Role of robotics and artificial intelligence in oral health education. Knowledge, perception and attitude of dentists in India

Deepak Baby, Lauabel John, Joseph Changankary Pia, PV Sreedevi, Samarjeet J. Pattnaik[1], Anish Varkey[2], Shivam Gupta[3]

Abstract:

BACKGROUND: Artificial intelligence or AI may be identified as the use of Personal Computers and/or machines in performing certain specific types of tasks that usually have the requirement of humanized knowledge. These specific tasks include acknowledgment of the problem, understanding disease dynamics, and determining the clinical diagnosis.

MATERIALS AND METHODS: This cross-sectional and prospective study was conducted on Dental professionals who were practicing all across India after obtaining approval from the Institutional Ethical Board. A previously validated as well as pre-analyzed questionnaire form was distributed using electronic mail and through the use of social media with a briefly explained description of the study purpose and an informed consent form. The study questionnaire comprised "close-ended" queries that were then divided into foursections. All the study participants were then instructed to select any one option among all the provided answers. The entire study was completed within one month. Collected observations were entered within a Microsoft Excel 2007® master chart. Statistical analytical software tool SPSS version 20.0, IBM Corporation was employed. "Chi-square" test was performed for evaluating statistical association. A *P* value lesser than 0.05 was fixed with statistical significance.

RESULTS: On analyzing the level of knowledge, 82.5% of subjects had knowledge of artificial intelligence while 11.4% had no knowledge and 6.1% had some knowledge of this tool. 69.1% were knowledgeable regarding the use of AI in lesional diagnosis, 12.8% had no knowledge regarding artificial intelligence for the diagnosis and 18.1% had no knowledge regarding AI in the diagnosis. 71% had knowledge concerning the use of AI for Imaging. Knowledge of AI in Oral Hygiene was seen in 54.3%. 91.2% of participants had knowledge of robotics use in Oral Surgery. 77% of dentists had knowledge regarding the use of AI for the enhancement of clinical practice. 95.5% had a higher 'positive' attitude toward the use of AI in academics. 69.1% of dentists had a positive attitude regarding AI incorporation in practice. 5% of dentists considered artificial intelligence better than human intelligence for diagnosis. 10% believed that disparities can exist between AI-based and human diagnosis.

CONCLUSION: Positive correlations were noted between knowledge, attitude, and practice of AI among studied dentists.

Keywords:

AI, attitude, dentistry, intelligence, knowledge

Department of Conservative Dentistry and Endodontics, P.S.M. Dental College and Research Center, Thrissur, Kerala, India, [1]Department of Periodontics, Hitech Dental College and Hospital, Bhubaneswar, Odisha, India, [2]Department of Periodontics, KMCT Dental College, Kozhikode, Kerala, India, [3]Private Dental Practitioner, New Delhi, Delhi, India

Address for correspondence:
Dr. Shivam Gupta, Private Practitioner, New Delhi, Delhi, India. E-mail: sgupta66688@gmail.com

Introduction

The use of technological advances for imitating human intelligence is a

How to cite this article: Baby D, John L, Pia JC, Sreedevi PV, Pattnaik SJ, Varkey A, *et al*. Role of robotics and artificial intelligence in oral health education. Knowledge, perception and attitude of dentists in India. J Edu Health Promot 2023;12:384.

concept dating as early as 1950.[1] Artificial intelligence or AI is a novel area in science and technology. AI is also termed as the "Stethoscope of the twenty-first century"as it is rapidly becoming an important tool in both medical and dental fields.[2]

Virtual assistance software like Alexa or Siri, facial recognition, robotics, healthcare-based software, and self-driven cars are a few of the day-to-day examples of artificial intelligence in almost all aspects of one's life. India being a technologically driven progressive country is slowly adopting these newer technological tools.[3]

