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EVALUATION OF PERCEPTION, KNOWLEDGE AND ATTITUDE REGARDING THE ROLE OF ARTIFICIAL INTELLIGENCE (AI) AMONGST DENTAL PRACTITIONERS PRACTICING IN NAGPUR REGION: A CROSS- SECTIONAL STUDY

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Abstract

Background: Digital assistants like Alexa and Siri have evolved into a regular feature of our life these days. Though the name usually conjures ideas of science fiction, artificial intelligence has a very major future in dentistry. The great growth in patient information and recorded data calls for the use of intelligence software and data computation.

Aim and Objective: The aim of this investigation was to assess the perceptions, knowledge, and attitudes of dental professionals in the Nagpur region with respect to the application of artificial intelligence (AI).

Study Design: A descriptive cross-sectional study was conducted to assess the role of Artificial Intelligence among dental practitioners Practitioning in Nagpur Region. A pre-designed, pre-validated questionnaire consisting of 14 questions was distributed to 200 dental practitioners. The survey was administered both personally, using printed questionnaires, and via email. A total of 190 responses were collected. The data was entered into a Microsoft Excel spreadsheet for analysis, and descriptive statistical analysis was performed using IBM SPSS version 26. The use of descriptive statistics was utilized in to estimate the percentages of the responses from the participants. A Chi-Square test (X2) was performed to examine the data, where the significant level was set at $P < 0.05$.

Results: Majority of the participants, specifically 93.9%, believed that artificial intelligence (AI) will pose a threat to dentists in the future. On the other hand, 42.4% of practitioners were aware of the applications of AI.

Conclusions: The study found that most participants were aware of AI and its applications. The survey solely included Nagpur dentists. Other parts of India or countries with varied technological adoption rates and AI awareness in dentistry may have different results.

Keywords: machine learning (ML); artificial intelligence (AI); voice command dental chairs; virtual dental assistants

Introduction

The human brain, considered the pinnacle of evolution, is the most intriguing and intelligent on Earth. Technology has been used to mimic human intellect since the 1950s[1]. This quest led to AI.

Artificial intelligence is a development in the modern science and technology. Many call it "The Stethoscope of the 21st Century." This description emphasizes the medicinal and dental importance of this tool[2].

Artificial intelligence (AI) mimics human intelligence in computers that learn, understand, and decide. Robotics, computer vision, natural language processing, and machine learning enable systems to perform cognitive tasks including pattern identification, problem solving, and decision making. AI can be divided into two categories: General AI replicates human intelligence in many activities, while narrow AI is designed for specific tasks.

AI is used in healthcare systems, self-driving cars, robotics, virtual assistants like Alexa and Siri, and facial recognition technology. Technologically advanced India is nearing its full potential in this area. Despite its pervasive influence, many people, even medical professionals and researchers, are unaware about artificial intelligence (AI) and its potential effects on personal and professional life.

Artificial intelligence algorithms are used in dentistry; especially diagnostic radiography benefits new dentists. AI analyzes face development, tracks cephalometric landmarks, detects cavities, alveolar bone loss, periapical pathosis, and auto-segments the inferior alveolar nerve[3]. Studies reveal that artificial intelligence is increasingly used to detect cervical lymph node metastases, mouth cancer, and orofacial disorders and for treatment planning[4]. Future AI-driven intelligence is projected to reduce educator workload and education costs. Dental professionals must grasp AI technology and adapt to new roles in clinical practice.

Therefore, this survey research was conducted to evaluate the perception, knowledge and attitude of artificial intelligence among dental practitioners practicing in the Nagpur region.

Materials and Methods

This simple random sampling cross-sectional descriptive study was conducted using a pre-validated and pre-designed closed-ended questionnaire (Annexure-I). The questionnaire was distributed to dental practitioners in the Nagpur region through personal contact with the printed questionnaire and via email. This study has been approved by the Institutional Ethics Committee. There were a total of two hundred dental practitioners who responded to questionnaire. The questionnaire consists of fourteen questions.

Following the completion of the data collection process, it was later imported into a spreadsheet created in Microsoft Excel. A descriptive statistical analysis was carried out by using Statistical Package for Social Sciences (SPSS) version 26, which was developed by SPSS Inc. in Chicago, Illinois, United States of America. The use of descriptive statistics was utilized in order to estimate the frequencies and percentages of the responses from the participants. A Chi-Square test (X^2) was used to examine the data, and the significance level was set at $P < 0.05$.

