *J Cell Biotechnolog* 2021; 7(1):1-6.
7. Grischke, J., Johannsmeier, L., Eich, L., Griga, L., Haddadin, S. Dentronics: Towards robotics and artificial intelligence in dentistry. 36(6):765-78. *De*
8. Li, W., Liang, Y., Zhang, X., Liu, C., He, L., Miao, L., et al. A deep learning approach to automatic gingivitis screening based on classification and localization in RGB photos. *Sci Rep* 2021; 11(1):1-8.
9. Ossowska, A., Kusiak, A., Świetlik, D. Artificial intelligence in dentistry— Narrative review. *International J Environ Res Public Health* 2022; 19(6):3449.
10. Jahantigh, F.F., Arbabi, S. The use of artificial intelligence techniques for the diagnosis of periodontal disease by clinical indices. *Industrial Engineering and Operations Management*. 2018. Available from: <http://ieomsociety.org/ieom2018/papers/48.pdf>.
11. Seram, T., Batra, M., Gijwani, D., Chauhan, K., Jaggi, M., Kumari, N. Attitude and perception of dental students towards artificial intelligence. *Univ J Dent Sci* 2021; 7(3).
12. Samyuktha, Somasundaram, P.S., J. Geetha, Awareness R.V., and knowledge about artificial intelligence in healthcare among doctors - a survey. *European J Molecular Clin Med* 2020; 1(7): 697-708.
13. Ranjana, V., Gayathri, R., Vishnu, P.V., Kavitha, S. Awareness on application of artificial intelligence in medicine among dental students: A survey. *J Contemporary Issues Business Govern* 2021; 27:3130-42.
14. Rieshy, V., Sasanka, L.K., Devi, R.G., Ramanadhan, V., Ganapathy, D. Artificial Intelligence in Dentistry-A Survey. *Ind J Forensic Med Toxicol* 2020; 14(4). Available from: <https://medicopublication.com/index.php/ijf/mt/article/view/12434>.
15. Jaiswal, M., Gupta, N., Singh, A. Study on patient's awareness towards role of artificial intelligence in dentistry. *Int J Health Sci Res* 2019; 9(10):35-9.
16. Mupparapu, M., Wu, C.W., Chen, Y.C. Artificial intelligence, machine learning, neural networks, and deep learning: futuristic concepts for new dental diagnosis. *Quintessence Int* 2018; 49: 687-8.
17. Hwang, J.J., Jung, Y.H., Cho, B.H., Heo, M.S. An overview of deep learning in the field of dentistry. *Imaging Sci Dent* 2019; 49: 1-7.