

Knowledge, Attitude, and Perception regarding the Integration of Artificial Intelligence (AI) for Radiological Diagnosis Among Dental Specialists in Saudi Arabia

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ABSTRACT

Objective: This study aimed to assess the knowledge, attitudes, and perceptions of dental specialists in Saudi Arabia regarding the use of artificial intelligence (AI) programs in radiological diagnosis.

Study Design: Cross sectional observational study

Place and Duration of Study: This Online questionnaire survey were sent from the College of Dentistry-Ar Rass Branch, Qassim university and responses were collected from August 2023 till the end of March 2024.

Methods: The total number of participants in the study were 145 (n=145). Primary data was collected through Questionnaire consisting of a 12-item close ended questions and quantitative methods(Chi-square test) was applied for analysis.

Results: The survey included 145 recent graduates, mostly aged 25–30 years. Most participants already knew about AI (81.4%) and its use in OMFR (72.4%), and many supported using it in clinics (71.7%). Many felt the software cannot exceed a radiologist's skill (62.1%) and would not accept an AI diagnosis that conflicts with their judgement (58.6%). Most believed AI will help new dentists (73.1%) and saw a future for it in oral radiology in Saudi Arabia (80%).

Conclusion: AI applications has become more common in every field and dentistry is no exception. This study reveals that recently graduated dental professionals are more favourable towards the integration of AI applications in Oral Radiology in the Kingdom of Saudi Arabia (KSA)

Key Words: Artificial Intelligence, Machine Learning (ML), Convolutional Neural Networks (CNNs), Clinical Decision Support Systems (CDS)

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INTRODUCTION

Artificial intelligence (AI) is defined as the ability of computers or machines to perform tasks that normally require human intelligence. AI can recognize speech, support decisions, and assist in medical diagnosis accurately and efficiently.

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Machine Learning (ML) algorithms can be utilized to enable the computers to recognize and analyze data to aid in the preparation of data sets. AI algorithms are used to analyze data in the industrial sector, medical field, for the assessment of trends in Stock market and also for weather analysis in the meteorology department.¹⁻³

The trend of using AI programs in the medical field is on the upsurge over the last few years even though the concept of AI has been under research for several years previously. Digital systems are now used more often in dentistry, especially in oral and maxillofacial radiology (OMFR). They help new dentists handle routine work and let experienced clinicians save time. These systems help to trace cephalometric points, detect caries, identify periapical and periodontal changes, with good input data and outline the inferior alveolar nerve, assess facial growth, review cervicofacial nodes, and spot many oral and maxillofacial diseases.³⁻⁵

METHODS

Online Questionnaires were sent to dental universities in KSA from College of Dentistry in Ar Rass in Qassim

University. A 12-items questionnaire was sent to dental specialists in the KSA through email. Only complete responses were accepted. The criteria for inclusion was recent graduates and with 1-3 years of experience. Quantitative data collection methods were utilized i.e., Questionnaires with close ended questions designed in google forms were sent via email and the responses were collected and analysis was undertaken for the responses. Since this is a questionnaire study, the feasibility of conducting was easier, and it had been conducted in other topics in KSA several times before. The 12-items closed ended online questionnaire was sent to young dentists in KSA and responses were collected. Data were processed in IBM SPSS 28 using the Chi-square test.

RESULTS

The survey included 145 dentists who had graduated within the past three years with 81 men (55.9%) and 64 women (44.1%). The age groups ranged from 25 to 30 years, with a mean of 26.28 ± 1.68 years. A large portion of the participants already knew the concept of AI, with 118 dentists (81.4%) reporting previous knowledge. The awareness of its use in OMFR was reported in 105 dentists (72.4%) and the knowledge of

CNNs as a commonly used method in these systems was present in 78 participants.

The support for incorporating these tools into routine radiological practice was observed in 104 dentists (71.7%). Many participants did not believe that the software can exceed the diagnostic skills of a trained radiologist which was shown in 62.1%, while 22.8% agreed to the usage of the software. A total of 58.6% stated that they would not depend upon a software-generated diagnosis when it could conflict with their own judgement, whereas 20% agreed to do so. 73.1% of the participants reported that these tools would help new graduates with diagnosis and treatment planning. The willingness to recommend the use of such tools amongst colleagues and friends and to incorporate them into their routine clinical practices was reported by 73.8% participants. The expectations for future adoption in oral radiology in Saudi Arabia were high, with 116 dentists (80%) anticipating an increased use of AI in dentistry. A smaller proportion (10.3%) did not expect future growth, and 9.7% participants were uncertain. The comparison of responses by gender showed no statistically significant difference in any of the items.

