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Artificial Intelligence in Periodontology: A Questionnaire-Based Assessment of Knowledge, Attitude, and Perception Among Postgraduate Periodontology Students

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Abstract: ***Background: Artificial intelligence (AI) is increasingly being explored in periodontology for diagnostics, prognosis assessment, and treatment planning. Aim: This study assessed the knowledge, attitudes, and perceptions of postgraduate periodontology students regarding AI applications in periodontology. Materials and Methods: A cross-sectional questionnaire-based survey was conducted among 103 postgraduate periodontology students in Gujarat, India. Participants were selected using purposive sampling. A 15-item electronic questionnaire was developed and validated by subject experts for content validity; internal consistency was assessed using Cronbach's alpha (α = 0.78). The questionnaire assessed familiarity with AI, understanding of its principles, and perceptions regarding its clinical and educational applications. Descriptive statistics and inferential analyses (Chi-square test and Spearman correlation) were performed using SPSS v20. Results: Most participants reported familiarity with AI (95%). Many believed AI could assist in periodontal diagnosis, radiographic analysis, treatment outcome prediction, and implant planning. Strong support was observed for inclusion of AI in postgraduate education. Opinions were divided regarding AI replacing periodontists. Positive correlations were observed between knowledge, attitude, and perception domains. Conclusion: Postgraduate periodontology students demonstrated favorable perceptions toward AI, though knowledge gaps persist regarding technical understanding. Educational integration and responsible clinical implementation are recommended.***

Keywords: artificial intelligence, periodontology, dental education, diagnosis, questionnaire survey

1. Introduction

Periodontitis is a multifactorial inflammatory disease associated with dental plaque accumulation and characterized by progressive destruction of the periodontium, including the periodontal ligament and alveolar bone.[1,2] The disease involves complex dynamic interactions among bacterial pathogens, destructive host immune responses, and environmental factors such as smoking.[1,3] Common clinical features include gingival inflammation, clinical attachment loss, radiographic bone loss, deep probing depths, mobility, bleeding on probing, and pathologic migration.[2,4,5]

Manual probing remains the gold standard for periodontal evaluation, but inter-examiner variability and time constraints can lead to patient misclassification. Artificial intelligence (AI)- the capability of machines to perform tasks typically requiring human intelligence- is increasingly utilized across healthcare as a component of precision medicine. AI employs machine learning (ML) algorithms to assist in diagnosis and clinical decision-making.[6] The term "artificial intelligence" was introduced by John McCarthy in 1956.[7]

AI encompasses subfields including machine learning and deep learning (DL), which enable computers to identify hierarchical patterns within large datasets.[8] Artificial neural networks (ANNs)- fundamental AI units composed of input, hidden, and output layers- process information in a structured manner.[9] Convolutional neural networks (CNNs) have been applied in dentistry as diagnostic tools to analyze radiographic images and facilitate accurate diagnosis of periodontal diseases.[10,11]

In periodontology, AI can assist in distinguishing normal from pathological structures, detecting disease, predicting therapy outcomes, localizing deposits,[11] predicting implant success,[1] identifying periodontally compromised teeth,[6,13] and distinguishing periodontitis subtypes.[14] Despite these advantages, AI currently lacks essential human attributes such as empathy, ethical judgment, and holistic decision-making.[15] This study aimed to assess the knowledge, attitude, and perception of postgraduate periodontology students regarding the application of AI in periodontology.

2. Materials and Methods

Study Design and Population: This cross-sectional questionnaire-based survey was conducted among postgraduate periodontology students in Gujarat, India, from January to March 2024.

Inclusion Criteria: Postgraduate students enrolled in MDS (Periodontology) programs at dental colleges affiliated with Gujarat University of Health Sciences, who consented to participate.

Exclusion Criteria: Undergraduate dental students, faculty members, and dental professionals outside the postgraduate periodontology program were excluded. Incomplete responses were also excluded from analysis.

Sampling Method: Purposive sampling was employed to target postgraduate periodontology students who had clinical exposure to AI-related tools or academic coursework. The survey was distributed to 114 eligible students, of whom 103 responded (response rate: 90.4%).

Questionnaire Development and Validation: A 15-item electronic questionnaire was developed encompassing four domains: (1) Familiarity with AI, (2) Understanding of AI working principles, (3) Perceived potential in periodontal diagnostics and treatment, and (4) Perceived role in professional training and clinical practice. The questionnaire was reviewed by three subject experts for content validity. Pilot testing was conducted on 15 respondents not included in the final sample, and revisions were made based on feedback. Internal consistency was assessed using Cronbach's alpha, yielding $\alpha = 0.78$, indicating acceptable reliability. The questionnaire included closed-ended and Likert-scale items. Sociodemographic data (age, gender, year of study) were also collected.

Ethical Considerations: As this was a voluntary, questionnaire-based survey involving no patient data, no clinical intervention, and no identifiable personal information beyond demographics, formal institutional ethics committee approval was not required per institutional policy. Participation was fully voluntary, and informed consent was obtained electronically from all respondents prior to data collection.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 20.0 (IBM Corp., Armonk, NY). Descriptive statistics (frequencies and percentages) summarized responses. The Chi-square test assessed associations between categorical variables. Spearman's rank correlation coefficient evaluated relationships between knowledge, attitude, and perception domain scores. Statistical significance was set at $p \leq 0.05$.

