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Perceptions, Readiness and Willingness of Dentists to Adopt Artificial Intelligence in Clinical Dental Practice: A Cross-Sectional Study

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KEYWORDS

Artificial intelligence, Dental practitioner, Healthcare, Clinical decision support, Digital dentistry

ABSTRACT:

Background: Artificial intelligence (AI) has emerged as a transformative technology in healthcare, with applications in radiographic interpretation, disease detection, treatment planning, and clinical decision support in dentistry. Despite promising advancements, translation of AI from research settings to routine clinical dental practice remains limited. Adoption depends largely on dentists' knowledge, perceptions, readiness, and willingness to integrate AI into daily practice. This study was conducted to assess the perceptions, readiness, and willingness of dentists to adopt artificial intelligence in clinical dental practice and to identify factors influencing AI adoption.

Methodology: A cross-sectional questionnaire-based study was conducted among 220 registered dental practitioners (BDS and MDS) practicing in academic, private, and government settings. A validated, self-administered questionnaire assessed awareness, exposure, perceptions, readiness, willingness, and perceived barriers related to AI adoption. Data were analyzed using descriptive and inferential statistics, with $p < 0.05$ considered statistically significant.

Results: Awareness of AI in dentistry was significantly higher among MDS practitioners (79.5%) compared to BDS practitioners (60.6%) ($p = 0.02$). However, actual use of AI-based decision-support tools was minimal in both groups. MDS practitioners demonstrated significantly higher agreement that AI improves diagnostic accuracy (56.4% vs 42.3%; $p = 0.04$) and is feasible for routine practice in India (48.7% vs 35.2%; $p = 0.04$). Willingness to use AI if available was significantly greater among MDS practitioners (48.7%) compared to BDS practitioners (33.8%) ($p = 0.03$). High cost, poor infrastructure, and medico-legal uncertainty were the most frequently reported barriers.

Conclusion: Dentists demonstrated positive perceptions and moderate readiness toward AI adoption; however, actual clinical utilization remains low. Specialists exhibited greater awareness and preparedness compared to general practitioners. Addressing structural barriers, strengthening digital infrastructure, and integrating formal AI training may facilitate responsible and effective implementation of AI in routine dental practice.

INTRODUCTION

Artificial intelligence (AI) systems, particularly generative and conversational models, have rapidly become integral to education and professional workflows across disciplines including healthcare. AI has emerged as a transformative technology with the potential to enhance diagnostic accuracy, improve efficiency, and support clinical decision-making. In dentistry, advances in machine learning and deep learning have enabled the development of AI-based applications for radiographic interpretation, disease detection, treatment planning and outcome prediction, contributing to the growing field of digital dentistry.[1-2]

AI has demonstrated promising applications across various domains of clinical dental practice. Studies have shown that AI-assisted systems can detect dental caries, periodontal bone loss, and periapical lesions with accuracy comparable to or, in some instances, exceeding that of human clinicians.[3-4] Additionally, AI tools have been applied in orthodontics for treatment planning, in implant dentistry for optimal implant positioning, and in prosthodontics for digital design workflows.[5] These

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applications highlight the potential of AI to act as a clinical decision-support system, augmenting rather than replacing dentists' clinical expertise.

Despite these advancements, the translation of AI from research settings to routine clinical dental practice remains limited. Adoption of AI technologies depends not only on technical performance but also on dentists' knowledge, perceptions, and readiness to integrate such tools into daily practice. Evidence from broader healthcare settings suggests that while clinicians generally recognize the benefits of AI, concerns related to lack of training, trust in algorithm-based decisions, ethical issues, and medico-legal accountability continue to pose significant barriers to adoption.[6-7]

Within dentistry, emerging survey-based studies have reported varying levels of awareness and acceptance of AI among dental professionals. Although many dentists express positive attitudes toward the potential of AI to improve diagnostic accuracy and reduce workload, actual utilization in clinical practice remains low.[8-9] Frequently cited concerns include high implementation costs, inadequate infrastructure, data privacy and security issues, insufficient training opportunities, and apprehension regarding loss of professional autonomy.[5,8] These factors may significantly influence dentists' readiness and willingness to adopt AI-based technologies in clinical decision-making.

Understanding dentists' perceptions and readiness toward AI is therefore essential for informing educational initiatives, guiding policy development, and facilitating effective implementation strategies. However, empirical evidence assessing dentists' readiness to use AI in routine clinical practice—particularly in low- and middle-income countries such as India—remains scarce. Generating such evidence can help identify existing gaps and inform strategies to support responsible and context-appropriate integration of AI into dental care. Therefore, the present study aims to assess the perceptions, readiness, and willingness of dentists toward the use of artificial intelligence in clinical dental practice, and to identify factors influencing the adoption of AI-based technologies.

