

# Knowledge And Attitudes Of Karnataka Orthodontic Postgraduates Toward Ai In Cephalometric Analysis: A Questionnaire Survey

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## ABSTRACT

To gauge readiness for artificial intelligence (AI) integration in orthodontic cephalometric analysis and address training gaps among Karnataka postgraduate, we have decided to assess the knowledge and attitude of orthodontic postgraduate students regarding the use of AI in cephalometric analysis using a cross-sectional survey among orthodontic postgraduate students in Karnataka. Data was collected through a web-based questionnaire distributed via Google Forms. The survey was designed predominantly using a Likert scale format to capture responses on a structured basis. The questionnaire was validated by subject experts to ensure its relevance and accuracy. In total, 170 responses were collected, after distributing the questionnaire link, which consisted of 20 questions divided into four sections. We found that, most of the participants believe that AI could be useful in diagnosis and treatment planning and could revolutionize dentistry in general. 68.9 % of the respondents agree and 31.1% strongly agree that AI increases the speed of cephalometric diagnosis, and interestingly, the primary source of information about AI tools for most orthodontic postgraduates appears to be academic literature and journal articles. A significant number of respondents believe that AI will eventually replace traditional manual and semi-automatic analyses of cephalometric images. We come to conclude that, although knowledge regarding AI application in Cephalometrics seems to be fair among the respondents, many of them have not used AI tools. Many agree that AI improves speed and accuracy. Significant number of respondents are enthusiastic to explore more about AI.

**Keywords:** : AI, Knowledge, Attitude, Orthodontic Postgraduate Students, Questionnaire.

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## INTRODUCTION

The term “Artificial Intelligence” was coined in 1956 in Dartmouth Summer Research Project.<sup>1</sup> AI refers to the capability of machines or computer systems to simulate human-like intelligence.<sup>2</sup> It involves creating programs or algorithms that allow machines to interpret and understand data, learn from experiences, and make decisions or take actions that help achieve specific objectives. Essentially, AI enables machines to think, reason, and solve problems in ways that traditionally required human intelligence, such as recognizing patterns, making predictions, or adapting to new situations. AI is being used in medicine and diagnostic imaging.<sup>3</sup> It is making significant strides in various fields, including orthodontics. AI is particularly well-suited to tackle the inconsistencies that come with subjective individual examination.<sup>4</sup> AI technologies are being integrated into orthodontic practice to improve diagnosis, treatment planning, patient management, and even outcomes.<sup>5</sup> AI has been used for analysing whether

extraction or non extraction treatment would be necessary, with 80% accuracy.<sup>6</sup>

Cephalometric analysis is fundamental in diagnosing malocclusions, planning orthodontic treatments and predicting treatment outcomes. Recent advancements in artificial intelligence (AI), particularly deep learning models such as convolutional neural networks, have demonstrated considerable success in automating cephalometric analysis. The shift from manual cephalometry to AI-based cephalogram is aimed at enhancing the diagnostic value of analysis by saving time and reducing errors.<sup>7</sup> However, manual detection of landmarks using conventional and semi-automated approaches on radiographic images is both time-consuming and susceptible to inaccuracies due to clinician variability. Due to concerns regarding potential inaccuracies in diagnosis and clinical decision-making, AI is being used cautiously. Although there has been substantial research

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into AI applications in radiology, studies specific to orthodontics are limited.

*Thus , this study aims to investigate the knowledge and attitude of orthodontic students toward AI-based cephalometric applications, exploring their perspectives on current tools and their expectations for future developments.*

**AIM**

To assess the knowledge and attitude towards application of Artificial Intelligence in Cephalometric Analysis among orthodontic postgraduate students in Karnataka.

**MATERIAL AND METHODS**

This study was an online cross sectional survey conducted among orthodontic postgraduate students in Karnataka. A questionnaire was developed in accordance with previous studies and it contained a total of 4 sections and 20 questions. The first section included the informed consent. The second was the demographic section with information regarding the respondents’ age, gender and year of postgraduation. Questions pertaining to knowledge regarding AI application in cephalometrics were asked in the third section. The fourth section consisted of questions pertaining to the attitude towards the same. The questionnaire was validated by subject experts for its accuracy and relevance. Postgraduate students in the department of Orthodontics in dental colleges of Karnataka were included in this study.

The sample size (n) is derived by using the “Sample size for Frequency in a Population” formula, where, N (Population size) = 1000000, p = 87.5 % (Lin L et Al 2023), d (Confidence limits)= 5%, DEFF (Design effect for cluster surveys) = 1, Z1-α/2– critical value at confidence level of 95%, α is 0.05 and the critical value is 1.96. Thus the sample size derived was n = 169~170 participants.

The link for questionnaire was distributed among orthodontic postgraduate students in Karnataka and the respondents were recruited in a snowballing approach. A total of 170 responses were subjected to statistical analysis.

