# Knowledge, attitudes, and perceptions regarding the future of artificial intelligence in oral radiology in India: A survey

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## ABSTRACT

**Purpose**: This study investigated knowledge, attitudes, and perceptions regarding the future of artificial intelligence (AI) for radiological diagnosis among dental specialists in central India.

**Materials and Methods**: An online survey was conducted consisting of 15 closed-ended questions using Google Forms and circulated among dental professionals in central India. The survey consisted of questions regarding participants' recognition of and attitudes toward AI, their opinions on directions of AI development, and their perceptions regarding the future of AI in oral radiology.

**Results**: Of the 250 participating dentists, 68% were already familiar with the concept of AI, 69% agreed that they expect to use AI for making dental diagnoses, 51% agreed that the major function of AI would be the interpretation of complicated radiographic scans, and 63% agreed that AI would have a future in India.

**Conclusion**: This study concluded that dental specialists were well aware of the concept of AI, that AI programs could be used as an adjunctive tool by dentists to increasing their diagnostic precision when interpreting radiographs, and that AI has a promising role in radiological diagnosis. *(Imaging Sci Dent 2020; 50: 193-8)*

**KEY WORDS**: Artificial Intelligence; Radiography, Dental; Awareness

## Introduction

Artificial intelligence (AI), in simple terms, can be defined as the acquisition of intelligence by computers or machines to perform tasks that normally require human intelligence.[1,2] A few examples of such tasks are speech recognition, decision-making, and medical diagnosis. A subset of AI, machine learning, can be used to teach machines and computers to analyse certain types of data using various algorithms.[3] AI programs have been developed to analyse data collected from a diverse range of sources, and AI systems have been widely used in the manufacturing sector, the stock market, the medical field, and meteorology, among other domains.[1,2] India is a technologically advancing country that has yet to reach its full potential. Among the age group of 18-60 years, 70% of people use mobile phones in India, while 87% of 1.3 billion Indians have access to an internet connection. Many people, including doctors and scientists, are not yet familiar with the concepts and true potential of AI, and the impact it can have on both our personal and professional lives.

The clinical use of AI programs in the medical profession has gained popularity over the last few years, and its possible applications in dentistry also need proper attention. Applications of AI programs in dentistry are quite interesting, especially in radiology, and AI can be a boon for novice dental practitioners. AI programs can help in the tracing of cephalometric landmarks; in the detection of caries, alveolar bone loss, and periapical pathosis; the auto-segmentation of the inferior alveolar nerve; the analysis of facial growth, and other similar tasks.[4] Studies have reported the use of AI in the early screening of oral cancer and cervical lymph node metastasis, as well as in the diagnosis and treatment planning of various orofacial

diseases.[4-7]

Nonetheless, stakeholders' opinions vary regarding the future of AI. While many think that AI will create many opportunities in the fields of medicine and dentistry and will pave a new way towards a great future, others still believe that AI is unreliable and will not even be able to replace radiologists in the future.[8] This study presents the responses of dentists from central India to a survey regarding their knowledge, attitudes, and perceptions regarding the future of AI.

## Materials and Methods

This study was approved by the institutional ethical

**Table 1.** Survey questionnaire

**KNOWLEDGE**

1) Are you familiar with the concept of artificial intelligence (AI) and its uses?
   a) Yes  b) Not sure

2) Do you agree that AI has useful applications in the medical field?
   a) Yes  b) Not sure  c) Maybe

3) Do you have any idea of how AI can be incorporated in dental practice?
   a) Yes  b) No  c) Maybe

4) What according to you are the advantages of using AI?
   a) AI can speed up processes in health care & reduce medical errors.
   b) AI can deliver vast amounts of clinically relevant high-quality data in real time
   c) AI has no emotional exhaustion nor physical limitation
   d) All of the above

**ATTITUDE**

5) Would you like to use a software/program that can be helpful in radiological diagnosis?
   a) Yes  b) No  c) Maybe

6) Do you agree that the diagnostic ability of AI is better than the clinical experience of a human doctor?
   a) Yes  b) No  c) Maybe

7) If your medical judgment and AI's judgments differ, which will you follow?
   a) My own opinion  b) AI's opinion  c) Not Sure

8) Will you recommend fellow practitioners to implement AI in their clinical practice?
   a) Yes  b) No  c) Maybe

**FUTURE**

9) Do you agree AI will help to evaluate minute details in radiographs which sometimes are missed by practitioners?
   a) Yes  b) No  c) Maybe

10) Do you agree that you may use AI while doing medical diagnosis in the future?
   a) Yes  b) No  c) Maybe

11) Do you agree that you may use AI while making dental diagnosis and treatment planning in the future?
   a) Yes  b) No  c) Maybe

12) In which field of dentistry do you think AI will be most useful?
   a) Making a diagnosis
   b) Making treatment decisions
   c) Direct treatment (including surgical robots)
   d) Interpreting complicated radiographic scans