MATERIALS AND METHODS

A cross-sectional, questionnaire-based clinical study was conducted to assess the perceptions, readiness, and willingness of dentists toward the use of artificial intelligence (AI) in routine clinical dental practice. The study was carried out among dental professionals practicing in academic institutions, private clinics, and government healthcare facilities. Ethical approval for the study was obtained from the Institutional Ethics Committee. Informed consent was obtained from all participants. Confidentiality and anonymity of the participants were strictly maintained. The study population comprised registered dental practitioners, including BDS graduates and Dental specialists (MDS).

Inclusion and Exclusion Criteria:

Inclusion criteria

- Dentists with a valid dental qualification (BDS or MDS).
- Actively involved in clinical dental practice or clinical training.
- Willing to participate and provide informed consent.

Exclusion criteria

- Dentists not involved in clinical practice.
- Incomplete or partially filled questionnaires.
- Participants who declined consent.

Sample Size and Sampling Technique: The sample size for the present study was estimated using the formula: $n=Z^2pq/d^2$

where n is the required sample size, Z is the standard normal deviation at a 95% confidence level (1.96), p is the expected proportion of dentists demonstrating adequate perception or readiness toward artificial intelligence, $q = 1 - p$, and d is the allowable error.

The expected proportion (p) was assumed to be 0.50. Using a 7% precision, the calculated minimum sample size was approximately 196 participants. Considering feasibility and the exploratory nature of the study, a minimum target of 200 participants was deemed adequate, consistent with pilot observations. To compensate for potential non-response and incomplete questionnaires, final sample size was 230 practitioners. Participants were recruited using a convenience sampling technique.

Study Instrument and Data Collection : Data was collected using a self-administered, structured questionnaire consisting of five sections: Section A: Sociodemographic and practice-related information, Section B: Awareness and exposure to AI in dentistry, Section C: Perceptions toward the use of AI in clinical dental practice, Section D: Readiness and willingness to adopt AI-based tools and Section E: Perceived barriers and concerns related to AI adoption. The questionnaire was reviewed by a panel of subject experts to establish content

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and face validity. A Content Validity Index (CVI) of 0.87 was obtained, indicating strong agreement among experts. Necessary modifications were made based on expert feedback to improve clarity and relevance. The reliability of the perception and readiness domains was evaluated using Cronbach's alpha, with a value ≥0.70 considered acceptable. The questionnaire was distributed personally by the investigator to ensure wider participation.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Inferential statistics such as the Chi-square test, independent t-test, and one-way ANOVA were applied to assess associations between demographic variables and perception/readiness scores. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 220 dental practitioners participated in the study. The majority of participants were aged 31–40 years (38.2%), followed by those aged ≤30 years (35.5%) and >40 years (26.4%). Males constituted 59.1% of the study population, while 40.9% were females. With respect to professional qualification, 142 (64.5%) participants were BDS practitioners and 78 (35.5%) were MDS specialists. More than half of the respondents (57.3%) had less than 10 years of clinical experience. Most practitioners were engaged in private practice (64.1%), followed by academic (23.2%) and government healthcare settings (12.7%). [Table 1]

Awareness of artificial intelligence in dentistry was significantly higher among MDS practitioners (79.5%) compared to BDS practitioners (60.6%), and this difference was statistically significant (p = 0.02). However, actual exposure to AI-based or advanced decision-support tools was extremely limited in both groups, with only 0.7% of BDS and 2.6% of MDS practitioners reporting any prior use, and the difference was not statistically significant (p = 0.21). [Table2] Use of electronic patient records was low among both groups, though slightly higher among MDS practitioners (15.4%) compared to BDS practitioners (8.5%); however, this difference was not statistically significant (p = 0.11). Digital radiography was more commonly used, particularly among MDS practitioners (79.5%) compared to BDS practitioners (67.6%), though the difference did not reach statistical significance (p = 0.07). Use of advanced digital decision-support tools was negligible across both groups and showed no significant association with qualification (p = 0.28). [Table 3]