Results

(I). Demographic Details

Fig. 1 represents the gender distribution of the participants. A total of 56% of the participants were male and 44% were females.

(II). Awareness on the role of AI in Dentistry

Fig. 2 shows 87.4% of dentists were aware of the AI based applications that have already been

used in the dentistry. The results obtained were statistically significant [p= 0.022].

Fig. 3 depicts the awareness of the participants, on Artificial Intelligence (AI) and Machine Intelligence (ML) is the same or not. The majority of participants (98.5%) were aware that AI and ML are the same. The results that were obtained were quite significant from a statistical point of view [p = 0.000].

Fig. 4 shows 94.9% of the participants were aware of the virtual dental assistants which are based on artificial intelligence and are accessible on the market. it. Whereas the least awareness seen among (6.1%) participants. The results that were obtained were quite significant from a statistical point of view [P = 0.000].

Figure 5 shows that the Virtual dental assistants perform more accurately, although only 32.4% of people were aware of them while 64.40 percent of participants are still not familiar with AI-based voice-activated dental chairs. [P=0.000] indicated that the results were statistically significant.

Fig. 6 shows that all the participants except 3.6% firmly believed that AI cannot duplicate human emotions. The results obtained were statistically

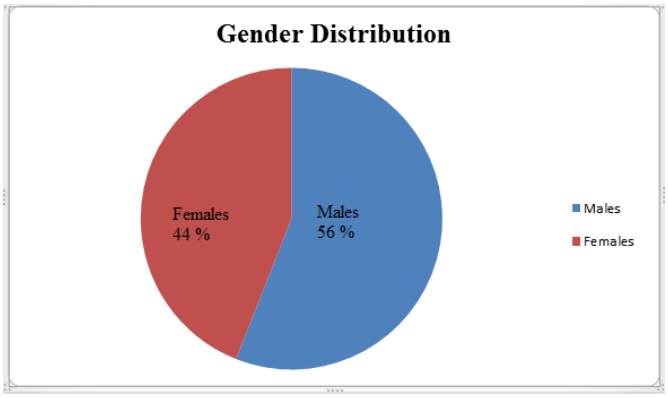

Fig 1. Distribution of subjects according to their Gender

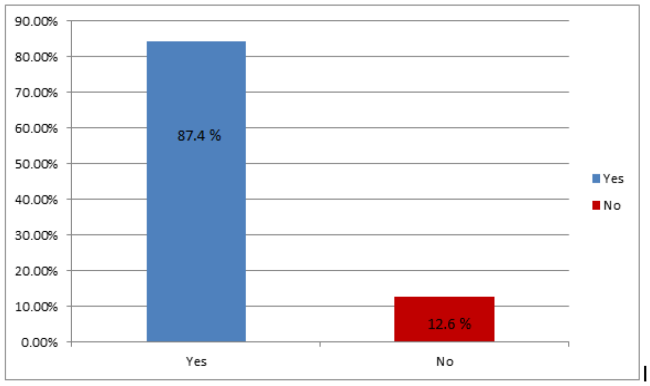

Fig 2. Distribution of subjects on the basis of awareness about artificial intelligence application which are already practicing in Dentistry

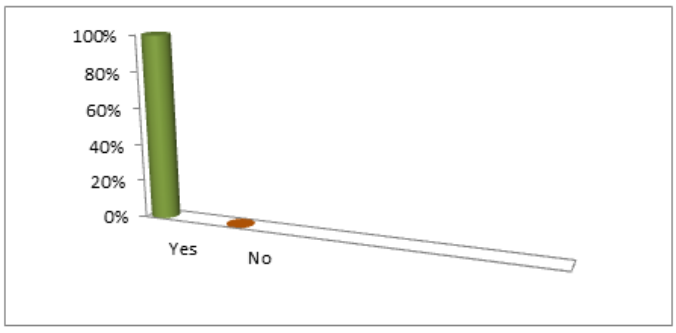

Fig 3. Distribution of subjects according to their awareness on artificial intelligence (AI) and Machine intelligence are same.