**STATISTICAL ANALYSIS**

In our study, it was performed using Statistical package for social sciences (SPSS) software (IBM Corp) (v.21.0). Frequency and percentage statistics was performed of the different questionnaire items in the study. Chi-square test of proportion was used to assess statistically significant differences within the responses of each question. A p value of less than 0.05 was considered as statistically significant at 95% confidence intervals in the study.

**RESULTS**

The results pertaining to the four sections of the questionnaire have been enumerated in different tables. **Table 1** depicts the information related to the demographics. Among all the respondents, 68.9% were of the age group 26-30 years, 30% fell under the 20-25 years age group and 1.1% were above 30 years of age. From **Table 2** it can be inferred that the majority of the

respondents were females i.e., 55.6% while the remaining 44.4% were males. **Table 3** gives the frequency distribution of study participants according to the year of postgraduation and it can be seen that there were almost equal number of participants from each academic year. 33.3% of them were in 1<sup>st</sup> year, 32.2% were 2<sup>nd</sup> year and 34.4% of them were 3<sup>rd</sup> year postgraduates.

All the Responses which were statistically significant pertaining to knowledge have been tabulated in **Table 4**. 90% of the respondents were aware of the use of artificial intelligence for cephalometric analysis. However 51.1% have not used AI tools. Majority of participants (37.8%) responded that their knowledge is based on literature in journals.

**Table 5** shows responses related to the attitude towards the use of AI in cephalometric analysis only those who showed significant result. All the participants agreed that the use of AI increases the speed of cephalometric analysis with better landmark identification thereby aiding in faster diagnosis. However, 50% of respondents stated that they encountered challenges while operating AI tools. 92.4% participants agreed that AI applications will replace manual and semiautomatic analyses in the future.

AGE	FREQUENCY	PERCENTAGE
20-25 years	27	30%
26-30 years	62	68.9%
>30 years	1	1.1%
<b>Total</b>	90	100%

**TABLE 1 – FREQUENCY DISTRIBUTION OF STUDY PARTICIPANTS ACCORDING TO AGE**

GENDER	FREQUENCY	PERCENTAGE
Male	40	44.4%
Female	50	55.6%
<b>Total</b>	90	100%

**TABLE 2– FREQUENCY DISTRIBUTION OF STUDY PARTICIPANTS ACCORDING TO GENDER**

YEAR OF POST-GRADUATION	FREQUENCY	PERCENTAGE
1 <sup>st</sup> Year	30	33.3%
2 <sup>nd</sup> Year	29	32.3%
3 <sup>rd</sup> Year	31	34.4%
<b>Total</b>	90	100%

**TABLE 3 – FREQUENCY DISTRIBUTION OF STUDY PARTICIPANTS ACCORDING TO YEAR OF POSTGRADUATION**

QUESTIONS AND RESPONSES	FREQUENCY (N)	PERCENTAGE (%)	CHI-SQUARE

				P VAL UE
<b>3.I KNOW AI SOFTWARES SPECIFICALLY DESIGNED FOR CEPHALOMETRIC ANALYSIS</b>	Disagree	5	5.6%	0.023*
	Neutral	30	33.3%	
	Agree	33	36.7%	
	Strongly agree	22	24.4%	
<b>4.I HAVE USED AI-BASED TOOLS IN CEPHALOMETRIC ANALYSIS</b>	Disagree	46	51.1%	0.041*
	Neutral	8	8.9%	
	Agree	18	20.0%	
	Strongly agree	18	20.0%	
	Convolutional neural networks (CNN)	11	12.2%	
	Deep Learning	7	7.8%	
	Machine Learning	6	6.7%	
<b>8.MY SOURCE OF KNOWLEDGE IS FROM</b>	Academic Conference	15	16.7%	0.001*
	Lectures	29	32.2%	
	Literature in Journals	34	37.8%	
	Peers	7	7.8%	
	Social Media	5	5.6%	

**TABLE 4 – FREQUENCY AND PERCENTAGE DISTRIBUTION OF THE STUDY PARTICIPANTS ACCORDING TO KNOWLEDGE QUESTIONS AND RESPONSES**

QUESTIONS AND RESPONSES	FREQUENCY (N)	PERCENTAGE (%)	CHI-SQUARE P VALUE
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<b>1.I THINK AI CAN IMPROVE THE SPEED OF CEPHALOMETRIC ANALYSIS</b>	Agree	62	68.9%	0.000*
	Strongly agree	28	31.1%	
<b>2.I THINK AI CAN ASSIST IN IDENTIFYING CEPHALOMETRIC LANDMARKS MORE ACCURATELY THAN MANUAL METHODS</b>	Neutral	5	5.6%	0.000*
	Agree	72	80.0%	
	Strongly agree	13	14.4%	
<b>4.I AM INTERESTED IN LEARNING MORE ABOUT AI APPLICATIONS IN CEPHALOMETRIC S</b>	Neutral	2	2.2%	0.032*
	Agree	41	45.6%	
	Strongly agree	47	52.2%	

**TABLE 5 – FREQUENCY AND PERCENTAGE DISTRIBUTION OF THE STUDY PARTICIPANTS ACCORDING TO ATTITUDE QUESTIONS AND RESPONSES**