The use of AI programming has slowly become popular in the field of dentistry, most importantly, in Radiodiagnosis. Auto-segmentation of mandibular or inferior alveolar nerve, facial growth analysis, tracing methods for the landmarks in cephalometry, diagnosis of dental caries, loss of alveolar bone, periapical pathologies are few of the newer applications in Dentistry that involve AI. AI is being considered to play an important role inthe early detection of oral cancer and its metastases to cervical lymph nodes as well as in diagnosing and treatment planning of oro-facial disorders.[4]

Artificial intelligence can be used in the field of dentistry for making academic tasks like pre-clinical exercises such as the arrangement and preparation of teeth, behavioral management in children with anxiety, and treatment procedures performed by robots.Thus, artificial intelligence can reduce the workload on educators as well as reduce the cost involved in education.[5] Hence, Understanding theAI technique and slowly adapting to the re-defined roles of a dentist is an important need of clinical dental practice in the near future.[6,7]

AI may be incorporated within Dental Educational System by creating scenarios in virtual reality which can enable the simulation of practical-based three-dimensional procedures.[8]

Thus, AI may be usedfor making a clinical diagnosis of any lesion for planning treatment. Hence, AI can be of advantage in Dentistry.

Although AI is useful in dentistry and may have utility in dental offices, it has not found extensive use. As a result, a wide gap is present in the knowledge concerning the applicability of Artificial Intelligence in Dental clinics as well as in academics.

Hence, this study was carried out to assess knowledge, attitude, and practice of robotics and artificial intelligence in dental health education among dental professionals in India.

Materials and Methods

Study design and setting
This cross-sectional prospective study was carried out involving Dental professionals practicing all over the country (India).

Study participants and sampling
This study comprised 100 MDS and 100 BDS professionals. A pre-validated and pre-tested questionnaire with a Crohnback α value of 0.85 was circulated by electronic mail and through social media sites such as WhatsApp or Telegram along with a brief description explaining the aim of this study and a consent form.

Data collection tool and technique
The study questionnaire contained nineteen close-ended questions that were divided into three sections. The first part of the study dealt with collecting socio-demographic data concerning the participating dental practitioners whereas the remaining part of the study was concerned with the dental professional's Knowledge, Attitude, and Practice of artificial intelligence and robotics in dentistry. The study respondents were instructed to select a single option from all the answers that were given for every query. The entire survey was completed in 1-month period.

Ethical consideration
The ethical clearance for the study was obtained from the concerned Institute's Ethical Review Board committee (EC/PP/098/2022). Written informed consent was obtained from all the selected study participants.

Statistical analysis
Collected observations were entered into a Microsoft Excel master chart 2007®. Statistical analysis was done by using the statistical software tool SPSS (statistical package for social sciences version 20.0 (IBM) version®. A Chi-square statistical test was performed to evaluate any association. *P* value less than 0.05 was set as statistically significant.

Results and observations
On analyzing the study data, 112 participants were found to be male subjects while 88 were female dental professionals. One hundred fifty-threedental professionals were in active practice for a period lesser than a 1-year duration. The age range of participating dentists was found to be ranging between 20 to 34 years.

a) Levels of knowledge
It was seen that 82.5% of studied subjects had knowledge of artificial intelligence with only 11.4% of dentists havingno knowledge while 6.1% had some knowledge of artificial technology.

69.1% had knowledge regarding the use of AI in diagnosing lesions clinically, 12.8% had no knowledge of its diagnostic use whereas only 18.1% had some knowledge.

