ORIGINAL ARTICLE

Familiarity and Attitude Survey about Artificial intelligence (AI) as Detection Tools in Dental Radiology

Muhammad Faisal Omarzai, Sneha Kulkarni
College of Medicine and Dentistry, Birmingham, UK

Abstract

Background and Objectives: Artificial intelligence (AI) applications have been shown beneficial in both health care and dentistry.

Methodology: The purpose of the present study was to assess familiarity and attitude of postgraduate dental students about artificial intelligence (AI) as detection tools in dental radiology at the College of Medicine and Dentistry (CoMD), Ulster University, United Kingdom (UK). The survey was an observational and descriptive study. In order to gather quantitative data for the study, postgraduate dental students were given a survey that contained 15 set of questions divided into 4 themes. The survey was then analyzed using graphical formats.

Results: The results of the current study indicated that while the majority of respondents were aware of artificial intelligence (AI) potential uses in dentistry and had a favorable opinion of the technology's future applications like; facilitation and improvement in clinical diagnosis and decision making steps of clinicians, hence increasing the prognosis of treatment, but still further research is required in this field.

Conclusion: All the participants had enough knowledge about use of AI in dentistry. Respondents of the study reported enhanced diagnostic capability with use of AI. Participants believed AI has will have advantageous role in UK's dentistry of the future.

Key Words: Familiarity, Attitude, Artificial intelligence, dental radiology.

Introduction:

Artificial intelligence (AI) and similar technologies are becoming more and more common in business and society, and they are starting to be used in healthcare. Many facets of patient care could be changed by these technology, as well as internal administrative procedures at payer, provider, and pharmaceutical organizations.[1] In particular, artificial intelligence (AI) applications have been shown beneficial in medical image analysis (e.g., radiography, pictures, and histological sections), with accuracy levels on par with or better than those of knowledgeable experts.[2] Understanding of artificial intelligence (AI) applications in healthcare / dentistry

Artificial intelligence (AI) has become more prevalent in public healthcare as more and more clinicians attempt to make a diagnosis utilizing technology that enables them to work more quickly and precisely, lowering expenses and the number of medical errors. Applying artificial intelligence (AI) to the massive amounts of data generated by healthcare facilities offers enormous advantages and a variety of opportunities for contributions, including predictive, more focused, and customized healthcare prevention; better and more accurate symptom detection; automated use of analysis results (images, laboratory analysis, etc.).

Corresponding Author:
Muhammad Faisal
College of Medicine and Dentistry, Birmingham, UK
Email: faisaliidc@gmail.com
Received: 3rd March 2023
Revised: 2nd April 2023
Accepted: 7th April 2023
DOI: https://doi.org/10.52442/jrcd.v4i1.74

formulation of treatment plans or tailored protocols; and facilitation of care team coordination.[3]

Radiology is perhaps the field where artificial intelligence (AI) is mostly used as it uses digitally recorded images that are easily converted into computer language and hence artificial intelligence (AI) has been applied in dental radiology as well for a variety of reasons such as to detect dental caries, apical lesions, periodontal bone loss, tooth fractures, and sinusitis.[3]

When compared to other diagnostic tools and methods like visual and tactile perception, radiographs (periapical and bitewing), and fiber optic trans illumination, which can be unreliable, expensive, time consuming, and prone to false positives and negative readings, artificial intelligence (AI) has shown promising results.[4]

In terms of radiographic assessment of lesions and their interpretation, artificial intelligence (AI) has significantly improved the diagnostic proficiency of the radiologist.[5] The stated accuracy for the majority of these activities is encouraging, and the first artificial intelligence (AI) solutions for dental diagnostics presently being released.

Artificial intelligence (AI) is a new concept in terms of technology which is effective to execute specific tasks with learning and using knowledge.[6] Machine learning models being part of artificial intelligence (AI) in dentistry, can be helpful to asses and evaluate dental caries, periodontal inflammation, granuloma, periapical cysts, bone cancer, and stages of osteoporosis.[7]

Artificial intelligence (AI) consists of 2 parts; Machine learning and deep learning associated with convoluted

neural networks (CNN). Defining machine learning, which is basically building newer computer programs and by operating these programs there is improvement noticed. Deep learning is a part of machine learning concerned with algorithms inspired by the structure and function of the brain. Machine learning enables computers to think in the same manner as humans do to learn and establish from previous experiences. This mechanism involves data discovery, pattern recognition and requires minimal human effort. In addition, it is subdivided into supervised and unsupervised learning.