Table No.1: Correlation between the questionnaire responses with gender and the corresponding statistical significance values (n=145)

		Male	Female	Total	p-value
Have you heard about Artificial intelligence and its application?	Yes	65-44.8%	53-36.5%	118-81.4%	0.312
	No	16-11%	11-7.6%	27-18.6%	
Do you know that artificial intelligence can be utilized in dentistry especially in oral and maxillofacial radiology?	Yes	60-41.4%	45-31%	105-72.4%	0.212
	No	21-14.5%	19-13.1%	40-27.6%	
What according to you are the advantages of AI?	It can aid in oral maxillofacial diagnosis	7-4.8%	6-4.2%	13-9%	0.762
	Dental implant planning	10-6.9%	8-5.5%	18-12.4%	
	It does not have emotional saturation nor physical exhaustion.	2-1.4%	4-2.7%	6-4.1%	
	All the above	62-42.7%	46-31.8%	108-74.5%	
Which among the algorithms are utilized predominantly for AI application in oral and maxillofacial radiology?	Convolutional neural networks (CNNs)	46-31.7%	32-22.1%	78-53.8%	0.062
	Non-convolutional neural networks	8-5.5%	6-4.2%	14-9.7%	
	DICOM-5	6-4.1%	3-2.1%	9-6.2%	
	I don't know	21-14.4%	23-15.9%	44-30.3%	
Which among the following processes is directly related to OMF radiologists	Proper data set preparation	15-10.3%	13-9%	28-19.3%	0.075
	Operation of surgical robots	6-4.1%	5-3.5%	11-7.6%	
	All the above	60-41.4%	46-31.7%	106-73.1%	

Would you like to incorporate AI software/program for OMF radiology in your clinic?	Yes	57-39.3%	47-32.4%	104-71.7%	0.086
	No	10-6.9%	9-6.2%	19-13.1%	
	May be	14-9.7%	8-5.5%	22-15.2%	
Do you think that AI can surpass the clinical competence of OMF radiologist?	Yes	21-14.4%	12-8.3%	33-22.8%	0.060
	No	50-35.5%	40-27.6%	90-62.1%	
	May be	10-7%	12-8.2%	22-15.2%	
Will you consider accepting the diagnosis given by AI program if it differs from your diagnosis or clinical judgement	Yes	15-10.3%	14-9.7%	29-20%	0.234
	No	46-31.7%	39-26.9%	85-58.6%	
	May be	20-13.8%	11-7.6%	31-21.4%	
Do you think that AI will help a recently graduated dentist in diagnosis and treatment plan?	Yes	59-40.7%	47-32.4%	106-73.1%	0.078
	No	11-7.6%	7-4.8%	18-12.4%	
	May be	11-7.6%	10-6.9%	21-14.5%	
What is the main advantage of using AI in OMF radiology	It reduces time for monotonous tasks	10-6.9%	8-5.5%	18-12.4%	0.913
	It is better for OMF diagnosis	5-3.4%	6-4.2%	11-7.6%	
	It is useful in interventional radiology	4-2.7%	2-1.4%	6-4.1%	
	All the above	62-42.7%	48-33.1%	110-75.9%	
Would you recommend AI program software usage in your friend's /colleague's clinical practice	Yes	61	46	107-73.8%	0.876
	No	9	10	19-13.1%	
	May be	11	8	19-13.1%	
Do you think AI has future in Oral Radiology stations in KSA	Yes	66-45.5%	50-35.5%	116-80%	0.598
	No	9-6.2%	6-4.1%	15-10.3%	
	May be	6-4.1%	8-5.6%	14-9.7%	

DISCUSSION

Artificial intelligence (AI) has been used across many technical fields, and interest in its role continues to grow. Dentistry also follows this direction, with strong use cases in OMFR.⁶⁻⁸ Most recent work in OMFR has used convolutional neural networks built for image-processing tasks. These networks form the base of deep learning systems that perform well in identifying dental caries on radiographic images.⁴ Current systems support radiographic assessment, image interpretation, forensic science, and image quality improvement. Their use is not limited to basic detection, as these models can assist with more detailed diagnostic tasks, including separating subgroups of temporomandibular joint internal derangements with artificial neural networks.⁵ Large, well-curated datasets are needed to reach dependable performance, and the input of OMF radiologists remains essential for producing accurate and consistent training data.⁹⁻¹²