71% knew about the role of AI in diagnostic imaging while 25% had no knowledge and 4% had some knowledge regarding AI use in imaging. 54.3% of dentists had knowledge concerning AI in the assessment of Oral Hygiene status. 91.2% of study participants possessed knowledge about the use of robotics in Oral Surgery while 13.7% lacked any knowledge of the same. 5.1% had some knowledge regarding robotics usage in Oral Surgical procedures. 77% of participating dentists had knowledge regarding the role of AI in enhancing clinical dentistry while 16.3% were of negative opinion regarding the same. 6.7% considered that AI may have some role in upgrading clinical practice [Table 1, Figure 1].

b) Attitude

95.5% of all dental personnel were in agreement regarding the use of artificial intelligence academics while only 4.5% disagreed with this. 69.1% of dental professionals agreed that AI may improve diagnostic capabilities while 30.9% disagreed with this. 77% believed that AI can be employed for teaching as well as in clinical practice while 12% did not consider this a possibility. However, 11% thought that AI may have some role in teaching as well as clinics [Figure 2].

c) Practice

A very high percentage (81.2%) of practicing dental professionals were in favor of incorporating the technology of artificial intelligence in their practice with only 11.4% not in favor while 7.4% thought that AI may have some role. Only 5% of studied dentists felt that AI is better than human thought processes and intelligence in arriving at a final diagnosis while 57% had a negative opinion regarding this. However, 38% considered that there might be some advantage to prefer AI over human intelligence. 10% of dental practitioners believed that there may be disparities between AI-based diagnosis and human intelligence-based diagnosis while 21.1% thought of no such dissimilarities. 68.9% were not sure about this question [Figure 3].

Statistical tool applied: The Chi-square test, a non-parametric test was applied over collected qualitative data which was based upon qualification according to responses received and the total number of years in practice along with recorded response. A statistically significant association was observed between the total number of years spent in dental practice and awareness as well as attitude regarding the inclusion of AI on day-to-day basis.

Spearman's correlation test was worked over a qualitative set of data for establishing an inter-relationship between

Table 1: Questionnaire regarding knowledge, attitude, and practice regarding artificial intelligence among dental professionals

	Responses	Percentages
(I) Knowledge:		
a) Regarding artificial intelligence	Yes	82.5%
	No	11.4%
	May be	06.1%
b) Artificial intelligence can be part of clinical diagnosis	Yes	69.1%
	No	12.8%
	May be	18.1%
c) AI can be used in diagnostic imaging	Yes	71%
	No	25%
	May be	04%
d) AI can be used for checking oral hygiene status	Yes	54.3%
	No	34.6%
	May be	12.1%
e) Use of robotics in Oral surgery	Yes	91.2%
	No	13.7%
	May be	5.1%
f) AI has uses in the enhancement of clinical dentistry	Yes	77%
	No	16.3%
	May be	06.7%
(II) Attitude:		
a) Improving diagnostic capacities with artificial intelligence	Agree	69.1%
	Disagree	30.9%
b) AI can enhance the academic curriculum	Agree	95.5%
	Disagree	04.5%
c) Regarding including AI in dental teaching in theory as well as in clinics	Yes	77%
	No	12%
	May be	11%
(III) Practice:		
a) incorporation of AI in clinical practice	Yes	81.2%
	No	11.4%
	May be	07.4%
b) If AI is better than human intelligence and thought processes in diagnosis	Yes	05%
	No	57%
	May be	38%
c) Any disparities in the final diagnosis	Yes	10%
	No	21.1%
	May be	68.9%

responses regarding knowledge as well as perception regarding artificial intelligence. Positive correlative relation was noted between awareness concerned with artificial intelligence and a subsequent rise in clinical dental practice. Statistical significance *P* value of 0.04 was obtained.

Again, a positively significant statistical correlation was observed between the ease of involving artificial intelligence in one's day-to-day practice presently and the use of technology of Artificial Intelligence in previous years.