13) Which sector of health care do you think will be the first to commercialize AI?
   a) Public health centres
   b) Primary care in private clinics
   c) Specialized clinics
   d) University hospitals

14) Do you think AI has a future in dentistry in India?
   a) Yes  b) No  c) Maybe

15) Do you think AI will help budding dentists in diagnosis and decision-making?
   a) Yes  b) No  c) Maybe

board of Rungta College of Dental Sciences and Research. The survey was conducted with 15 close-ended questions. The content validity of the survey was verified by the researchers (n = 3). The questions were entered into an online survey using Google Forms and the link created was distributed among various dentists in central India (via WhatsApp groups/emails) including practitioners, post-graduate researchers, and oral radiologists during July and August 2019. Participants were informed about the goals of the survey and were given a brief description of AI in the preface of the questionnaire.

Interested participants entered basic details about themselves and then filled out the questionnaire. Responses were made on a single webpage with a single "submit" button that only allowed a single submission through a unique link.

The survey consisted of a questionnaire regarding respondents' recognition and attitudes towards AI and the possible future of AI in radiological diagnosis (Table 1). The questionnaires were broadly divided into 3 sections (knowledge, attitudes, and future). The first part of the survey asked 4 questions about respondents' fundamental knowledge of AI. The second part of the survey contained 4 questions inquiring about dental specialists' current attitudes towards AI. The last part of the survey asked 7 questions about the possible future of AI in radiological services among dentists in India.

The data collected were statistically analysed using PASW Statistics for Windows, version 18 (SPSS Inc., Chicago, USA). The level of significance was set at $p < 0.05$. The chi-square test was applied and frequency distributions of responses (i.e., the percentage of respondents who agreed) were presented as bar and pie charts.

## Results

A total of 250 dental specialists completed the survey questionnaire.

**Knowledge:** There was a remarkable knowledge of AI among dentists. Of the 250 respondents, 171 (68%) were already familiar with the AI framework (Fig. 1). Although 181 dentists (72%) accepted that AI has useful medical applications, only 106 (42%) had a basic understanding of how to integrate AI into their dental practice. Moreover, 136 dentists (55%) accepted that AI can speed up the healthcare system and minimize errors and can provide a large quantity of high-quality data without emotional or physical fatigue in a timely manner (Fig. 1).

**Attitude:** Most dentists (87%) would like to use software that would be useful for radiological diagnosis (Fig. 2). Although 15% of dentists fully agreed that AI can make better diagnoses than a human doctor, 45% were not sure. In the event of a difference of opinion in diag-



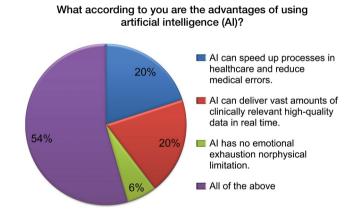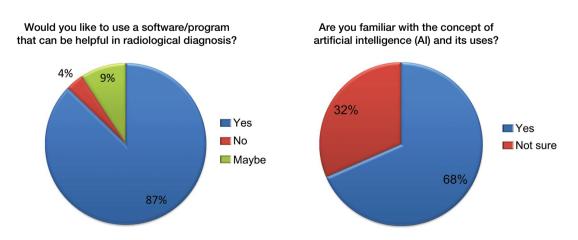**Fig. 1.** Knowledge about artificial intelligence (AI).



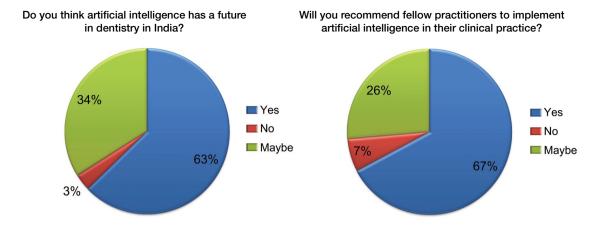**Fig. 2.** Perceptions regarding artificial intelligence (AI).

**Do you think artificial intelligence has a future in dentistry in India?**



- Yes
- No
- Maybe

**Will you recommend fellow practitioners to implement artificial intelligence in their clinical practice?**



- Yes
- No
- Maybe

**Fig. 3.** Future prospects of artificial intelligence (AI) in India.

**Do you agree artificial intelligence will help to evaluate minute details in radiographs which sometimes are missed by practitioners?**



- Yes
- No
- Maybe

**Fig. 4.** Evaluation of radiographs by artificial intelligence (AI).

**In which field of dentistry do you think AI will be most useful?**



- Interpreting complicated radiographic scans
- Making a diagnosis
- Making treatment decisions
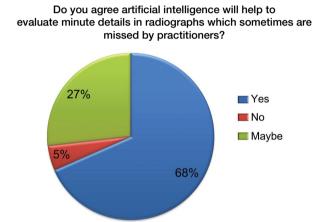- Direct treatment (including surgical robots)

**Fig. 5.** Utility of artificial intelligence (AI) in dentistry.

nosis, only 7% of participating dentists stated that they would follow the AI's prediction, while 59% of the participating dentists would rely on their ability to diagnose and 34 were not sure. Furthermore, 168 of the participating dentists (67%) stated that they would recommend AI to their fellow practitioners (Fig. 3).

