



Unlocking AI Potential: Dental Students' Awareness and Hurdles

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ABSTRACT:

Background-In the rapidly changing field of technology, artificial intelligence has been an increasingly popular subject. Determining dental students' knowledge and attitudes on the application of artificial intelligence in dentistry is important because of the exponential growth in its use in recent years.

Aim-This study attempts to determine the attitude, perceptions and barriers among dental undergraduate students in India towards the use of artificial intelligence (AI) in dentistry.

Material and Methods-A questionnaire based descriptive cross-sectional survey was done through google forms among the undergraduates. The survey was conducted in the period of January 2024 to June 2024. The questionnaire had 21 questions divided into several sections with the aim of evaluate dental students' knowledge and attitudes towards AI and its potential uses in dentistry. The confidentiality of the participants was ensured, and the data collected was statistically analysed using SPSS software.

Results- A total of 242 participants responded to the questionnaire of which 128 (59%) were familiar with the working principles of AI and 87 (36%) were aware about its usage in dentistry. For most of the participants (46%) social mediawas the source of information regarding AI.33.9 % illustrated that lack of awareness and lack of training were the main reasonsthat hindered the use of AI.29.8 % agreed that AI applications being included in undergraduate training curriculum.

Conclusion- In accordance to the outcomes of the current study, students were aware of artificial intelligence and had the belief that it would transform dental practice in the future. Further research into the applications of AI and its incorporation into dental curricula is necessary.

Introduction

The human brain, the most advanced and intellectual among all species, has captivated researchers for decades. Since the 1950s, efforts to replicate its

intelligence through technology have led to significant advancements aimed at simplifying human life. Artificial intelligence (AI), defined as a system's ability to acquire, process, and apply knowledge akin to human



intelligence, exemplifies such innovation.¹ Coined by John McCarthy,² AI integrates machine learning (ML) and deep learning to enable efficient data processing, predictive modeling, and problem-solving. AI's integration into healthcare has gained global traction, with applications poised to revolutionize healthcare systems and improve patient care.³ In dentistry, AI is transforming diagnostic and therapeutic approaches. ML algorithms, such as Support Vector Machine (SVM) and Random Forest (RF), analyze imaging modalities like Cone Beam Computed Tomography (CBCT) to classify oral pathologies based on cytological and intrinsic features. Convolutional Neural Networks (CNN) further aid in staging malignancies and diagnosing potentially malignant lesions. Applications also include diagnosing temporomandibular joint disorders, caries detection, and treatment planning for periodontally compromised teeth using advanced imaging and robotics for precision.⁴ The COVID-19 pandemic has further accelerated AI adoption in dentistry, with telehealth technologies enabling AI-driven virtual consultations. AI-powered chatbots and virtual assistants now personalize treatment plans for procedures like orthodontics, implant placement, and smile design.⁵ However, AI adoption remains limited due to gaps in awareness, technical expertise, and scepticism about AI outcomes.⁶ This study examines the attitudes, perceptions, and barriers to AI adoption among Indian dental students. It explores whether incorporating AI into dental curricula could enhance understanding and acceptance, aiming to highlight AI's transformative potential for improving oral healthcare and fostering innovation.

Methodology

This research employed a cross-sectional descriptive design to assess the level of awareness concerning artificial intelligence among dental students in central India. From January 2024 to June 2024, the study included extensive stages of data collection, thorough analysis, and careful compilation of results. The study received ethical approval from the Institutional ethics Board of the Peoples College of Dental Sciences And Research Centre, Bhopal (EC244234). The target sample included dental undergraduates from both genders (first year to interns) who consented to participate in the study. The individuals were

determined using a continuous sampling method. Exclusion criteria were passed-out students, non-consented and psychologically ill participants. In this online questionnaire survey data was collected through Google Forms circulated via emails or social media platforms. A questionnaire consisting of 21 close-ended questions of multiple-choice type having five levels of agreement (strongly disagree, disagree, no idea, agree, strongly agree) was used. Reliability and validity of the same were assured before circulating the forms. It was divided into various sections. The first section consisted of questions about participants' sociodemographic and educational characteristics. The form also consists of questions about the source from which the participant has perceived knowledge about AI and his/her perception of the scope and application of artificial intelligence in dentistry. The barriers or hindrances in the use of AI were also included as a part of questionnaire. The questionnaire contained the consent form. The data was analysed using Statistical Package for Social Sciences software 26 version (IBM, Chicago). Statistical calculation was done using a chi-square test and tests for proportions were used wherever applicable. A P-value of less than 0.05 was deemed statistically significant.