3. Results

A total of 103 postgraduate periodontology students participated. Most were aged between 25 and 30 years, with females constituting the majority (Table 1).

Table 1: Demographic characteristics of the participants (N = 103)

Variable	Category	n	%
Age group	25–30 years	100	97
	31–35 years	3	3
Gender	Female	74	72
	Male	29	28

The majority of respondents were familiar with AI and acknowledged its potential in periodontal diagnosis, prognosis prediction, radiographic analysis, and treatment planning. Strong support was observed for AI incorporation into postgraduate training. Opinions were divided on AI replacing periodontists (Table 2).

Table 2: Responses Regarding Knowledge, Attitude, and Perception Toward AI

Question	Agree n (%)	Neutral n (%)	Disagree n (%)	p-value
Familiar with AI	98 (95)	2 (2)	3 (3)	0.002*
Understand working principle	57 (55)	7 (7)	39 (38)	0.596
AI useful in diagnosis	81 (79)	9 (9)	13 (13)	0.483
AI predicts prognosis	68 (66)	14 (14)	21 (20)	0.08
AI predicts treatment outcome	80 (78)	10 (10)	13 (13)	0.679
AI useful in radiographic analysis	81 (79)	14 (14)	8 (8)	0.247
AI in implant planning	85 (83)	11 (11)	7 (7)	0.023*
AI in postgraduate training	80 (78)	8 (8)	15 (15)	0.772
AI superior diagnostically	69 (67)	7 (7)	27 (26)	0.05*
AI may replace periodontists	48 (47)	16 (16)	39 (38)	0.12

*Statistically significant ($p \leq 0.05$).

Spearman correlation analysis demonstrated a strong positive relationship between knowledge and attitude ($r = 0.70$) and between knowledge and perception ($r = 0.64$). Gender showed weak correlations with all three domains (Table 3).

Table 3: Spearman Correlation Between Study Variables

Variable	Gender	Knowledge	Attitude	Perception
Gender	1	-0.12	0.34	0.05
Knowledge	-0.12	1	0.7	0.64
Attitude	0.34	0.7	1	0.39
Perception	0.05	0.64	0.39	1

4. Discussion

The results of this survey highlight a generally positive reception of AI among postgraduate periodontology students. A high proportion (95%) reported familiarity with AI, demonstrating widespread recognition of its transformative potential. However, only 55% understood the underlying principles, indicating a gap between awareness and technical knowledge that warrants structured educational intervention.

The strong support for AI in diagnostic applications aligns with existing literature. Lee et al. demonstrated that deep learning models can predict the prognosis of periodontally compromised teeth with high accuracy.[18] Papantonopoulos et al. showed that ANNs can categorize patients with chronic or aggressive periodontitis based on immunologic

profiles.[17] Miller et al. reported that AI-assisted radiographic detection of periodontal disease achieved variable accuracy depending on the algorithm.[16] These findings confirm AI's role as a valuable adjunct diagnostic tool.

Opinions on AI replacing periodontists were divided: 47% agreed while 38% disagreed, likely reflecting concerns about AI's inability to replicate empathy, communication, and nuanced decision-making. Yauney et al. demonstrated AI's capacity to detect porphyrin biomarkers and link oral findings to systemic conditions,[19] reinforcing the view that AI functions best as a complement to, rather than replacement for, the clinician. Strong support for AI integration in postgraduate training (78%) reflects the growing emphasis on preparing future practitioners for technology-driven clinical environments.

A notable limitation is the exclusive recruitment of postgraduate periodontology students from Gujarat, limiting generalizability to broader dental professional populations. Additionally, as this was a cross-sectional survey, causal relationships cannot be established. Future studies should include larger, geographically diverse samples and employ validated psychometric tools for domain assessment.

5. Conclusion

Postgraduate periodontology students demonstrated favorable perceptions toward AI in periodontology, with strong support for its diagnostic and educational applications. However, significant knowledge gaps exist regarding AI operational principles, underscoring the need for structured AI curricula within postgraduate dental education. Collaboration between clinicians and technology developers will be essential for responsible and evidence-based clinical implementation.

6. Future Scope

Future research should assess AI knowledge and attitudes longitudinally as AI integration in clinical practice evolves. Multicentric studies with larger and more diverse samples of dental professionals will improve generalizability. Development of validated, specialty-specific AI literacy tools for periodontology would further advance understanding of technology readiness across postgraduate curricula.

Author Contributions
Concepts: Shreya Rawal, Mishal Shah | Design: Mishal Shah | Literature Search: Sweety Christie, Dhriti Dhorajia | Data Acquisition: Shivani Jani, Shreya Rawal | Statistical Analysis: Medha Kalyan | Manuscript Preparation: Shreya Rawal | Manuscript Editing: Mishal Shah | Manuscript Review: Mishal Shah, Amit Benjamin | Guarantor: Mishal Shah.

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Conflict of Interest
The authors declare no conflict of interest.

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