Again, statistically significant and positive correlative values were observed between existing awareness regarding the use of artificial intelligence as well as related
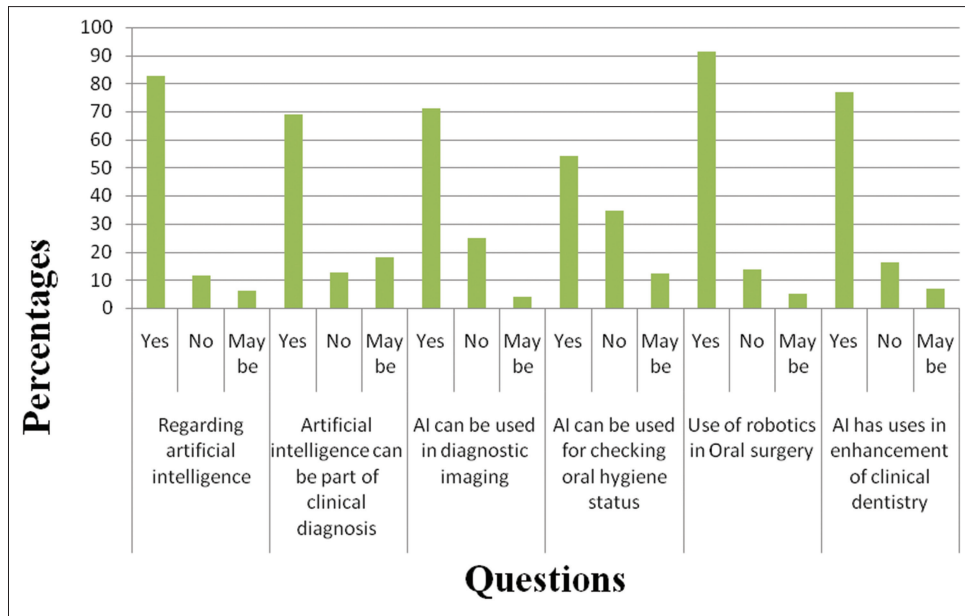
Figure 1: Graph illustrating knowledge regarding use of artificial intelligence in dental education in India
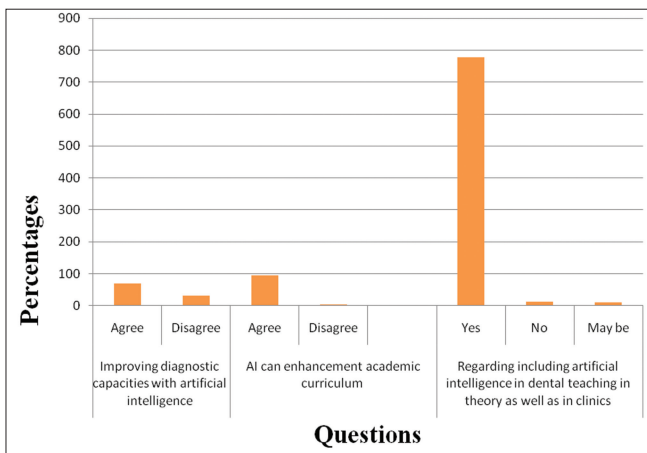

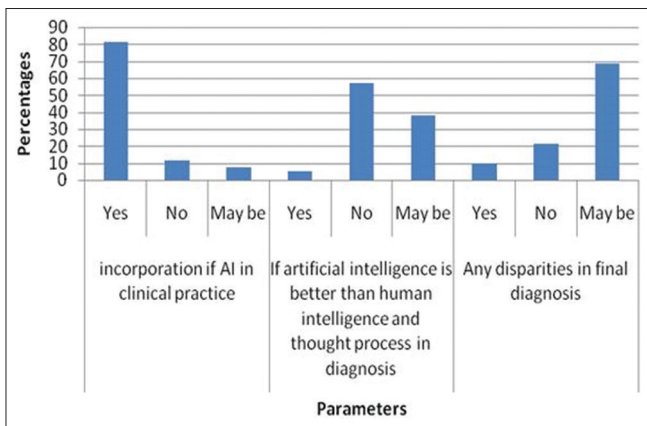**Figure 2:** Graph illustrating attitude regarding using Artificial intelligence in dental education in India

Figure 3: Graph depicting the practice of AI in dental education in India

On employing a logistic regression test, a statistically significant correlation was observed between practicing dentist's qualifications i.e. if possessing a master's or bachelor's degree as well as total experience in dental practice with a 95% confidence interval.(OR = 0.6, CI = 1.-8.9),(OR = 0.69; CI = 0.9-0.277). However, no statistical association was obtained between a dental professional's age and gender with that knowledge.