Result

The cross-sectional research was conducted on 250 participants out of which 242 were completed the survey form. Among the study participants, majority were females (n=182, 75.3%). 20-30 years of age group and BDS 1st year comprised of 77.7% and 27.3% respectively. (Table 1) This study surveyed dental students to evaluate their perceptions and readiness regarding the integration of artificial intelligence (AI) in dentistry. Of the total 242 participants, 128 (59%) were aware about the working principles of AI and 87 (36%) were aware about the usage of AI in dentistry. The P-Value is more than 0.05 so the result shows there are no significant differences between the groups. (Table 2) The participant's source of AI information is highlighted in Graph 1. The majority of participants (46%) obtained their information about AI via social media, followed by university lectures (24%), friends and family (23%), and newspapers and periodicals (7%). Graph 2 shows the respondents obstacles to the application of AI in dentistry. Among all the respondents, 33.9% illustrated that lack of awareness prevents the use of AI in



dentistry while 33.9% shows that lack of training personnel in college was the main reason which hinders the use of AI. Furthermore, 16.9% of respondents cite a lack of technical resources, 5.4% claim that it is not cost-effective, 3.3% confirm that it is not necessary in the curriculum and is not patient-friendly, and just 2.1% cite limited future application as the main drawbacks of using AI in dentistry. A total of 13 questions / statement regarding perception of AI were presented to respondents as shown in Table-3. Among the participants, only 29.8% of participants think that dental education should include AI applications, whilst 25.6% think that AI in dentistry is exciting. Least number of undergraduates (3.3 %) believe that AI can replace dentists at work although 22.7 % suggests that AI will lead to major advances in dentistry ,19.8%

recommend the use of AI in forensic dentistry and 20.2 % suppose that it can be used for radiographic diagnosis of pathologies in the jaw. 15.3% and 17.8% of the students, respectively, strongly agreed that it can be utilized as a tool for treatment planning and quality control. In addition, 20.2 % participants consider that it can be used in 3-dimensional implant positioning and planning whereas 16.1 % were feel that it can be used in diagnosis of soft tissue lesions and 17.8 % consider it for radiographic diagnosis of dental caries. Among the undergraduates, 14% and 10.7% used it as prognostic and diagnostic tool respectively. On analyzing the level of perception, a statistically significant association was found between the levels of education. Respondents gave statistically significantly more answers to all the statements except Q3, Q4, Q5 and Q13 ($p > 0.05$)

Table 1- Demographic details of participants n(242)

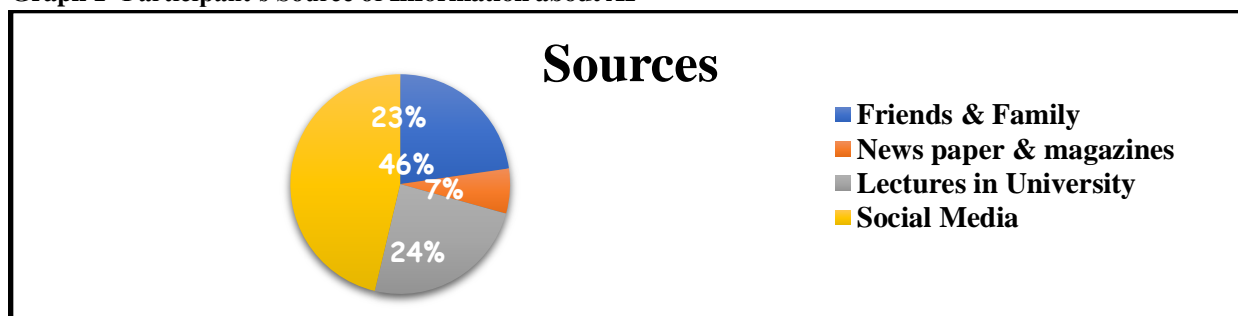
Variables		Total Number (n)	Percentages (%)
Age	Below 20	54	22.3 %
	20-30 years	188	77.7%
Gender	Male	60	24.7
	Female	182	75.3
Qualifications	BDS I Year	66	27.3
	BDS II Year	49	20.2
	BDS III Year	55	22.7
	BDS IV Year	48	19.8
	Interns	24	10