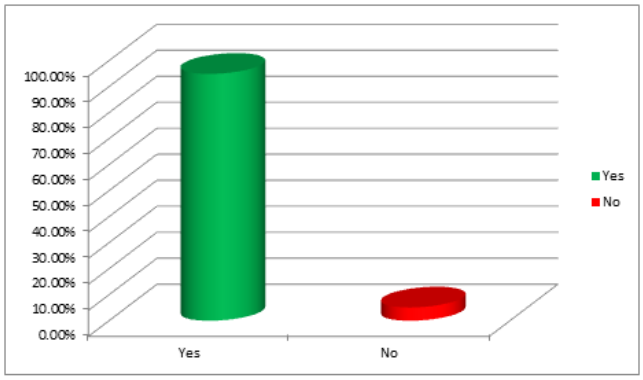

Fig. 4 Distribution of subjects based on their awareness on AI-based virtual dental assistance in the market

significant [P = 0.008].

Fig.7 shows the information about the 'Haptic gloves' which can offer a particular tactile experience. Nearly all (98.5%) are aware of the special quality of Haptic gloves. The results obtained were statistically significant [P = 0.001].

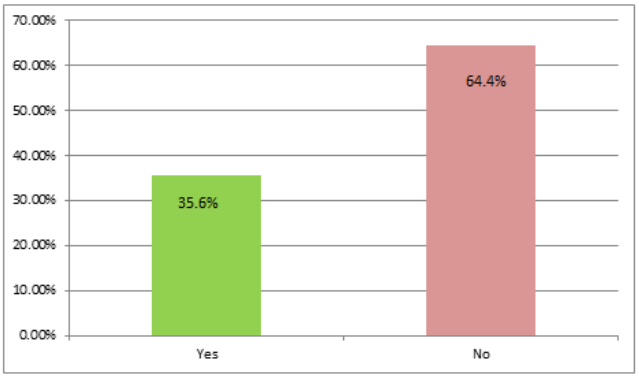

Fig. 5 Distribution of subjects according to their awareness on Dental Chairs working on AI based voice.

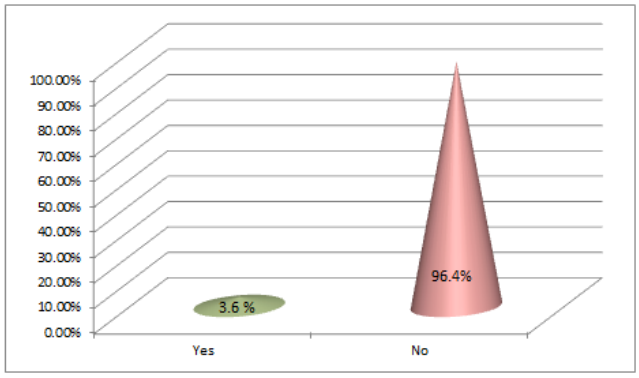

Fig. 6 Distribution of subjects based on their knowledge on whether artificial intelligence (AI) can replicate human emotions

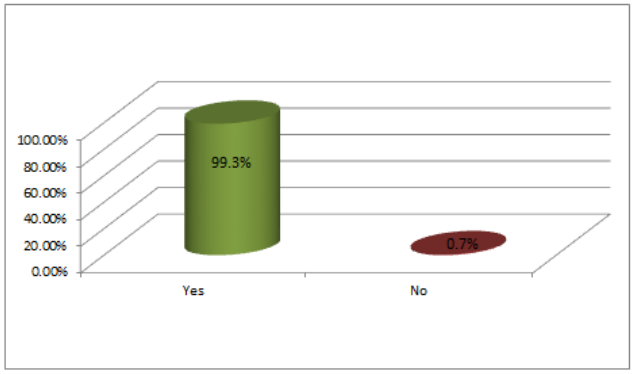

Fig. 8 Subjects distribution opinion of AI can reliably predict Oral cancer genetic predisposition in large population

Fig.8 shows AI can accurately predict oral cancer genetic propensity in a large population. Nearly all participants (99.3%) said AI can reliably forecast oral cancer genetics in a big population. The results obtained were statistically significant [P = 0.008].

Fig.9 shows that AI can generate a complete virtual database for each patient. Nearly all participants (99.3%) said that Virtual patient databases can be created by using AI applications. The results obtained were statistically significant [P = 0.022].

