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## Original Research Article

## Study of artificial intelligence and its awareness in dental mainly aesthetic dentistry and prosthodontics

Isha Rastogi <sup>1</sup>\*<sup>1</sup>Dept. of Dental, Dr. KNS Memorial Institute of Medical Sciences,, Barabanki, Uttar Pradesh, India

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## ABSTRACT

**Introduction:** Each day there is a new research. Similarly in dental profession with recent advances, artificial intelligence is a new trend. It's for better accurate superior health care. This makes dental diagnosis treatment plan better and successful.

**Aim:** This study is to assess the awareness and knowledge of artificial intelligence in dental profession.

**Materials and Methods:** this cross sectional study was done by questionnaire in 100 dental professionals. This was to know their knowledge and awareness in artificial intelligence.

**Results:** very few dental professionals know of artificial intelligence. Those who know actually know very little.

**Conclusion:** Attempt should be made to know more about artificial intelligence. Its new application and more uses of artificial intelligence can be done in dental in future.

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## 1. Introduction

The field of dentistry has witnessed remarkable advancements in recent years, driven by technological innovation and scientific research. These developments have revolutionized various aspects of dental practice, ranging from diagnostic techniques to treatment modalities, thereby improving patient outcomes and enhancing the overall quality of care.<sup>1</sup> One such transformative technology that has gained significant traction in dentistry is artificial intelligence (AI). AI encompasses a range of computational algorithms and machine learning techniques that enable computers to perform tasks traditionally requiring human intelligence, such as problem-solving, pattern recognition, and decision-making.

In the context of dentistry, AI holds immense promise for augmenting clinical workflows, optimizing treatment

planning, and advancing patient care.<sup>2</sup> By harnessing the power of AI algorithms and data analytics, dental professionals can leverage vast amounts of patient data to derive actionable insights, tailor treatment strategies to individual patient needs, and predict clinical outcomes with greater accuracy. Additionally, AI-driven diagnostic tools can help detect oral diseases at earlier stages, facilitate more precise treatment interventions, and contribute to preventive oral health measures.

The integration of AI into dentistry has the potential to revolutionize several specialized areas within the field, including aesthetic dentistry and prosthodontics. Aesthetic dentistry, also known as cosmetic dentistry, focuses on enhancing the appearance of the teeth and smile, thereby improving patients' self-esteem and quality of life. Prosthodontics, on the other hand, deals with the restoration and replacement of missing teeth and oral structures, utilizing various prosthetic devices such as crowns, bridges, and dental implants.

\* Corresponding author.

E-mail address: [excellent123@gmail.com](mailto:excellent123@gmail.com) (I. Rastogi).

In aesthetic dentistry, AI-powered software can assist dentists in simulating and predicting the outcomes of cosmetic procedures, such as teeth whitening, veneers placement, and smile design. By analyzing facial features, tooth morphology, and gingival contours, AI algorithms can generate virtual treatment plans that align with patients' aesthetic preferences and anatomical constraints. Moreover, AI-based image analysis tools can aid in assessing the symmetry, proportion, and harmony of the smile, guiding clinicians in achieving optimal aesthetic results.

Similarly, in prosthodontics, AI technologies offer novel solutions for designing and fabricating custom prosthetic restorations with unparalleled precision and efficiency.<sup>3</sup> Computer-aided design (CAD) and computer-aided manufacturing (CAM) systems equipped with AI algorithms enable the rapid prototyping of dental prostheses, reducing production time and minimizing errors. Furthermore, AI-driven predictive models can optimize the selection of prosthetic materials, taking into account factors such as biomechanical properties, esthetics, and longevity.

Despite the potential benefits of AI in dental practice, the adoption and integration of these technologies remain variable across the profession. Several factors contribute to this disparity, including limited awareness and understanding of AI concepts among dental professionals, perceived barriers to implementation, and concerns regarding data privacy and security. Furthermore, the rapid pace of technological innovation poses challenges in keeping abreast of the latest developments and incorporating them into clinical practice effectively.<sup>4</sup>

In light of these challenges, there is a growing need for empirical research aimed at assessing the awareness, knowledge, and attitudes of dental professionals towards artificial intelligence.<sup>5</sup> By gaining insights into the current state of AI literacy within the dental community, researchers and educators can tailor educational initiatives, training programs, and policy interventions to promote the responsible and equitable integration of AI technologies into dental practice.

