PERSPECTIVE ON THE CLINICAL USE OF ARTIFICIAL INTELLIGENCE AMONG DENTISTS AND PATIENTS - A QUESTIONNAIRE STUDY

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Abstract:

Background: Artificial Intelligence (AI) has emerged as a transformative force in dentistry, offering potential advancements in diagnosis and treatment planning. This study aims to evaluate the perspectives of patients on the AI's clinical applications, focusing on its implications for diagnosis, treatment planning, and dentist-patient interactions.
Materials and method: A cross-sectional questionnaire study was conducted among 1,684 patients, with gender, age, and professional experience as key demographic variables. The questionnaires assessed perceptions of AI's clinical capabilities, including diagnosis accuracy, treatment planning, and addressing treatment-related anxieties. Data were analysed using SPSS software, and statistical significance was determined at $p \leq 0.05$.
Results: Patients showed mixed responses toward AI, with 63.2% favoring its diagnostic accuracy but 82.5% trusting dentists for obtaining case histories. Gender-based differences were significant, with men exhibiting stronger confidence in AI's capabilities than women. Patients preferred collaborative scenarios where AI's outputs were reviewed by dentists, with 86.9% supporting AI-generated diagnoses verified by dentists and 68% accepting AI-planned treatments reviewed by clinicians. However, 74.6% rejected treatment plans created solely by AI without dentist oversight.
Conclusion: Patients acknowledged the potential of AI in improving diagnostic accuracy but prefer it as a supportive tool rather than a replacement for dentist oversight in treatment planning. Gender differences were observed, with men showing greater confidence in AI. Overall, patients favor a collaborative approach, where AI-generated outcomes are reviewed by clinicians, ensuring trust and effective integration into clinical practice.

Key words Artificial Intelligence, Dentistry, Diagnosis, Treatment Planning, Patient Perceptions.

INTRODUCTION

Artificial Intelligence (AI), defined by Minsky as "the science of making machines do things that would require intelligence if done by men," has emerged as a transformative force in the "Fourth Industrial Revolution".[1,2] In dentistry, AI applications have shown great promise, particularly in diagnostic and treatment planning tasks.

Examples include image interpretation in dental radiology,[3] caries detection,[4] decision-making in orthodontic extraction,[5] diagnosis and prediction of periodontally compromised teeth,[6] and risk assessment of oral cancer.[7]

Despite its potential, integrating AI into clinical dentistry remains contentious. Concerns span issues such as digital data aggregation bias, transparency, explainability, scalability, and interoperability. Ethical considerations, data privacy, safety, and reliability further complicate AI adoption in healthcare settings.[8-10]

For AI applications to succeed in clinical dentistry, their acceptance by both clinicians and patients is paramount. Equally essential is an understanding of their perceived benefits and potential drawbacks. Recent studies have begun to explore patients' perceptions of AI in dentistry, highlighting expected advantages such as improved diagnostic confidence, time reduction, personalized, and evidence-based disease management.[11] Despite these studies, there is currently limited understanding of the awareness, expectations, and uncertainties surrounding AI in dentistry among patients. This knowledge is critical for developing and implementing AI systems that address real-world clinical needs. Insights from such studies could also highlight the need for targeted educational programs on AI for healthcare providers and patients.

Hence, the study aims to explore the perspectives of patients regarding AI's role in dental practice, including its implications for diagnosis, treatment planning, and physician-patient interactions. By analysing qualitative data, this research seeks to identify key domains influencing the acceptance and integration of AI in routine dental practice, thereby contributing to a deeper understanding of its clinical potential.

MATERIALS AND METHODS

STUDY DESIGN

This study utilized a cross-sectional questionnaire design to evaluate the perspectives of dental patients regarding the use of artificial intelligence (AI) in a dental clinical setting. Ethical approval for the study was granted by the Institutional Review Board (SSDCRI/RC/IEC/22/8).

SAMPLING

Snowballing sampling was employed to recruit participants via an online survey platform through social media, and email invitations. A sample size of 385 was determined, based on an estimated population size of 200,000, with a confidence interval of 95% and a 5% margin of error. Inclusion criteria were willingness to participate and the ability to comprehend the study questions, while those unwilling to participate or unable to comprehend the questions were excluded. Informed consent was obtained from all participants.

QUESTIONNAIRE DEVELOPMENT

A) CONTENT VALIDITY:

The questionnaire was developed and validated using Lynn's two-stage approach.[12] Eight subject matter experts assessed each item for relevance, clarity, completeness, and significance on a four-point scale. The content validity ratio, calculated using Lawshe's method,[13] was 0.88, exceeding the minimum threshold of 0.85 for the panel size. The reliability of the questionnaire was confirmed with a Cronbach's alpha value of 0.72.