Table 2- Participants Awareness regarding AI in dentistry

S. No.	Questions related to Knowledge	Yes n (%)	No n (%)	May be n (%)	P- Value
1.	Are you aware about working principle of AI?	128 (52.9)	46 (19)	68 (28.1)	0.221
2.	Are you aware about usage of AI in dentistry?	87 (36)	105 (43.4)	50 (20.7)	0.664

P value is significant at >0.05

Graph 1- Participant's Source of Information about AI-





Graph 2 –Barriers in use of AI in dentistry-

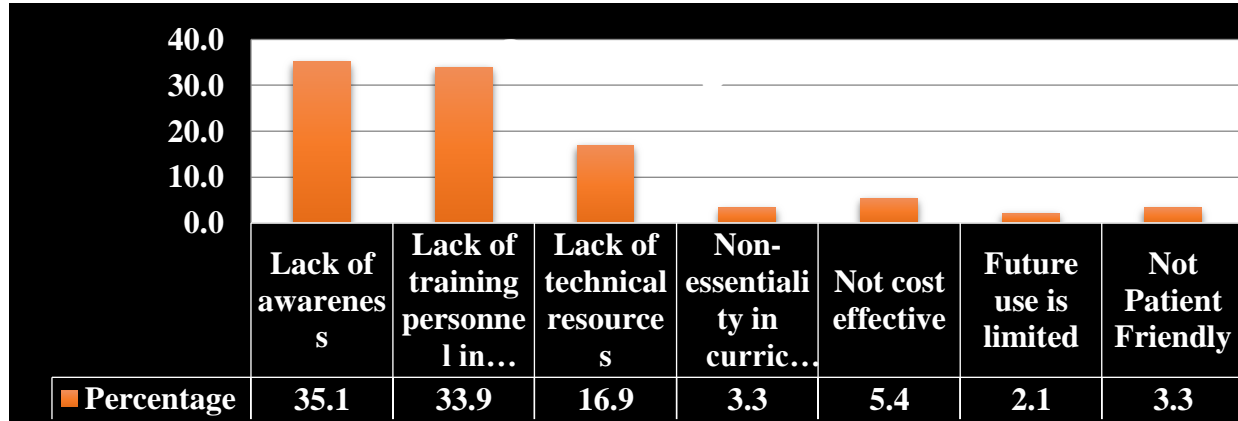


Table 3- Participants perception regarding AI in dentistry-

S.No.	Questions related to attitude	Strongly Agree	Agree	No Idea	Disagree	Strongly Disagree	P- Value
1.	AI application should be a part of dental training?	72 (29.8)	121 (50)	34 (14)	11 (4.5)	4 (1.7)	0.046*
2.	Use of AI in dentistry is exciting	62 (25.6)	125 (51.7)	44 (18.2)	6 (2.5)	5 (2.1)	0.015*
3.	AI can replace dentists at work?	8 (3.3)	44 (18.2)	55 (22.7)	100 (41.3)	35 (14.5)	0.087
4.	AI will lead to major advances in dentistry?	55 (22.7)	138 (57)	34 (14)	13 (5.4)	2 (0.8)	0.142
5.	AI can be used in forensic dentistry?	48 (19.8)	141 (58.3)	44 (18.2)	7 (2.9)	2 (0.8)	0.300
6.	AI can be used for radiographic diagnosis of pathologies in the jaw?	49 (20.2)	136 (56.2)	53 (21.9)	3 (1.2)	1 (0.4)	0.002**
7.	AI can be used as a “quality control tool” to assess the success of treatments?	37 (15.3)	141 (58.3)	55 (22.7)	5 (2.1)	4 (1.7)	0.000**
8.	AI can be used as a “treatment planning tool” in dentistry?	43 (17.8)	138 (57)	39 (16.1)	19 (7.9)	3 (1.2)	0.000**
9.	AI can be used in 3-dimensional implant positioning and planning?	49 (20.2)	128 (52.9)	58 (24)	5 (2.1)	2 (0.8)	0.002**
10.	AI can be used in diagnosis of soft tissue lesions of oral cavity?	39 (16.1)	122 (50.4)	62 (25.6)	16 (6.6)	3 (1.2)	0.005**
11.	AI can be used for radiographic diagnosis of dental caries?	43 (17.8)	138 (57)	53 (21.9)	6 (2.5)	2 (0.8)	0.014**