Perceptions toward AI varied significantly by qualification for certain domains. A significantly higher proportion of MDS practitioners (56.4%) agreed that AI could improve diagnostic accuracy compared to BDS practitioners (42.3%) (p = 0.04). Similarly, more MDS practitioners perceived AI as feasible for routine dental practice in India (48.7% vs 35.2%; p = 0.04). Agreement that AI outputs require human verification was also significantly higher among MDS practitioners (53.8%) compared to BDS practitioners (39.4%) (p = 0.03). No statistically significant difference was observed between the two groups regarding concerns related to reduced clinical autonomy (p = 0.53) or reduction in clinical workload (p = 0.09). [Table 4]

Readiness to adopt AI-based tools differed significantly by qualification. Nearly half of MDS practitioners (48.7%) expressed willingness to use AI if available, compared to 33.8% of BDS practitioners, and this difference was statistically significant (p = 0.03). Willingness to undergo formal AI training was higher among MDS practitioners (71.8%) than BDS practitioners (60.6%), although this difference did not reach statistical significance (p = 0.08). [Table 5]

The mean perception score toward AI was significantly higher among MDS practitioners (3.3 ± 0.6) compared to BDS practitioners (3.0 ± 0.6) (p = 0.04). Similarly, the mean readiness score was significantly greater among MDS practitioners (3.2 ± 0.7) than BDS practitioners (2.8 ± 0.7) (p = 0.03), indicating higher preparedness among specialists to adopt AI-based technologies. [Table 6]

High cost was the most commonly reported barrier among both groups, with no significant difference between BDS and MDS practitioners (p = 0.43). Poor infrastructure was reported significantly more often by BDS practitioners (59.2%) compared to MDS practitioners (43.6%) (p = 0.03). Medico-legal uncertainty was also significantly higher among BDS practitioners (49.3%) than MDS practitioners (33.3%) (p = 0.02). No statistically significant differences were observed between the groups regarding lack of training (p = 0.27) or data privacy concerns (p = 0.09). [Table 7]

Table 1. Demographic and Practice Characteristics of Dental Practitioners

Variable	Category	n (%)
Age group (years)	≤30	78 (35.5)
	31–40	84 (38.2)

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	>40	58 (26.4)
Gender	Male	130 (59.1)
	Female	90 (40.9)
Qualification	BDS	142 (64.5)
	MDS	78 (35.5)
Years of practice	<10 years	126 (57.3)
	≥10 years	94 (42.7)
Type of practice	Private	141 (64.1)
	Academic	51 (23.2)
	Government	28 (12.7)

Table 2. Awareness and Exposure to AI

Variable	BDS (n = 142) n (%)	MDS (n = 78) n (%)	p-value
Aware of AI in dentistry	86 (60.6)	62 (79.5)	0.02*
Ever used AI / decision-support tools	1 (0.7)	2 (2.6)	0.21

Table 3. Use of Digital Systems

Digital system	BDS n (%)	MDS n (%)	p-value
Electronic patient records	12 (8.5)	12 (15.4)	0.11
Digital radiography	96 (67.6)	62 (79.5)	0.07
Advanced digital decision-support tools	1 (0.7)	2 (2.6)	0.28

Table 4. Perceptions Toward AI in Clinical Dental Practice ***(Agree / Strongly Agree responses)***

Statement	BDS n (%)	MDS n (%)	p-value
AI improves diagnostic accuracy	60 (42.3)	44 (56.4)	0.04*
AI reduces clinical workload	54 (38.0)	38 (48.7)	0.09
AI feasible for routine practice in India	50 (35.2)	38 (48.7)	0.04*
AI may reduce clinical autonomy	52 (36.6)	32 (41.0)	0.53
AI outputs need human verification	56 (39.4)	42 (53.8)	0.03*

Table 5. Readiness and Willingness to Adopt AI

Variable	BDS n (%)	MDS n (%)	p-value
Willing to use AI if available	48 (33.8)	38 (48.7)	0.03*
Willing to undergo AI training	86 (60.6)	56 (71.8)	0.08