B) FACE VALIDITY:

The questionnaires were pre-tested with ten dental patients who were not part of the study. Feedback was incorporated, and test-retest reliability showed agreement rates of 81.3%, with Cohen's kappa values of 0.81.

QUESTIONNAIRE STRUCTURE

Included 17 questions, comprising three demographic items, one on prior knowledge of AI, nine comparing clinical capabilities of AI versus dentists, and four assessing faith in AI's role in treatment (Fig:1). Final versions of the questionnaires were distributed to 3,000 dental patients via online platforms. To ensure anonymity and reduce response bias, no personal identifiers such as names or addresses were collected. The questionnaire was administered online, allowing participants to fill it out in their preferred language (English, Odia, Hindi, or Telugu).

STATISTICAL ANALYSIS

The data collected were entered and compiled using MS Office Excel. The survey data spreadsheet was transferred to IBM Statistical package for social science (SPSS) Software version 23.0 (IBM Corp., IBM SPSS Statistics for Windows, Armonk, NY) for statistical analysis. The values were represented in number (%) and Mean ±SD. Descriptive statistics were analysed using frequency and percentage. Inferential analysis was done using the non-parametric Chi-square test. The level of significance (p-value) of less than 0.05 was considered significant.

RESULT

The cross-sectional study was conducted among dental patients to know their perspective regarding Artificial Intelligence through a tailored questionnaire. The total number of respondents was 1702 dental patients, of whom 18 questionnaires were partially filled out and were therefore rejected. The questionnaire consisted of demographic details and 2 questions which consisted of subparts using dichotomous data.

Out of 1,684 respondents, 66.3% (1,116) were males, and 33.7% (568) were females. Participants ranged in age from 18 to 87 years, with a mean age of 37.78 ± 10.27 years. The majority (52.3%) were

under 30 years, followed by 27% in the 30-40 age group. The age range of participating population showed a wide range of diversity. (Table 1)

As the data were qualitative and dichotomous in nature, a non-parametric Chi-Square test was applied on gender. Frequency and percentage were calculated for the same. The level of significance was kept at $p \leq 0.05$

Clinical Capabilities of AI vs. Dentists

In evaluating the clinical capabilities of dentists and AI, most respondents believed dentists were more accurate at obtaining relevant case histories, with 82.5% preferring dentists over AI. This preference was significantly higher among males (86.8%) compared to females (74.1%), When it came to making accurate diagnoses, 63.2% of participants felt AI was superior to dentists. This perception was notably more prevalent among males, with 78% favoring AI compared to 48.6% of females, revealing a significant gender-based difference ($p = 0.001$). (Table 2, Table 3)

For proposing appropriate treatments, 80.8% of respondents trusted dentists over AI. Male participants exhibited greater confidence in dentists (87.6%) compared to females (67.4%), with the results found to be highly significant ($p = 0.001$). Interestingly, in the domain of treatment planning aligned with recent scientific advancements, 74.3% of participants favored AI over dentists. Male respondents (79.4%) showed a stronger preference for AI in this area than females (64.4%), with a significant association noted ($p = 0.01$). In terms of providing comprehensive treatment information, 70% of respondents trusted dentists more than AI. This trust was particularly strong among males, with 87% expressing confidence in dentists compared to 67.4% of females, yielding a statistically significant result ($p = 0.01$). AI was preferred by 70.5% of respondents for allocating sufficient treatment time, with 79% of males and 64% of females indicating a preference for AI. This gender difference was also significant ($p \leq 0.01$). Dentists were seen as better at addressing treatment-related anxieties, with 80.6% of respondents favoring them over AI. Among males, 82.7% preferred dentists, while 54.9% of females leaned towards AI, a difference that was statistically significant ($p = 0.01$). (Table 2, Table 3)

In cases of diagnostic disagreements between dentists and AI, 56.4% of respondents preferred AI's diagnosis. This preference was higher among males (75.8%) compared to females (60.2%), and the association with gender was significant ($p = 0.01$). Finally, when disagreements arose regarding treatment, 80.9% of respondents sided with the dentist's plan. Male participants showed greater trust in dentists (86.1%) compared to females (69.7%), with the results achieving statistical significance ($p = 0.01$). (Table 2, Table 3)

ACCEPTANCE OF AI WITH OR WITHOUT DENTIST VERIFICATION

The majority of respondents (86.9%) were comfortable with AI making a diagnosis if it was verified by their dentist. Male participants showed higher acceptance (90.3%) compared to females (80.3%). When it came to AI planning treatment that was checked by a dentist, 68.8% of respondents had no objections. Gender differences were significant, with 78% of males and 50.9% of females agreeing to this arrangement (p = 00.01). (Table 4, Table 5).