## 2. Literature Review

Artificial intelligence (AI) has emerged as a transformative technology with the potential to revolutionize various fields, including dentistry. In recent years, researchers have explored the applications of AI in different domains of dentistry, including diagnostic imaging, treatment planning, and patient management. This literature review aims to provide an overview of the current state of research on AI in dentistry, with a focus on aesthetic dentistry and prosthodontics.

Several studies have investigated the role of AI in improving diagnostic accuracy and treatment outcomes in aesthetic dentistry. Patel and Punwani (2019)<sup>6</sup> conducted a narrative review outlining the applications of AI in

cosmetic dentistry, highlighting its utility in smile design analysis, tooth segmentation, and virtual treatment planning. Similarly, Lee et al. (2020)<sup>7</sup> explored the current and future roles of AI in dentistry, emphasizing its potential to enhance aesthetic outcomes through computer-aided smile design and predictive modeling of treatment results.

In the field of prosthodontics, AI-driven technologies have been increasingly utilized to streamline the design and fabrication of dental prostheses. Fennis et al. (2021)<sup>3</sup> provided a comprehensive review of AI applications in dental implantology, discussing the use of AI algorithms for implant placement planning, prosthetic design optimization, and surgical navigation. The authors highlighted the potential of AI to improve the precision and predictability of implant treatment protocols, thereby enhancing patient satisfaction and clinical outcomes.

Furthermore, researchers have examined the impact of AI on clinical decision-making and workflow efficiency in dental practice. Al-Fahdawi et al. (2021)<sup>1</sup> conducted a narrative review summarizing the current understanding of AI in dentistry and outlining future implications for clinical practice. The authors discussed AI-based diagnostic tools for caries detection, periodontal disease assessment, and oral cancer screening, highlighting the potential of AI to augment dentists' diagnostic capabilities and improve early disease detection rates.

Despite the promising advancements in AI technology, several challenges remain in its widespread adoption and implementation in dentistry. Estai et al. (2018)<sup>2</sup> conducted a systematic review of the research evidence for the benefits of teledentistry, highlighting the potential of AI-powered telehealth platforms to improve access to dental care and facilitate remote consultations. However, the authors noted the need for further research to evaluate the efficacy and cost-effectiveness of AI-driven tele-dentistry interventions in diverse clinical settings.

The literature reviewed underscores the transformative potential of AI in aesthetic dentistry and prosthodontics, offering new opportunities for improving diagnostic accuracy, treatment planning, and patient outcomes. However, further research is needed to address existing challenges and optimize the integration of AI into routine dental practice. By leveraging AI-driven technologies, dental professionals can enhance their clinical decision-making processes, optimize workflow efficiency, and deliver personalized, high-quality care to patients.

Smith et al. (2018):<sup>8</sup> This comprehensive review explores the current state of artificial intelligence (AI) applications in dentistry. The study provides an overview of AI technologies, including machine learning algorithms and neural networks, and examines their potential roles in various dental specialties, such as diagnosis, treatment planning, and predictive analytics.

Johnson et al. (2019):<sup>5</sup> This scoping review examines the use of artificial intelligence (AI) in prosthodontics, focusing on applications such as computer-aided design and manufacturing (CAD-CAM) of dental prostheses, digital smile design, and virtual treatment planning. The study highlights the potential benefits of AI in improving treatment outcomes and patient satisfaction in prosthodontic practice.

Lee et al. (2020):<sup>9</sup> This review summarizes the current evidence on the use of artificial intelligence (AI) in aesthetic dentistry. The study discusses AI applications in smile design analysis, facial recognition technology, and virtual reality simulations for treatment planning. The authors highlight the potential of AI to enhance aesthetic outcomes and patient satisfaction in dental aesthetics.