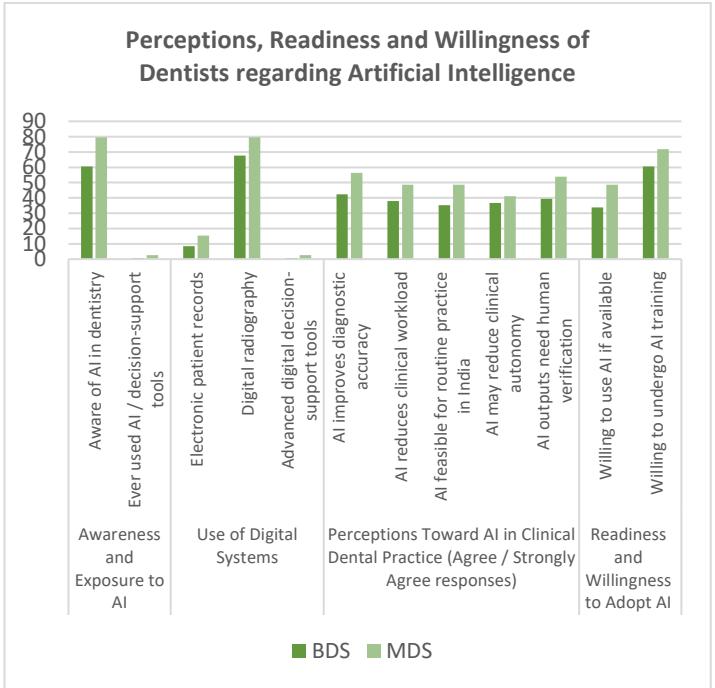
Table 6. Mean Perception and Readiness Scores by Qualification

Score	BDS (Mean ± SD)	MDS (Mean ± SD)	p-value
Perception score	3.0 ± 0.6	3.3 ± 0.6	0.04*
Readiness score	2.8 ± 0.7	3.2 ± 0.7	0.03*

Table 7. Perceived Barriers to AI Adoption by Qualification

Barrier	BDS n (%)	MDS n (%)	p-value
High cost	102 (71.8)	52 (66.7)	0.43
Lack of training	98 (69.0)	48 (61.5)	0.27
Poor infrastructure	84 (59.2)	34 (43.6)	0.03*
Data privacy concerns	72 (50.7)	30 (38.5)	0.09
Medico-legal uncertainty	70 (49.3)	26 (33.3)	0.02*

Graph 1: Perceptions, Readiness and Willingness of Dentists regarding Artificial Intelligence



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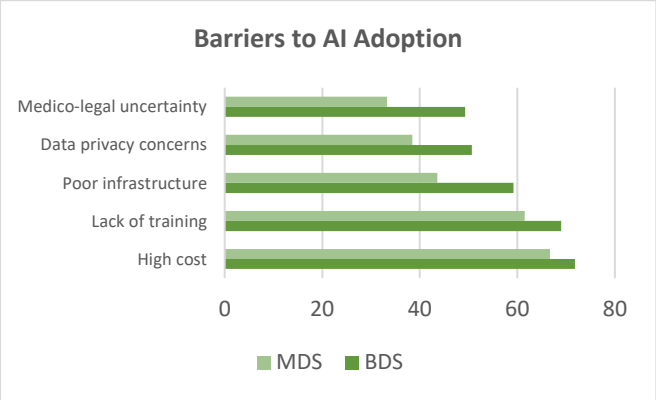
Graph 2: Barriers to AI Adoption



DISCUSSION

The present study explored perceptions, readiness, and willingness of dental practitioners to adopt artificial intelligence (AI) in routine clinical dental practice. The findings demonstrate a generally positive attitude toward AI, with moderate to high readiness among a majority of practitioners, despite relatively low levels of actual clinical use. These results highlight the growing interest in AI among dentists while underscoring existing gaps between awareness, readiness, and implementation.

In this study, more than 80% of dental practitioners reported awareness of AI applications in dentistry. This finding is comparable to reports by Gowdar et al., who observed high awareness of AI concepts among dental professionals in India, largely driven by continuing dental education programs and online platforms.[8] Similar levels of awareness have also been reported in studies conducted in Europe and the Middle East, indicating that AI-related knowledge among dentists is increasing globally.[2,10] However, consistent with the present findings, these studies also reported limited hands-on clinical use of AI tools. Similar trends have been reported among dentists and dental students, indicating that while AI is increasingly recognized within professional discourse, translation into routine practice remains minimal due to structural and educational barriers.[11-13] These observations reinforce the notion that awareness alone is insufficient for technology adoption, particularly in resource-constrained healthcare environments.

Despite high awareness, only a small proportion of practitioners in the present study had previously used AI-based tools in clinical practice. This discrepancy between awareness and utilization has been widely reported in the literature. Kostov and Yordanova found that although dentists expressed positive attitudes toward AI, actual implementation remained low due to lack of access and training.[9] Likewise, Schwendicke et al. emphasized that most AI tools in dentistry are still confined to research or early commercial stages, limiting routine clinical adoption.[14]

The present study also revealed very low utilization of electronic patient records and advanced decision-support systems, suggesting an early stage of digital maturity within the local dental ecosystem. Since AI implementation typically depends on digitized clinical data, interoperable software, and integrated workflows, inadequate digital infrastructure may represent a foundational barrier to adoption. Comparable concerns regarding data readiness, infrastructure limitations, and system integration have been emphasized in international assessments of AI readiness among healthcare professionals.[12,15] Consequently, strengthening baseline digitalization appears essential before meaningful AI integration can occur in routine dental care.