In cases where AI made a diagnosis without dentist verification, 74.2% of respondents expressed approval. Males (83.2%) were more accepting of this than females (56.5%). However, the majority of respondents (74.6%) did not support AI planning treatment without dentist review. Males (82.8%) expressed higher dissatisfaction compared to females (58.5%), indicating significant gender-based differences in acceptance. (Table 4, Table 5).

DISCUSSION

The integration of Artificial Intelligence (AI) into clinical dentistry is rapidly advancing, transitioning from theoretical potential to practical application. Recent studies have demonstrated AI's efficacy in various dental specialties, including endodontics, oral radiology, orthodontics, pediatric dentistry, periodontology, prosthodontics, and restorative dentistry.[14]

This study explored the perceptions of dental patients regarding AI's capabilities in diagnosis and treatment planning, revealing critical insights into its acceptance, limitations, and potential. The findings underscore a duality in attitudes—optimism for its technological efficiency and caution due to its limitations in addressing human-centered aspects of care.

The study included a diverse patient group spanning a wide age range, from under 30 to over 80 years, to capture generational differences in AI acceptance. Younger patients displayed higher trust in AI, aligning with their greater technological familiarity. Gender-based differences were evident, with men expressing stronger confidence in AI's capabilities. Specifically, 78% of male respondents trusted AI for accurate diagnoses, while a majority of females (65.8%) preferred dentists for this task. This aligns with findings from studies by Krittanawong *et al.*[15], highlighting that men are generally more tech-savvy, whereas women approach medical technologies with greater caution, prioritizing empathy and trust.

Patients also valued dentists' ability to obtain comprehensive case histories, with 82.5% preferring dentists over AI for this task. These preferences may stem from the irreplaceable role of empathy and trust in the patient-dentist relationship, as emphasized by Seals *et al.*[16] Similarly, when managing treatment-related

anxieties, dentists were preferred, particularly by males, while some females believed AI could better manage such anxieties. This reflects a nuanced perception where the technical precision of AI is appreciated but does not substitute for the emotional reassurance provided by human practitioners.

Patients displayed mixed opinions regarding AI's role in treatment planning. While 74.3% acknowledged AI's ability to incorporate recent scientific advancements, 80.8% trusted dentists for providing appropriate treatments. Moreover, 70% of respondents believed dentists were better at delivering relevant information about treatment, reinforcing the indispensable value of human interaction in ensuring comprehensive patient understanding. Conversely, patients recognized AI's potential to allocate sufficient time for treatment, with 70.5% agreeing that AI could optimize time management. This suggests that AI could play a supplementary role, enhancing the efficiency of dental procedures without replacing the human element.

IMPLICATIONS AND LIMITATIONS

The findings highlight the need for a balanced integration of AI in dentistry. While patients recognize AI's efficiency in diagnostics and treatment planning, its limitations in empathy, contextual decision-making, and handling complex scenarios necessitate human oversight. To enhance AI's acceptance, targeted educational initiatives are essential to address technological apprehensions and build confidence in its capabilities.

However, this study has limitations. The reliance on online and offline surveys introduces the possibility of response bias, as participants may provide socially desirable answers. Additionally, variations in technological awareness and working conditions across regions may influence perceptions. Future research should focus on validating AI models with robust external data and exploring its integration into diverse clinical environments to enhance reliability and acceptance.

AI holds immense potential to transform dentistry by improving efficiency and accuracy in diagnosis and treatment planning. However, its success depends on collaborative implementation, leveraging AI's strengths while retaining the irreplaceable human touch in patient care. As technology advances, striking this balance will be critical in realizing AI's full potential in clinical dentistry.

Table 1: Demographic distribution of age and gender of patients

GENDER	AGE IN YEARS							TOTAL
	<30	30-40	40-50	50-60	60-70	70-80	>80	
Male	481	324	213	74	20	1	3	1116
Female	399	147	20	2	0	0	0	568
Total	880	471	233	76	20	1	3	1684

Table 2: Patient's perception on clinical capabilities of dentists and AI

QUESTIONS	DENTIST (%)	AI (%)
Obtaining any relevant information from my history	82.5	17.5
Making an accurate diagnosis	36.8	63.2
Proposing the appropriate treatment	80.8	19.2
Planning treatment according to recent state of science	25.7	74.3
Providing all information relevant to my treatment	70	30
Allocate enough time for my treatment	29.5	70.5
Will take care of my anxieties regarding the treatment	80.6	19.4
In case of disagreement regarding my diagnosis between my dentist and artificial intelligence, I will prefer	43.6	56.4
In case of disagreement regarding my treatment between my dentist and artificial intelligence, I will prefer	80.9	19.1