**Future:** One hundred seventy-one dentists (68%) believed that AI will come to the rescue to evaluate minute details on X-rays that they sometimes miss (Fig. 4). A total of 172 dentists (69%) agreed that they would use AI for dental diagnosis and treatment planning and 181 (72%) stated that they would utilise AI algorithms for medical diagnosis in the near future. One hundred twenty-six (51%) dentists agreed that the key function of AI is to interpret complicated radiographic scans, and 72 (29%) indicated that AI would be valuable for diagnostic purposes, while 29 (12%) and 21 (8%) of the participating dentists agreed that AI would be used for making treatment deci-

sions and direct treatment, respectively (Fig. 5). One hundred dentists (40%) favoured the use of AI in specialised dental clinics (centres for radiology, prosthodontic clinics, and orthodontic clinics), 77 (31%) approved of the use of AI at university hospitals, 49 (20%) at public health centres and 24 (9%) for primary care at private clinics. A total of 157 (63%) dentists believed that AI has a future in India, while 161 dentists (64%) agreed that AI will help budding dentists in their diagnosis and decision-making.

## Discussion

This was the first survey-based study of the knowledge, attitudes, and perceptions of the future of AI in among the dental community in India. The recognition of AI among the dental community was quite high and most of the dentists were familiar with it. Most of them agreed that AI will be beneficial in dentistry and 51% stated that it will help in interpreting complicated radiographic scans, while

speeding up the processes. A survey-based study by Oh et al.[1] was done among Korean medical practitioners to determine the awareness and attitudes of medical practitioners towards AI. In the study done by Oh et al.[1] in Korea, out of 669 participants, only 6% were familiar with the concept of AI, 83.4% agreed that AI is useful in the medical field, and 43.9% agreed that the diagnostic ability of AI is superior to that of humans. The respondents stated that the advantages of using AI are its ability to quickly obtain vast amounts of clinically relevant, high-quality data in real time (62.3%), speed up processes in health care (19.1%), and decrease the number of medical errors (9.6%).

In this current study, 68% of dentists were familiar with the concept of AI, while 69% were optimistic that AI can be used in diagnosis and treatment planning and 63% affirmed that AI can have a future in India. The majority (68%) of dental specialists agreed that AI will be useful in evaluating minute radiographic details missed by practitioners and 64% stated that AI will help budding dentists make radiological diagnoses. Pakdemirli[9] stated that AI has been a source of great innovation and a prominent topic of discussion within radiological societies and ground-breaking research in recent years. It is promising for the future for healthcare; despite its risks and potential quality assurance issues, tremendous changes are sure to occur in terms of how radiological services will be delivered in the future. This study revealed that 63% of dentists were sure of AI having a future in India and 51% of dentists agreed that the major beneficial task of AI is interpretation of complicated radiographic scans. Similarly, Hwang et al.[4] reported that the diagnostic accuracy of deep learning algorithms in the medical sector is reaching the standards of humans, transforming aided diagnostics from a "second opinion" method to a more interactive process. Hosny et al.[10] stated that AI methods excel at automatically recognizing complex patterns in imaging data and providing quantitative, rather than qualitative, assessments of radiographic characteristics. Similarly, Wong et al.[11] suggested that AI has the potential to change the landscape of modern clinical radiology and that it will be necessary to keep up with future developments.

The higher efficiency provided by AI will allow radiologists to perform more value-added tasks, becoming more visible to patients and playing a vital role in multidisciplinary clinical teams.[12]

Park et al.[13] stated that the use of AI is expanding quickly beyond text-based and image-based dental work, and as the use of AI in the entire medical field increases, the role of AI in dentistry will also greatly expand.

Mupparapu et al.[14] pointed out that dentists could benefit from the added luxury of having a second opinion in nanoseconds using AI technologies that could bolster the diagnosis and eventually help patients, and stated that the intention of AI was perhaps never to replace healthcare providers.

Dentists may have varying opinions regarding the utility of AI. The main limitation of our study is the limited number of participants, who were mainly specialists practicing in central India; therefore, further studies should be carried out at a larger scale to increase the statistical accuracy.

In India, dentists favoured AI and agreed that it can aid in radiological diagnoses. With its promising potential opportunities, most of us agree that it can assist in the analysis of complex radiographic scans, improve diagnostic precision, minimize errors, and potentially lead to the more precise and reliable detection of various maxillofacial disorders. In the future, more studies should be carried out with larger samples to validate the accuracy and usefulness of AI programs in various dental specialties.

## Acknowledgements

**Conflicts of Interest:** None

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