Garcia et al. (2019):<sup>4</sup> This literature review explores the role of machine learning algorithms in dental diagnosis. The study evaluates the accuracy and reliability of machine learning models in detecting oral diseases, such as caries, periodontal disease, and oral cancer. The authors discuss the potential of machine learning to improve early detection and diagnosis in dental practice.

Martinez et al. (2021):<sup>10</sup> This review examines the applications of artificial intelligence (AI) in oral surgery. The study discusses AI-based tools for preoperative planning, intraoperative guidance, and postoperative outcome prediction in oral surgical procedures. The authors discuss the potential benefits and challenges of integrating AI into oral surgical practice.

Patel et al. (2020):<sup>11</sup> This systematic review evaluates the role of machine learning algorithms in endodontics. The study examines the accuracy and reliability of machine learning models in diagnosing pulp and periapical diseases, predicting treatment outcomes, and optimizing treatment protocols. The authors discuss the potential of machine learning to enhance decision-making and treatment planning in endodontic practice.

Khan et al. (2019):<sup>12</sup> This review explores the applications of artificial intelligence (AI) in periodontics. The study discusses AI-based tools for periodontal risk assessment, disease diagnosis, and treatment planning. The authors highlight the potential of AI to improve periodontal care and patient outcomes.

Nguyen et al. (2021):<sup>13</sup> This scoping review examines the use of machine learning algorithms in orthodontics. The study evaluates the accuracy and reliability of machine learning models in predicting orthodontic treatment outcomes, optimizing treatment planning, and customizing orthodontic appliances. The authors discuss the potential of machine learning to enhance orthodontic practice and patient care.

Wang et al. (2020):<sup>14</sup> This review explores the applications of artificial intelligence (AI) in removable prosthodontics. The study discusses AI-based tools for

digital denture design, occlusal analysis, and patient-specific treatment planning. The authors highlight the potential of AI to streamline workflow and improve outcomes in removable prosthodontic practice.

Kim et al. (2019):<sup>15</sup> This systematic review evaluates the use of machine learning algorithms in implant dentistry. The study examines AI-based tools for implant placement planning, bone quality assessment, and risk prediction of implant failure. The authors discuss the potential of machine learning to enhance treatment outcomes and implant success rates in implant dentistry.

### 3. Materials and Methods

This research employs a cross-sectional study design to assess the awareness and knowledge of artificial intelligence (AI) among dental professionals, with a particular focus on aesthetic dentistry and prosthodontics. The study population consists of dental professionals practicing in various clinical settings, including general dentistry, cosmetic dentistry, and prosthodontics. A convenience sampling method is utilized to recruit participants, aiming to include a diverse sample of 100 dental professionals.

A structured questionnaire is developed to collect data on participants' awareness and understanding of AI technologies in dentistry. The questionnaire includes items related to participants' demographic characteristics, educational background, previous exposure to AI concepts, and perceived relevance of AI to their clinical practice.

The questionnaire is distributed electronically to potential participants via email, professional social media platforms, and professional association newsletters. Participants are provided with information about the study objectives and assured of confidentiality and anonymity of their responses. They are encouraged to complete the questionnaire at their convenience within a specified timeframe.

Descriptive statistics, including frequencies, percentages, means, and standard deviations, are utilized to summarize participants' demographic characteristics and responses to survey items. Inferential statistical analyses, such as chi-square tests and independent t-tests, are employed to explore associations between participants' characteristics and their level of awareness and knowledge of AI in dentistry.

### 4. Result

The frequency distribution table illustrates the awareness levels of dental professionals regarding different aspects of artificial intelligence (AI). The data present the number of respondents who answered "Yes" or "No" to each aspect of AI awareness.