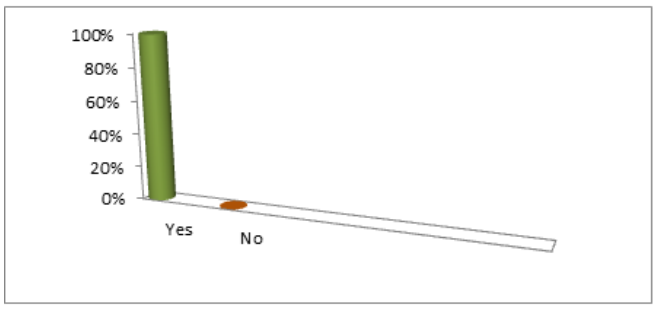

Fig 7. Distribution of subjects whether Haptic gloves which provides a unique experience of touch.

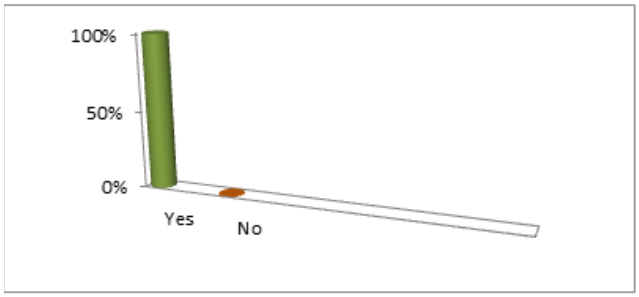

Fig. 9 Distribution of subjects according to knowledge on AI can create complete virtual database for every patient

Result

In total, 190 members participated. Out of which, (97) are male and (93) are female. A significant proportion of the participants, specifically 93.9%, held the belief that artificial intelligence (AI) will pose a threat to dentists in the future. On the other hand, 42.4% of practitioners were aware of the applications of AI that are now being utilized in dentistry.

Discussion

Artificial Intelligence (AI) was initially conceptualized as "machines thinking" by Turing AM, who proposed the 'Turing test' to evaluate whether machines could achieve human-level intelligence. In the present study, a significant percentage of participants (88.5%) were aware that Artificial Intelligence (AI) and Machine Learning (ML) are synonymous terms.[6] As noted by Banerjee M et al.[5], Ma J et al.[7], and Isra ST et al.[8], AI is regarded as an application that complements rather than replaces the human brain, providing additional information and assisting clinicians with accuracy. The results of the present study strongly indicate (99.3%) that AI cannot replicate human emotions. Sefira F suggests that AI can detect things imperceptible to humans.[9]

AI serves as a valuable tool for patient education, exemplified by products like Genius X, a toothbrush from Oral-B, which can detect brushing techniques and provide guidance to users[5]. Some dental institutions have begun to recognize the significance of AI in enhancing the learning experience for dental students. According to Topol EJ, AI implementation can lead to reduced post-operative complications, fewer unnecessary procedures, and overall improved healthcare quality.[10]

The dental practice is already experiencing the utilization of Virtual Dental Assistants, which are readily available in the market. Studies by Khanna S et al.[11] and Rieshy V et al.[12] have indicated that virtual assistants can perform certain routine tasks more accurately than physical dental assistants. In our present study, 47.4% of teaching faculty were aware of the availability of Dental Virtual Assistants in the market. Other studies, such as those by Lim K et al.[13] and Yeager D et al.[14], have highlighted the efficacy of AI applications in identifying malignant and premalignant changes in oral mucosa, thus facilitating improved treatment. Bas B et al. have suggested that AI can differentiate between low and high-risk malignant lesions and aid in treatment planning.[15] In contrast, Majumdar B et al. have proposed that AI could accurately predict genetic predispositions for oral cancer within a large population.16 However, our study results contradict these findings.

The applications of Artificial Intelligence (AI), already showing its footprints in various dental speciality treatments which includes Radiology and diagnosis[15,16], Pediatric Dentistry[17]; Periodontics[18,19]; Implantology[20,21]; Maxillofacial Surgery [22]; Orthodontics[23-25]; Prosthodontics[2,26-29]; Endodontics[30,31]; and Forensic Odontology[32]. The present study 67.6% participants of the opinion that AI based applications are already using in various dental specialities.