On analyzing the level of perception, a statistically significant association was found between the level of education and gender at a 95% confidence interval (OR = 0.49, CI = 0.7-1.2); (OR = 0.45, CI = 1.8-0.89) while no statistical association was obtained between age and total experience in dental practice.

Discussion

The expansion, as well as the applicability of artificial intelligence, presently exhibits involvement in the medical and dental fields.[9] Artificial intelligence may be used for supporting dental diagnosis and has demonstrated continued expansion since the previous decade.[10]

Robotics is a next generational based technology that has created novel pathways in different areas of dentistry. Specified robots for dental training resemble humanoid robots which are termed "Phantoms". Robots specified for treatment procedures are nanorobots, simroids, Endomicro robots, implant robots, robotics-derived dental drills, and orthodontic arch wire bending robots.[11]

The use of robotics can result in the improvement of dental procedures associated with clinical dentistry.

comfort in the use of artificial intelligence in day-to-day practice which indicated linear inter-relationship.

The applications that are based upon the use of artificial intelligence may help in restructuring patient-based care, reducing dental treatment procedural period, improvements in health care at reduced cost factor covering a wide population, and finally assisting prognosis, acting as a protective barrier in case of infectious diseases such as COVID-19.[12]

Yu KH *et al.* in 2006 included the then "proposed system of Artificial Nerve Organs Network"that can detect the wearing loss of teeth. By making use of backward propagation of neural-based networks, most specifically, X-ray radiographic images of teeth can be analyzed and thus, the resultant networking system may prove to be more accurate for the detection of dental caries.[13]

Thus employing AI has numerous challenges as it cannot be incorporated into high-level discussions with different individuals for attaining their trust and assurance regarding procedures.[14] Even today for attaining a thorough diagnosis in clinical situations, dentists are required for assessing tricky oral and maxillofacial conditions which may include health-related background, conducting physical systemic examinations, and encouragement of discussions on interesting cases.[15,16]

Hence, considering the future influence of artificial technology on the healthcare system and associated industry, this topic must be necessarily included in the existing curriculum.

According to our findings, 82.5% of practicing Dental professionals possessed awareness as well as knowledge concerning AI. Similarly, 81.2% of these professionals were favoring the incorporation of novel technology involving AI in clinical dental practice. According to the present findings a high amount of knowledge, awareness as well as willingness to use artificial intelligence in Dental practice represents the acknowledgment of solutions that can be derived from the use of this technology in the field of Dentistry.

Pauwels R *et al.* (2021) reported a lowering of doubts regarding the use of AI after an information-based lectureon artificial intelligence.[17] Hence, imparting knowledge and training regarding the applicability of artificial intelligence might help in reducing negative responses and attitudes toward using this tool. In the current study, 95.5% of dental practitioners were found to possess greater adaptability along with a higher positive attitude toward enhancing their knowledge regarding the usage of this modern technology in various fields of Dentistry including academics.

In a similar study conducted on the Turkish population, it was found that 74.60% of dental professionals believe that artificial intelligence must be incorporated into both post-graduate as well as undergraduate curricula, respectively.[18]

Most of the dental personnel within the purview of this survey-based analysis believed that artificial intelligence cannot completely replace dentists or physicians or surgeons when compared with other types of professions such as engineering or the information technology sector.

Limitations and recommendations
The limitations of this study included limited sample size, close-ended questionnaires, and misinterpretations of the questions.

Future studies are recommended with more precise questionnaires that may include all the healthcare professionals across India.