**DISCUSSION**

In recent years, artificial intelligence (AI) technologies have made significant strides and are increasingly being utilized across various areas of healthcare, including clinical visual data processing, diagnostic support, and prognosis evaluation. In the field of orthodontics, one of the most promising applications of AI is in the detection of landmarks and the analysis of cephalometric measurements. This application holds considerable potential for enhancing both accessibility and convenience for orthodontic postgraduates by automating processes that traditionally require substantial manual effort.<sup>7</sup> AI-driven tools can help speed up the identification of key anatomical landmarks on cephalometric images, facilitating more efficient and accurate diagnostic assessments. The analysis from study done by Fracchia et al highlights the reproducibility and consistency of artificial intelligence in landmark identification.<sup>8</sup> Additionally, these tools can assist in treatment planning, offering orthodontic postgraduates valuable insights into potential treatment options. Although there are studies related to this, survey related to knowledge, availability, use and accessibility to postgraduate students in Karnataka is limited. This questionnaire was designed to evaluate the same. About 90% of respondents were aware about the application of AI in orthodontics and cephalometrics, which is higher in comparison to 77.4 % as stated in a study by Seram et al.<sup>9</sup> Despite the growing adoption of AI technologies in orthodontic practice, there has been a noticeable lack of research exploring how orthodontic postgraduates perceive and experience AI-assisted cephalometric applications. Although many studies have examined AI's potential to support orthodontic care, very few have focused on the

firsthand experiences and perceptions of orthodontic professionals who are using these technologies.<sup>10</sup> Cephalometrics remains one of the most critical diagnostic tools in orthodontics, and it continues to play a central role in the treatment planning process. Over the years, several semi-automatic and fully automated AI-based technologies have been developed to improve the efficiency and accuracy of cephalometric analysis. While many orthodontic professionals are familiar with these advancements, it is noteworthy that not all orthodontic postgraduate students have access to these AI-powered tools. This is similar to a study by Mengi et al where in spite of recognizing the importance and advantages of artificial intelligence, 62.5 % of clinicians are not using AI.<sup>11</sup> In our study it has been found that only 40% of the respondents have themselves used the AI applications. Among those who have had the opportunity to use them, the feedback has been overwhelmingly positive, with many reporting that AI tools significantly enhance the speed and precision of cephalometric diagnoses. Various studies have shown that AI based technologies assist in identifying anatomical landmarks more reliably and efficiently, which can help streamline the overall diagnostic process.<sup>12</sup> Interestingly, the primary source of information about AI tools for most orthodontic postgraduates appears to be academic literature in journal articles. This is in contrast with previous studies, where the most common sources of information were lectures, academic conferences, web browsing or social media platforms.<sup>12</sup> This shift suggests that orthodontic postgraduates may be increasingly turning to peer-reviewed research for reliable, evidence-based information about emerging technologies in the field. About 50% of participants said that they would recommend the use of AI in clinical practice. The crucial component of cephalometric analysis is accurate landmarking of anatomical structures. In a busy orthodontic practice, automating this process through AI powered algorithms could improve speed and efficiency.<sup>13</sup> Moreover, many respondents expressed a strong interest in learning more about AI and its applications in orthodontics. This is in conjunction with a study by Yüzbaşıoğlu where 74.60% and 79.80% of students agreed that topics about AI should be included in undergraduate and postgraduate dental education, respectively.<sup>14</sup> However, in a study by Hanenkrath et al, 87.8% of orthodontic programs in North America have not included AI training programs.<sup>15</sup> This shows the need for academic institutions to incorporate advanced training so that the students can be up to date. The potential for AI to reshape orthodontic practice in the future is a topic of growing fascination among orthodontic postgraduates. A significant number of respondents i.e. 76.7% believe that AI will eventually replace traditional manual and semi-automatic analyses of cephalometric images, marking a transformative shift in orthodontic diagnostic procedures. In a systematic review by Hendrickx et al, it was concluded that although AI showed promise in 2D cephalometric analysis, however, the accuracy and performance was inconsistent in 3D, thereby indicating need for improvement.<sup>16</sup> Even in a scoping review of AI in

orthodontics, it has been mentioned that although it shows promise, human supervision is must at all times as AI is not consistent enough yet to surpass clinicians.<sup>17</sup> The growing enthusiasm highlights the potential for AI to drive significant improvements in both the efficiency and accuracy of orthodontic care, making it a topic worth further exploration as AI technologies continue to evolve.

#### **LIMITATION**

Limitation of the study is that it was conducted in a single state. Further analysis across the country could give a better outlook of the knowledge and usage of AI in cephalometrics.

#### **CONCLUSION**

Knowledge regarding AI application in Cephalometrics seems to be fair among the respondents, however 50% of them have not used AI tools. 68.9 % of the respondents agree and 31.1% strongly agree that AI improves speed and accuracy. 52.2% of respondents strongly agree that they are eager to explore more about AI.

#### **ETHICAL CLEARANCE**

Ethical approval has been obtained from Institutional research and ethics committee of KLE VK Institute of Dental Sciences.

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