However, the adoption of AI in dentistry is progressing slowly and is accompanied by certain concerns among clinicians. According to Tandon D Rajawat, the utilization of AI is complex, expensive, and requires meticulous training to handle the software, while concerns regarding the potential compromise of patient data further contribute to apprehension.[33]

Although the use of AI in the medical field dates back several decades, its adoption in dentistry began around four decades ago. AI applications in dentistry initially emerged in dental tutoring systems, marking its inception into the field.[34] Crowley R et al.[35] demonstrated

significant improvement in preclinical skills among students through the utilization of virtual patients. The introduction of AI in the form of the Unified Medical Language System (UMLS) represents a substantial advancement in manual teaching methods. Feeney L et al.[36] noted that the application of AI in dental student training allows for individual self-assessment, contributing to enhanced learning experiences and attain improved professional skills

"The creation of a comprehensive virtual database for all patients using AI software has been a practice adopted by many dentists worldwide for a considerable period.[37,38] The findings of the present research align with previous studies in this regard. Aminoshariae A et al.[39] assert that AI usage in dentistry is cost-effective, reliable, efficient, thorough, and expeditious. However, Shan T et al.[40] note that AI lacks human communication, a crucial aspect in healthcare services, such as clinical intuition and physical touch.

Nguyen TT et al.[41] raise concerns about the accountability of AI in dentistry. While AI usage yields promising clinical results, questions arise about liability for conflicting outcomes or errors during treatment. The majority of teaching faculty in the present study (93.9%) expressed concerns that AI applications in dentistry may pose a threat to dentists in the future. In contrast, a study conducted in Saudi Arabia by Aboal shamat KT 42 found that a smaller percentage (49.1%) of dental professionals agreed or strongly agreed that AI could replace dentists in the future.

It is common to encounter myths surrounding the use of new technologies initially, but as positive results emerge, these myths tend to be dispelled. Nonetheless, nearly all participants in the present study (98.5%) expressed their belief that AI-based treatments would be accepted by patients.

Recent Innovations

Recent innovations in the dental field include the Digital Dental assistant (DeXVoice), which is currently available in the market.[43,44] Additionally, dental chairs equipped with AI-incorporated voice command technology have been introduced.[2] To maintain human touch sensations, 'Haptic gloves' are now commercially available.[45]

The present study's findings on Haptic gloves indicate that nearly all participants (98.5%) are aware of their tactile exclusionary property.[46] AI demonstrates the ability to distinguish between healthy and non-healthy tissues in the oral cavity. Furthermore, the Bio/Screen Oral Exam Light is equipped with Artificial Intelligence software.[47,48] The field of 'bioprinting' of both hard and soft tissues is one of the most inventive applications of artificial intelligence (AI).

Limitations

The study was conducted exclusively among dental practitioners in the Nagpur region. The findings may differ to other regions in India or to other countries with different technological adoption rates and levels of AI awareness in dentistry.

Conclusion

The majority of participants expressed their opinions regarding AI-based treatments, and all of them were aware of the most recent advancements in AI in the field of dentistry.

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QUESTIONNAIRE

Annexure (I)

I. **Demographic details:**

1. Name (optional) :
2. Gender : Male : ( ) Female : ( )

II. **Awareness on the role of AI in Dentistry:**

3. Are you aware of artificial intelligence (AI) applications which are already practicing in the dentistry?

   Ans. Yes ( ) No ( )

4. Are you aware that Artificial Intelligence (AI) and Machine Intelligence (ML) are the same?

   Ans. Yes ( ) No ( )

5. Are you aware that AI based Virtual dental assistants are available in the market?

   Ans. Yes ( ) No ( )

6. Are you aware of dental chairs working on AI based dental commands?

   Ans. Yes ( ) No ( )

III. **Knowledge on the role of AI in Dentistry:**

7. Do you know that Virtual Dental Assistants powered by AI carry out work with more accuracy with fewer mistakes than human counter parts?

   Ans. Yes ( ) No ( )

8. Do you think that AI can replicate human emotions?

   Ans. Yes ( ) No ( )

9. Do you know about 'Haptic gloves' which can provide a unique experience of touch?

   Ans. Yes ( ) No ( )

10. Do you agree that AI can accurately predict a genetic predisposition for Oral cancer for a large population?

    Ans. Yes ( ) No ( )

11. Do you know that AI can be used in Forensic dentistry?

    Ans. Yes ( ) No ( )

12. Do you know that AI can create a complete virtual database for every patient?

    Ans. Yes ( ) No ( )

13. Do you think AI will be a threat for dentist in the future?

    Ans. Yes ( ) No ( )

14. Do you think that AI based treatment will be accepted by the patient?

    Ans. Yes ( ) No ( )