Perceptions toward AI in the current study were cautiously optimistic, with specialists more likely to recognize potential improvements in diagnostic accuracy and clinical feasibility. Previous perception-based investigations similarly report positive expectations regarding efficiency, decision support, and diagnostic enhancement, while simultaneously documenting concerns about reliability, ethical implications, and professional autonomy.[11,13] Notably, dentists in multiple studies have expressed low confidence in fully autonomous AI decision-making, preferring AI to function as a supportive adjunct under clinician supervision, which aligns closely with the present findings.[16] These perspectives are consistent with contemporary frameworks of human-AI collaboration, emphasizing augmentation rather than replacement of clinical expertise.

Readiness to adopt AI in clinical practice was moderate to high among participants. This level of readiness is comparable to findings reported by Hung et al. among dental students and early-career dentists, who demonstrated openness toward AI adoption but emphasized the need for structured training.[17]

Readiness to adopt AI was significantly higher among MDS practitioners, suggesting that advanced education, academic exposure, and specialty practice environments may facilitate openness toward emerging technologies. Similar qualification-based differences have been documented in perception studies where specialists and academically affiliated professionals demonstrated greater acceptance and preparedness for AI integration.[13,18]

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However, the overall low readiness across the broader sample indicates that systemic barriers—rather than individual resistance—are the dominant limiting factors. Similar findings from previous studies suggest that advanced training and academic exposure positively influence acceptance of emerging technologies.[9,10] Prior exposure to AI-based tools was also a strong predictor of readiness, reinforcing the importance of experiential learning in building trust and confidence in AI systems.

High implementation cost, inadequate infrastructure, medico-legal uncertainty and insufficient training emerged as the primary barriers to AI adoption in the present study. These findings closely mirror international survey evidence identifying financial constraints, lack of regulatory clarity, and limited educational opportunities as the most significant challenges to clinical AI integration in dentistry.[2,16,18] Importantly, persistent medico-legal ambiguity may reduce professional confidence in AI-assisted decision-making, underscoring the need for clear governance frameworks and ethical guidelines.

These barriers have been consistently reported across diverse settings.[5,8,14] In low- and middle-income countries, financial constraints and infrastructural limitations may further impede adoption, as highlighted by Mallineni et al.[2] Additionally, concerns regarding medico-legal accountability reflect the absence of clear regulatory frameworks governing AI use in dentistry, an issue that has been widely discussed in healthcare AI literature.[7]

Despite these barriers, a substantial proportion of dentists expressed willingness to undergo AI-related training, indicating that resistance to AI is not primarily attitudinal but structural. This finding aligns with recommendations from recent educational studies emphasizing the need to prepare future dentists for digitally enabled practice environments.[14,17] Educational research consistently highlights the importance of curriculum integration, continuing professional development and hands-on training in improving AI readiness among dental professionals.[13,15] Strengthening educational infrastructure may therefore represent a practical pathway toward gradual and responsible AI adoption in low- and middle-income settings. Integrating AI concepts into dental education may help bridge the gap between awareness and effective clinical application while promoting ethical and responsible use.

The present study has certain limitations. Its cross-sectional design limits causal inference, and the use of convenience sampling may affect generalizability. Additionally, responses were self-reported and may be subject to social desirability bias. Nevertheless, the study provides important real-world insights into dentists' readiness to adopt AI at a time when empirical evidence from clinical practitioners, particularly in the Indian context, remains limited.

Overall, the findings suggest cautious optimism among dental practitioners toward AI integration. While perceptions are largely positive and readiness is emerging, targeted training programs, affordable technologies and clear regulatory guidance will be essential to support the effective and ethical incorporation of AI into routine dental practice.

CONCLUSION

Dental practitioners demonstrated positive perceptions and moderate readiness toward artificial intelligence in clinical dental practice; however, actual utilization remains limited. MDS practitioners showed significantly greater awareness, perception, and willingness to adopt AI compared to BDS practitioners. High cost, inadequate infrastructure, medico-legal uncertainty, and limited training were key barriers. Strengthening digital infrastructure, providing structured AI training, and establishing clear regulatory guidance are essential for responsible integration of AI into routine dental practice.

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