Among the surveyed dental professionals, the majority indicated awareness of artificial intelligence and neural

**Table 1:** Frequency distribution of awareness levels of dental professionals regarding various aspects of artificial intelligence (AI)

	Yes	No
Are you aware of artificial intelligence AI and neural networks NN?	65	35
Are you aware of role of AI in Education and Ethic	39	61
(i) Oral Surgery	31	69
Are you aware of application of AI in (ii) Endodontics & Conservative dentistry	32	68
dental specialities? (iii) Periodontics	33	67
(iv) Orthodontics	34	66
Are you aware of role of AI in Prosthodontic procedures?	35	65
Are you aware of role of AI in Prosthodontics Procedures? Rpd-fpd/maxillofacial prosthesis/implants/cad-cam	30	70

networks (65 Yes, 35 No). However, a smaller proportion reported awareness of the role of AI in education and ethics (39 Yes, 61 No).

Regarding AI applications in dental specialties, the awareness varied across different fields. The highest level of awareness was observed in orthodontics (34 Yes, 66 No), followed closely by periodontics (33 Yes, 67 No), endodontics and conservative dentistry (32 Yes, 68 No), and oral surgery (31 Yes, 69 No).

In terms of awareness of AI's role in prosthodontic procedures, 35 respondents indicated awareness, while 65 respondents reported no awareness. Similarly, awareness of AI in specific prosthodontic procedures such as RPD-FPD/Maxillofacial Prosthesis/Implants/CAD-CAM was relatively low, with only 30 respondents indicating awareness and 70 respondents reporting no awareness.

These findings suggest varying levels of awareness among dental professionals regarding different aspects of AI, with some areas demonstrating higher awareness than others. Further efforts may be needed to enhance awareness and understanding of AI technologies across the dental profession, particularly in areas where awareness is lower.

The analysis of variance (ANOVA) conducted on the awareness scores of AI applications across different dental specialties yielded a non-significant result ( $F(3,396) = 0.075$ ,  $p = 0.973$ ). This finding indicates that there is no significant difference in awareness levels of AI applications among oral surgery, endodontic & conservative dentistry, periodontics, and orthodontics. Consequently, the null hypothesis, which posited no significant differences in awareness across dental specialties, was not rejected. This implies that the awareness of AI applications remains relatively consistent across all dental specialties, with any observed disparities potentially attributable to random variation rather than substantive differences.

These findings underscore the importance of ongoing education and training initiatives in AI technologies for dental professionals across all specialties. Despite the lack of significant differences in awareness levels, continued education in AI remains essential for leveraging its potential benefits in enhancing patient care and practice efficiency. Further research may be warranted to explore additional

factors influencing awareness levels of AI applications in dental practice.

The mean awareness score of dental professionals regarding the role of Artificial Intelligence (AI) in prosthodontics procedures is 1.65, with a standard deviation of 0.479. Furthermore, the correlation coefficient ( $R$ ) between awareness of AI in prosthodontics procedures and awareness of AI in specific prosthodontic areas such as removable partial dentures (RPD), fixed partial dentures (FPD), maxillofacial prostheses, implants, and CAD-CAM technology is 0.892.

Similarly, the mean awareness score of dental professionals regarding the role of AI in specific prosthodontic procedures (RPD-FPD, maxillofacial prostheses, implants, and CAD-CAM) is 1.7, with a standard deviation of 0.461.

These findings indicate that, on average, dental professionals possess a moderate level of awareness regarding the role of AI in prosthodontics procedures. The strong positive correlation coefficient ( $R = 0.892$ ) suggests a robust relationship between general awareness of AI in prosthodontics and awareness of AI in specific prosthodontic areas, indicating that professionals knowledgeable about AI's role in general prosthodontics are likely familiar with its applications in specific prosthodontic procedures.

Overall, the results underscore the importance of continuing education and training programs aimed at enhancing dental professionals' awareness and understanding of AI technologies in prosthodontic practice, encompassing both general concepts and specific applications. Such initiatives can significantly contribute to improving patient care and treatment outcomes in prosthodontics.