The inclusion of AI into the dentistry has evolved from innovation to necessity especially for recently graduated dentists who can avail the features provided by the AI applications to aid them in diagnosis and treatment planning. This transition is part of a broader futuristic concept for new dental diagnosis that encompasses artificial intelligence, machine learning, neural networks, and deep learning as interconnected and powerful tools.⁶ There are few previous studies which has explored the knowledge, attitude, and perceptions about AI in dentistry and oral radiology. Keser G et al.¹³ had conducted a study amongst Turkish dental students to test their knowledge on artificial intelligence applications in oral radiology. The study included 140 participants out of which 55 were male students and 85 were female students. The age range was between 20 to 28. In this study 84 (64%) of the students were already aware of AI applications in dentistry. 111(79.3%) of students agreed that AI has medical uses but only 55 (39.3%) of those were aware about how to incorporate AI in daily practice. 92.9% of

the study participants expressed interest in AI applications in oral diagnosis. 41.1% were unsure that an AI program can make a better diagnosis than a human doctor. A total of 114 (81.4%) participants agreed that they would use AI for diagnosis and treatment planning. 50% of the dental students agrees that the role of AI is to help in interpretation of complicated radiographic scans. 40% (56) students were unsure about the future of AI in Turkey. In our study, 116(80%) of the 145 study participants felt that AI applications have a future in Oral Radiology in the Kingdom of Saudi Arabia and only 9.7% were unsure about the future of AI in Oral radiology in KSA.

Sur J et al.¹⁴ conducted an online survey using google forms with 15 items closed ended questionnaire in India among dental professionals to know about their knowledge towards AI, their attitude and opinion towards AI applications and their perceptions about integration of AI software applications in dental practice. There were 250 study participants and 68% of them were already familiar with the concept of AI. 69% of them were positive for utilising AI applications in dental diagnoses. 51% of them agreed that the main application of AI is to be utilised in interpretation of complicated radiographic scans. 63% of the study population agrees that AI will have a future in India. This positive inclination was also shown by Seram et al.¹⁵ who found that a majority of dental students had positive attitude towards AI and identified its potential to transform dentistry. Singh et al.¹⁶ also reported that while dental professionals perceived AI as a beneficial tool for improving diagnostic accuracy and efficiency, but prominent limitations existed with regards to its adoption with a lack of structured training and high costs. The historical development of artificial neural networks in dentistry provides a foundation for understanding this global optimism, showing a long-standing research interest in automating and enhancing diagnostic processes.⁷ AI based clinical decision (CDS) support systems are being increasingly employed nowadays in the dental clinical practices and dental hospital-based radiology practices. These CDS systems can help in correlating clinical features with radiological features to make informed decisions. It can also be helpful in identifying peculiar anatomical features and ambiguous radiology reports creating inconsistencies in diagnosis. This is relevant because AI can support multiple dental fields, including orthodontics, where it helps plan treatment and predict outcomes.¹¹ The deployment of these systems reflects a broader trend in medicine, where AI in medical imaging is increasingly viewed not as a threat, but as a significant opportunity to place radiologists at the forefront of innovation.⁸ Advanced algorithms can extract detailed quantitative information from medical images to improve diagnostic and prognostic accuracy. This approach is directly applicable to oral cancer detection in OMF radiology, where accurate and consistent analysis of imaging features is essential for

reliable diagnosis and treatment planning.¹⁰ These CDS algorithms are more developed in the medical field rather than in dentistry and more refined datasets in the coming future may enable the CDS developers to come up with better workflow tailored for specific treatment needs for a given clinical situation.¹⁷⁻²⁰ A strong dataset is still a basic requirement for reliable algorithm performance in DMF radiology, and ongoing work continues to build the volume and quality needed. A clear need for structured training is also evident, as several surveys show uneven baseline knowledge among students and clinicians.^{15,21,22} A related survey reported clear differences between dental and non-dental groups, which supports the need for focused training tailored to clinical practice.²³ Hence, decision-support systems can improve accuracy and reduce errors in radiology, but their safe and effective use requires careful planning and proper implementation.

CONCLUSION

Artificial intelligence applications have become more common in every field and dentistry is no exception. This study reveals that recently graduated dental professionals are more favourable towards the integration of AI applications in Oral Radiology in KSA. They feel that AI applications can reduce time and help in diagnosis and treatment planning. They can be utilised to simplify complex software applications for implant planning and other various clinical situations. More studies with higher sample size are necessary to further enlighten us about this highly interesting and evolving topic. The Hippocratic principle of "First Do No Harm" should be kept in mind during developing AI based programs specific to dentistry for various clinical situations.

Author's Contribution:

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