The second part which is deep learning; motivated by the hugely equal design found in brain and its sources can be followed to Frank Rosenblatt's Perceptron.[8] Deep learning algorithms use an extensive measure of unaided information to consequently extricate complex patterns.
Such algorithms are largely convinced by the field of artificial intelligence (AI) which aims generally to imitate the human brain's capacity to watch, break down, learn, and decide, particularly for amazingly complex issues.[9]

Innovative artificial intelligence (AI) manufacturers and developers are available for multiple dental specialties. Researches came up with a computer aided periodontal disease diagnosis system employing computer vision. Essentially, the technology "automates the probing depth and contains a colour camera fitted along with a plastic probe that automatically and exactly acquires the probing depth measure".

By using computer vision to identify and highlight important pathologic and non-pathologic findings, such as dental caries, discrepancies at the margin of existing restorations, calculus, periapical radiolucency, crowns, fillings, root canals, bridges, and implants, Pearl's system assists dental professionals in their review of radiographs. When X-rays are taken, Second Opinion® immediately displays the images and any detected issues on monitors in the operatory, offering dentists finer view into their patients' oral health and giving patients greater understanding of their oral findings.

AssistDent® is another product and is being utilized by community dentists to help them discover early indicators of tooth decay and for training dental students. It does this by employing artificial intelligence (AI) to enhance the clinical judgment of dentists when they are looking for the presence of early-stage proximal caries by evaluating bitewing radiographs.

Two deep learning based computer vision algorithms were employed in a recent work titled "Automated Detection and Classification of Oral Lesions Using Deep Learning" to categorize oral lesions using photos with the purpose of answering two questions:
Are lesions present?
Do lesions pose a cancer risk?

While not perfect, the artificial intelligence (AI) system generated encouraging results.

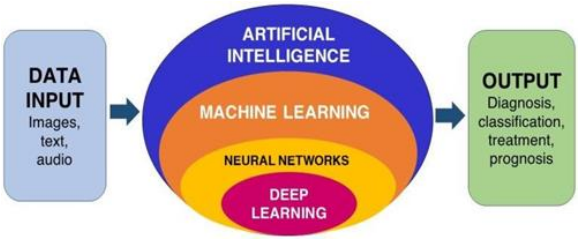

Figure 1: Mechanism of action of Artificial Intelligence

Methodology:

The study design was an observational descriptive survey with 15 set of online questions. Information about the survey and its topic (Artificial intelligence (AI) as detection tools in dental radiology) was provided to the postgraduate dental students in the form of a participant information sheet.
The questionnaire was properly designed following the recommended protocol by the investigator and there after validation process was done through a peer review process.
The structure of the questionnaire has 2 sections;
section 1 with participant information sheet and
section 2 with questions including 4 themes; familiarity of AI in everyday life, familiarity about AI and dental radiology, attitudes with AI and dental radiology and future with AI and dental radiology.

The study was conducted in accordance with research ethical standards. Double level ethical approval was sought both from the Ulster University and College of Medicine and Dentistry (CoMD) in the United Kingdom (UK). The respondent's anonymity was protected through their voluntary involvement and the use of implied consent. The study's participants were properly told that by taking part, they gave permission for the data to be used in the dissertation and any research publications. Leaflets containing participant information that highlighted compliance with the General Data Protection Regulations (GDPR) were made available. Additionally, neither rewards nor sanctions were applied to the non-participants.

Results:

The results revealed that 53% of the participants heard about AI, 55% participants use AI in daily life, 40% participants knew about health care AI applications, and 36% participants knew about use of AI in dentistry. All the results of the study are tabulated in table 1.