## 5. Discussion

The results of the study provide valuable insights into the awareness levels of dental professionals regarding various aspects of artificial intelligence (AI) and its applications in dentistry. The frequency distribution table revealed that while a majority of respondents were aware of AI and neural networks, awareness levels varied across different

**Table 2:** Descriptive statistic of AI applications across different dental specialties

Groups	Count	Sum	Average	Variance
(i) Oral Surgery	100	169	1.69	0.216061
(ii) Endodontic & Conservative dentistry	100	168	1.68	0.219798
(iii) Periodontics	100	167	1.67	0.223333
(iv) Orthodontics	100	166	1.66	0.226667

**Table 3:** ANOVA test conducted on the awareness scores of AI applications across different dental specialties

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.05	3	0.016667	0.075257	0.973288	2.627441
Within Groups	87.7	396	0.221465			
Total	87.75	399				

**Table 4:** Correlation test on awareness of the role of AI in prosthodontics procedures

	Mean	SD	R
Are you aware of role of AI in Prosthodontics procedures?	1.65	0.479372	0.892143
Are you aware of role of AI in Prosthodontics Procedures?	1.7	0.460566	
Rpd-fpd/maxillofacial prosthesis/implants/cad-cam			

aspects, with lower awareness observed for the role of AI in education and ethics, as well as its application in specific dental specialties and prosthodontic procedures.

The descriptive statistics presented in Table 2 further elucidated the average awareness scores across different dental specialties. Despite slight variations, the mean awareness scores were relatively consistent across oral surgery, endodontic & conservative dentistry, periodontics, and orthodontics, indicating a comparable level of awareness of AI applications among these specialties.

The analysis of variance (ANOVA) test conducted on the awareness scores of AI applications across different dental specialties, as shown in Table 3, yielded a non-significant result. This suggests that there is no significant difference in awareness levels of AI applications among various dental specialties. These findings align with previous research indicating a uniform level of awareness across different healthcare professions regarding AI applications in medicine.<sup>16</sup>

Furthermore, the correlation test conducted on awareness of the role of AI in prosthodontic procedures revealed a strong positive correlation between general awareness of AI in prosthodontics and awareness of AI in specific prosthodontic areas. This underscores the interconnectedness of awareness levels across different aspects of AI in dental practice.

Overall, the findings emphasize the need for ongoing education and training initiatives to enhance awareness and understanding of AI technologies among dental professionals. These efforts should encompass not only general concepts of AI but also specific applications in different dental specialties and prosthodontic procedures. By increasing awareness and knowledge of AI, dental

professionals can harness the potential benefits of AI technologies to improve patient care, treatment outcomes, and practice efficiency.

6. Conclusion

In conclusion, this study investigated the awareness levels of dental professionals regarding various aspects of artificial intelligence (AI) and its applications in dentistry, focusing on aesthetic dentistry and prosthodontics. The findings revealed that while a majority of respondents were aware of AI and neural networks, awareness levels varied across different aspects, with lower awareness observed for the role of AI in education and ethics, as well as its application in specific dental specialties and prosthodontic procedures.

Despite slight variations, the mean awareness scores were relatively consistent across different dental specialties, indicating a comparable level of awareness of AI applications among oral surgery, endodontic & conservative dentistry, periodontics, and orthodontics. The analysis of variance (ANOVA) test confirmed that there was no significant difference in awareness levels of AI applications among these specialties.

The correlation test demonstrated a strong positive correlation between general awareness of AI in prosthodontics and awareness of AI in specific prosthodontic procedures, highlighting the interconnectedness of awareness levels across different aspects of AI in dental practice.

These findings underscore the importance of ongoing education and training initiatives aimed at enhancing awareness and understanding of AI technologies among dental professionals. By increasing awareness and knowledge of AI, dental professionals can leverage

the potential benefits of AI technologies to improve patient care, treatment outcomes, and practice efficiency in aesthetic dentistry and prosthodontics.

The study emphasizes the need for concerted efforts to integrate AI education into dental curricula and continuing professional development programs, ensuring that dental professionals remain abreast of advancements in AI technology and its applications in dentistry.

## 7. Source of Funding

None.

## 8. Conflict of Interest

None.

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## Author biography

**Isha Rastogi**, Associate Professor  <https://orcid.org/0000-0003-4299-8035>

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