12.	AI can be used as a “prognostic tool” to predict the course of a disease and determine the chance of recovery?	34 (14)	121 (50)	77 (31.8)	8 (3.3)	2 (0.8)	0.014**
13	AI can be used as a ‘definitive diagnostic tool’ in the diagnosis of diseases?	26 (10.7)	118 (48.8)	74 (30.6)	18 (7.4)	6 (2.5)	0.108
* P value is significant at P < 0.05, ** P value is highly significant at P < 0.00							

Discussion

In an era where technology plays a crucial role, Artificial intelligence holds great promise as a technical improvement in the medical industry, especially in the field of dentistry.^{1,7} In addition to having knowledge, it is crucial to investigate its possible uses in dentistry. Enhancing diagnosis, prognosis, and treatment outcomes may be possible by combining artificial intelligence (AI) with the knowledge of dentists. This emphasizes how important it is to include AI education in undergraduate and graduate programs in order to guarantee that students acquire knowledge that is both pertinent and supported by research. The Reframing Organizations approach by Bolman and Deal has been suggested by Islam et al. as a framework for introducing AI-focused dental education courses.⁸ The survey found that the majority of participants were female, comprising 75.3% of the population. Zia et al.⁹ reported comparable outcomes (67%). However, there was an equal gender distribution in the study by Kahveci et al.¹⁰ Although there was agreement that AI would not completely replace dentists, more than half of the 55.4% of students in the current study thought that integrating AI into dental education was exciting and could result in significant advancements in dentistry, which is consistent with the findings of earlier researchers.^{10,11} Previous research⁶ also emphasizes that AI cannot replace dental surgeons because physical dexterity and sensory awareness are essential for many dental operations. Furthermore, patient interaction is necessary for the efficient administration of dental treatments in order to build trust, reassure patients, and show empathy all of which are outside the purview of AI. According to the literature^{12,13} majority of participants were familiar with the working principles of AI, had basic knowledge and were aware that AI applications

were being used in dentistry. These findings were in agreement with the present study. The study revealed that, in contrast to a previous study¹⁴ that found less knowledge; dentists had a very good grasp of artificial intelligence. However, because AI is so adept at detecting conditions in picture analysis and even automatically recommending the appropriate test, it is said to improve therapy efficacy, reliability, and accuracy. However, awareness regarding AI applications in dentistry was nearly evenly split between those knowledgeable and those unaware. These findings highlight the growing interest among dental students in emerging technologies like AI and their enthusiasm to learn. Participants stressed the importance of incorporating the fundamental principles of AI into dental education, aligning with observations from other studies in the literature.¹⁵ A large number of participants expressed excitement about the use of AI, viewing it as a definitive tool for diagnosis, prognosis, and treatment planning. Most participants agreed that AI could be effectively applied in radiographic diagnosis of tooth caries, identification of oral soft tissue lesions, 3D implant positioning, and forensic dentistry. Several studies have proposed various models for detecting caries, diagnosing oral pathologies, accurately positioning dental implants, and leveraging data in forensic dentistry.¹⁶ However, challenges remain, including the collection of accurate data and the use of multiple AI models. When asked about barriers to AI adoption in dentistry, the majority cited a lack of awareness, while insufficient training personnel and technical resources were also identified as obstacles. Incorporating AI into the dental curriculum would not only improve the quality of dental care but also enhance the precision of diagnosis, treatment planning, and treatment outcome predictions. Additionally, it would



provide an unbiased and objective method for assessing students' clinical and laboratory work, as well as their use of materials and equipment.⁹

Limitations

The study's limitations include the sample size which may render it more difficult to execute the results overall. Additionally, the use of closed-ended questions may have led to biased responses, as some participants may have been sensitive to certain questions, resulting in inaccurate feedback or survey fatigue. Future research should focus on developing more accurate AI models for diagnosing and predicting the outcomes of different dental treatments. Furthermore, for dental students to learn more about AI and its applications, seminars, lectures, and workshops must be organized.

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