QUESTIONS	OPTIONS	RESPONSES	QUESTIONS	OPTIONS	RESPONSES
1.AI is a rapidly Developing field. Have you Heard about the term AI?	Yes	53 (96.3%)	8. Would you like to use a software that could help you in radiographic interpretation?	Yes	51 (92.7%)
	No	1 (1.81%)		No	0 (0%)
	Not sure	1 (1.81%)		Not Sure	4 (7.27%)
2. AI is a part of our Everyday lives in many applications we use (e.g., smart replies in emails, smart maps, and speech / Text recognition). Are you Familiar with these Applications?	Yes	55 (100%)	9. Do you agree that diagnostic capacity of AI is better than the clinical experience of a dental practitioner?	Yes	13 (23.6%)
	No	0 (0%)		No	24 (43.6%)
	Not sure	0 (0%)		Not Sure	18 (32.7%)
3. Are you aware about AI Applications in healthcare?	Yes	40 (72.7%)	10. If your dental decision differs from the AI's judgment - what will you do?	Go with my opinion Go with AI's opinionNot sure	30 (54.5%)
	No	8 (14.5%)		Go with my opinion Go with AI's opinionNot sure	4 (7.27%)
	Not sure	7 (12.7%)		Go with my opinion Go with AI's opinionNot sure	21 (38.1%)
4. Do you have any idea about how AI might be used in Dentistry?	Yes	36 (65.4%)	11. Would you use AI for diagnosis and treatment planning in future?	Yes	44 (80%)
	No	13 (23.6%)		No	1 (1.81%)
	Not sure	6 (10.9%)		Not sure	10 (18.1%)
5. Do you think AI will help identify details missed by a Dental practitioner?	Yes	45 (81.8%)	12. Would you recommend AI to a fellow dentist to use in their clinical practice?	Yes	39 (70.9%)
	No	2 (3.63%)		No	1 (1.81%)
	Not sure	8 (14.5%)		Not Sure	15 (27.2%)
6. What do you think is the biggest advantage of using AI in Dentistry?	Improved diagnostic accuracy	34 (61.8%)	13. What would be your biggest concern with using AI in your practice?	Receiving a false positive or false negative reading	27 (49%)
	Reduced workload	8 (14.5%)		Set up and maintenance costs	15 (27.2%)
	Comprehensive reporting	7 (12.7%)		Potential data breaches orlegal conflict	11 (20%)
	Better patient - provider	6 (10.9%)		All of the above	2 (3.63%)
7. What field of dentistry do youthink AI will be most useful?	Interpretation of dental radiographs	24 (43.6%)	14. Which sector do you think willbe the first to use AI?	Public health centres	8 (14.5%)
	Dental diagnosis	19 (34.5%)		Primary care in private clinics Specialized clinics	5 (9.09%)
	Dental treatment planningDirect treatment	9 (16.3%)		University hospitals	25 (45.4%)
	Interpretation of dentalradiographs	3 (5.45%)		Public health centres	(30.9%)

Discussion:

A total number of 55 responses were received for all the survey's questions, which were then used and analyzed through graphical forms to collect quantitative data for the study.

Firstly, almost all of the participants reported knowing what artificial intelligence (AI) means and its applications in everyday life.

Secondly, almost all of the participants reported knowing applications of artificial intelligence (AI) in healthcare and dentistry with maximum number of participants reported thinking that artificial intelligence (AI) will help identify details missed by a dental practitioner with improved diagnostic accuracy being the biggest advantage of it. Moreover, majority of the participants reported thinking that artificial intelligence (AI) will be most useful in interpretation of dental radiographs.

Thirdly, almost all of the participants reported wanting to use software that could help in radiographic interpretation. Furthermore, majority of the participants didn't agree that diagnostic capacity of artificial intelligence (AI) is better than the clinical experience of a dental practitioner.

Lastly, almost all of the participants reported wanting to use artificial intelligence (AI) for dental diagnosis and treatment planning in the future. In addition, majority were in favor of recommending artificial intelligence (AI) to a fellow dentist to use in their clinical practice but the biggest concern being a false positive or false negative reading. Also, majority of the participants reported thinking that artificial intelligence (AI) has a future in dentistry in United Kingdom (UK) with specialized clinics being the first sector to use it.