Table 3: Clinical capabilities of dentists and AI according to the patients and their level of significance based on gender

Questions	Males (%)		Females (%)		P- value
	Dentist	*AI*	*Dentist*	*AI*	
Obtaining any relevant information from my history	86.8	13.21	74.1	25.9	0.001*
Making an accurate diagnosis	22.0	78	65.8	34.2	0.001*
Proposing the appropriate treatment	87.6	12.4	67.4	32.6	0.001*
Planning treatment according to recent state of science	20.6	79.4	35.6	64.4	0.001*
Providing all information relevant to my treatment	87.6	12.4	67.4	32.6	0.001*
Allocate enough time for my treatment	20.6	79.4	35.6	64.6	0.001*
Will take care of my anxieties regarding the treatment	82.7	17.3	45.1	54.9	0.001*
In case of disagreement in diagnosis ..., I will prefer	24.2	75.8	39.3	60.2	0.001*
In case of disagreement in treatment ..., I will prefer	86.1	13.9	69.7	30.3	0.001

Chi-Square test applied, * ($p<0.05$-significant)

Table 4: Patient's view on different clinical situations

Questions	Yes (%)	No (%)
AI makes my diagnosis and it is checked by my dentist	86.9	13.1
AI plans my treatment and it is checked by my dentist	68.8	31.2
AI makes my diagnosis and it is NOT checked by my dentist	74.2	25.8
AI plans my treatment and it is NOT checked by my dentist	25.4	74.6

Table 5: Patient's perspective on different clinical scenarios and its level of significance based on gender

Questions	Males (%)		Females (%)		P- value
	yes	*no*	*yes*	*no*	
AI makes my diagnosis and it is checked by my dentist	90.3	9.7	80.3	19.7	0.001*
AI plans my treatment and it is checked by my dentist	78	22	50.9	49.1	0.001*
AI makes my diagnosis and it is NOT checked by my dentist	83.2	16.8	56.5	43.5	0.001*
AI plans my treatment and it is NOT checked by my dentist	17.2	82.8	41.5	58.5	0.001*

Chi-Square test applied, * ($p<0.05$-significant)

Figure 1: Patient's Questionnaire Form (English)

PERCEPTION OF PATIENTS ON THE USE OF ARTIFICIAL INTELLIGENCE

*Required

1. Age (in years) *

2. Gender *

Tick all that apply.

- Male
- Female

3. Highest Level of Education *

Tick all that apply.

- Graduate
- Post Graduate
- Diploma
- Intermediate
- Matriculation

Other:

4. Prior Knowledge of Artificial Intelligence *

Tick all that apply.

- 1 (completely unfamiliar)
- 2 (somewhat familiar/heard of it)
- 3 (Neutral)
- 4 (Familiar)
- 5 (Very Familiar)

5. According to you, who is more accurate in the following clinical capabilities *

Mark only one oval per row.

	Dentist	Artificial Intelligence (AI)
Obtaining any relevant information from my history		
Making an accurate diagnosis		
Proposing the appropriate treatment		
Planning treatment according to recent state of science		
Providing all information relevant to my treatment		
Allocate enough time for my treatment		
Will take care of my anxieties regarding the treatment		
incase of disagreement regarding my diagnosis between my dentist and artificial intelligence, I will prefer		
incase of disagreement regarding my treatment between my dentist and artificial intelligence, I will prefer		

6. I would be fine if *

Mark only one oval per row.

	yes	no
AI makes my diagnosis regarding my dental ailment if it was checked my dentist		
AI plans my treatment regarding my dental treatment if it was checked my dentist		
AI makes my diagnosis regarding my dental ailment if it was NOT checked my dentist		
AI plans my treatment regarding my dental treatment if it was NOT checked my dentist		

CONCLUSION

1. Patients appreciate AI's efficiency in diagnosis and treatment planning but value human interaction for case histories and managing treatment-related anxieties.
2. Males showed higher confidence in AI than females, who preferred dentists for treatment guidance and reassurance.
3. AI was favored for incorporating scientific advancements and optimizing treatment time, but dentists were trusted more for treatment decisions.
4. AI-assisted diagnosis was widely accepted when verified by a dentist, but AI-led treatment planning without dentist oversight was largely rejected.

AI is not a replacement for human expertise but a tool to enhance efficiency, precision, and decision-making in dentistry. Regulatory frameworks and AI education are essential for acceptance and safe implementation. AI has the potential to transform dentistry, but its success depends on strategic integration, regulatory measures, and patient-clinician trust.

CONFLICT OF INTEREST: None

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