Conclusion

AI is an upcoming technological tool in medical and dental sciences. In the present study, the majority of dental practitioners were found to have high levels of knowledge regarding artificial intelligence and had positive attitudes regarding its inclusion in the teaching curriculum and patient management. Hence, it can be concluded that artificial intelligence can be included in teaching courses in Dental education though complete dependence on diagnosis should be restricted and more research to achieve complete reliability should be done.

Conflicts of interest
There are no conflicts of interest.

References

1. Asmatahasin M, Pratap KV, Padma TM, Kalyan VS, Kumar VS. Attitude and perception of dental students towards artificial intelligence. Indian J Med Res 2021;10:305-14.
2. Jindal A, Bansal M. Knowledge and education about artificial intelligence among medical students from teaching institutions of India: A brief survey. MedEdPublish 2020;9:200.
3. Sur J, Bose S, Khan F, Dewangan D, Sawriya E, Roul A. Knowledge, attitudes, and perceptions regarding the future of artificial intelligence in oral radiology in India: A survey. Imaging Sci Dent 2020;50:193-8.
4. Hwang JJ, Jung YH, Cho BH, Heo MS. An overview of deep learning in the field of dentistry. Imaging Sci Dent 2019;49:1-7.
5. Haleem A, Javaid M, Khan IH. Artificial intelligence (AI) applications in dentistry. Current Med Res Practice 2020;10:36-8.
6. Kalappanavar A, Sneha S. Artificial intelligence: A dentist's perspective. J Med Radio Patho Surg 2018;5:2-4.

7. Abouzeid HL, Chaturvedi S, Abdelaziz KM, Alzahrani FA, AlQarni AAS, Alqahtani NM. Role of robotics and artificial intelligence in oral health and preventive dentistry-knowledge, perception and attitude of dentists. Oral Health Prev Dent 2021;19:353-63.

8. Khanna SS, Dhaimade PA. Artificial intelligence: Transforming dentistry today. Ind J Basic and Appl Med Res 2017;6:161-7.

9. Javed S, Zakirulla M, Baig RU, Asif SM, Meer AB. Development of artificial neural network model for prediction of post-streptococcus mutans in dental caries. Comput Methods Programs Biomed 2020;186:105198.

10. Pesapane F, Codari M, Sardanelli F. Artificial intelligence in medical imaging: Threat or opportunity? Radiologists again at the forefront of innovation in medicine. Eur Radiol Exp 2018;2:35.

11. Grischke J, Johannsmeier L, Eich L, Griga L, Haddadin S. Dentronics: Towards robotics and artificial intelligence in dentistry. Dent Mater 2020;36:765-78.

12. Tanzawa T, Futaki K, Tani C, Hasegawa T, Yamamoto M, Miyazaki T, *et al.* Introduction of a robot patient into dental education. Eur J Dent Educ 2012;16:e195-9.

13. Yu KH, Kohane IS. Framing the challenges of artificial intelligence in medicine. BMJ Qual Saf 2019;28:238-41.

14. Seram T, Batra M, Gijwani D, Chauhan K, Jaggi M, Kumari N. Attitude and perception of dental students towards artificial intelligence. Univ J Dental Sci 2021;7:77-81.

15. Asmatahasin M, Pratap KVNR, Padma MT, Kalyan SV, Kumar VS. Attitude and perception of dental students towards artificial intelligence. Ind J Basic Appl Med Res 2021;10:305-14.

16. Joda T, Wolfart S, Reich S, Zitzmann NU. Virtual dental patient: How long until it's here? Curr Oral Health Rep 2018;5:116-20.

17. Pauwels R, Del Rey YC. Attitude of Brazilian dentists and dental students regarding the future role of artificial intelligence in oral radiology: A multicenter survey. Dentomaxillofac Radiol 2021;50:20200461.

18. Yüzbaşıoğlu E. Attitudes and perceptions of dental students towards artificial intelligence. J Dent Educ 2021;85:60-8.