Comparison of the results to previously published studies

The applications of artificial intelligence (AI) in dentistry, particularly in radiology, are fascinating, and new dentists may find artificial intelligence (AI) to be a useful tool. The future of artificial intelligence (AI) for radiographic diagnostics has only been the subject of a small number of research that examined dentistry student's knowledge, attitudes, and perspectives.[10]

(Sajjad, et al., 2021), conducted a cross sectional online survey on awareness and perception of dentists regarding role and future of artificial intelligence (AI) in dentistry in Karachi, Pakistan. General dentists, postgraduate trainees, and specialist consultant dental surgeons were all included. A total number of 118 participants responded to the questions and majority of them were already familiar with the artificial intelligence (AI) powered dental tools.

This study revealed that while the majority of respondents were aware of artificial intelligence (AI's) potential uses in dentistry and had a positive outlook on the technology's future, they did not consistently use artificial intelligence (AI) tools in their daily work and all of the participants had opinion that artificial intelligence (AI) applications should be part of dental trainings.[10] at Marmara University's Faculty of Dentistry in Turkey distributed an online survey made up of 11 questions using Google Forms to 4th and 5th grade students. The survey consisted of questions regarding participant's recognition of and attitudes towards artificial intelligence (AI), their opinions on directions of artificial intelligence (AI) development, and their perceptions about the future of artificial intelligence (AI) in oral radiology. A total number of 140 participants responded to the questions and majority of them were already familiar with the concept of artificial intelligence (AI). A greater number of participants agreed that would like to use a software / program that can be helpful in radiological diagnosis.[11] A cross sectional study was conducted using an online based questionnaire to assess the knowledge, attitudes, and perceptions of dental students in Riyadh, Saudi Arabia. A total number of 423 participants responded to the questions and around half of them had no basic knowledge about the mechanism of artificial intelligence (AI). Also, the majority were not aware of the usage of artificial intelligence (AI) in dentistry.

Limitations of the study:

The study identifies familiarities and attitudes of postgraduate dental students about artificial intelligence (AI) as detection tools in dental radiology. However, of note are some limitations to the study. First, data collected was from a single institution. Second, compared to the estimated 150 students to whom the survey was distributed, only 55 participants answered the questions. Furthermore, the study didn't include undergraduate students and demographic groups, therefore survey results were limited to descriptive statistics.

Despite these limitations, the results reveal valuable insight into the student's familiarity and attitude about artificial intelligence (AI) as detection tools in dental radiology.

Conclusion:

The aim of this survey was to check familiarity and attitude of postgraduate dental students about artificial intelligence (AI) as detection tools in dental radiology. A total number of 55 responses were received for all the survey's questions, which were then used and analyzed through graphical forms to collect quantitative data for the study. Almost all of the participants reported knowing what artificial intelligence (AI) means and its applications in everyday life, healthcare, and dentistry. Majority of the participants reported thinking that the biggest advantage of artificial intelligence (AI) is its diagnostic capability. Moreover, almost all of the participants reported wanting to use software that could help in radiographic interpretation. Lastly, majority of the participants reported thinking that artificial intelligence (AI) has a future in dentistry in United Kingdom (UK). The results of the survey could help to advance curriculum and introduce courses. The results of the survey could help facilitate and improve clinical diagnostic and decision-making steps of clinicians, hence increasing the prognosis of treatment. The results of the survey could help to open opportunities for research engagement in this field.

Conflicts Of Interest: None

Funding Source: None

References:

1. Ahmed N, Abbasi MS, Zuberi F, Qamar W, Halim MSB, Maqsood A, Alam MK. Artificial Intelligence Techniques: Analysis, Application, and Outcome in Dentistry-A Systematic Review. Biomed Res Int. 2021 Jun 22; 2021:9751564.
2. Artificial intelligence and life in 2030, 2016. Stanford, CA: Stanford University. Artificial Intelligence in Medicine, 1995. Artificial intelligence in medicine. 7(1), p.i-iv.
3. Carrillo-Perez F, Pecho OE, Morales JC, Paravina RD, Della Bona A, Ghinea R, Pulgar R, Pérez MDM, Herrera LJ. Applications of artificial intelligence in dentistry: A comprehensive review. J Esthet Restor Dent. 2022 Jan; 34(1):259-280.
4. Clinical Imaging, 2017. Clinical Imaging: Past, Present and Future. 45, p.v.
5. Davenport T, Kalakota R. The potential for artificial intelligence in Healthcare. Future Healthc J. 2019;6(2):94-98.
6. De Angelis F, et al. Artificial Intelligence: A New Diagnostic Software in Dentistry: A Preliminary Performance Diagnostic Study. Int J Environ Res Public Health. 2022;19(3):1728.
7. Eschert T, Schwendicke F, Krois J, Bohner L, Vinayahalingam S, Hanisch M. A survey on the use of artificial intelligence by clinicians in dentistry and oral and maxillofacial surgery, Medicina (Kaunas, Lithuania). U.S. National Library of Medicine.
8. Ezhov M, Gusarev M, Golitsyna M, Yates J, Kushnerev E, Tamimi D, et al. Clinically applicable artificial intelligence system for dental diagnosis with CBCT. Scientific Reports. 2021;11(1).
9. Futyma-Gąbka K, Różyło-Kalinowska I. The use of artificial intelligence in radiological diagnosis and detection of dental caries: a systematic review. J Stomatology. 2021;74(4):262-266.
10. Keser G, Namdar Pekiner F. Attitudes, perceptions and knowledge regarding the future of artificial intelligence in oral radiology. Clinical and Experimental Health Sciences. 2021.
11. Khanagar S, Alkathiri M, Alhamlan R, Alyami K, Alhejazi M, Alghamdi A. Knowledge, attitudes, and perceptions of dental students towards artificial intelligence in Riyadh, Saudi Arabia. Med Sci. 2021;25(114):1857-1867.
12. Lee J, Kim D, Jeong S, Choi S. Detection and diagnosis of dental caries using deep learning-based convolutional neural network algorithm. J Dentistry. 2018;77:106-111.
13. Liyanage H, Liaw ST, Jonnagaddala J, Schreiber R, Kuziemsky C, Terry AL, de Lusignan S. Artificial Intelligence in Primary Health Care: Perceptions, Issues, and Challenges. Yearb Med Inform. 2019;28(1):41-46.
14. Moran M, Faria M, Giraldi G, Bastos L, Oliveira L, Conci A. Classification of Approximal Caries in Bitewing Radiographs Using Convolutional Neural Networks. Sensors. 2021;21(15):5192.
15. Müller A, et al. Barriers and Enablers for Artificial Intelligence in Dental Diagnostics: A Qualitative Study. J Clin Med. 2021;10(8):1612.
16. Najafabadi M, Villanustre F, Khoshgoftaar T, Seliya N, Wald R, Muharemagic E. Deep learning applications and challenges in big data analytics. J Big Data. 2015;2(1).
17. Nguyen TT, 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:l7.
18. Patil S, et al. Artificial Intelligence in the diagnosis of oral diseases: Applications and pitfalls. Diagnostics. 2022;12(5):1029.
19. 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(5):20200461.
20. Sajjad I, et al. Awareness and perception of dentists regarding role and future of Artificial Intelligence in Dentistry. Pak J Med Health Sci. 2021;15(12):3555-3558.
21. Schwendicke F, Samek W, Krois J. Artificial Intelligence in dentistry: Chances and Challenges. J Dent Res. 2020;99(7):769-774.
22. Sur J, et al. Knowledge, attitudes, and perceptions regarding the future of artificial intelligence in Oral Radiology in India: A survey. Imaging Sci Dent. 2020;50(3):193.
23. White B, Rosenblatt F. Principles of Neurodynamics: Perceptrons and the Theory of Brain Mechanisms. Am J Psychol. 1963;76(4):705.

How to cite this article?

How to cite this article: Omerzai MF, Kulkarni S, Familiarity and Attitude Survey about Artificial intelligence (AI) as Detection Tools in Dental Radiology. J Rehman Coll Dent 2023; 4(1): 2-6

Author Contributions

1. Muhammad Faisal Omarzai- Conceptualization and Manuscript writing
2. Sneha Kulkarni- Literature review and, Methodology of study