



Beyond the Hype: Practical AI Applications for the Indian Dental Faculty

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Introduction

Artificial intelligence has emerged as a transformative force in modern healthcare, offering unprecedented opportunities to enhance diagnostic accuracy, streamline treatment planning, and improve educational outcomes. For Indian dental faculty navigating resource constraints and increasing patient loads, understanding practical AI applications is no longer optional but essential. This editorial synthesizes the current evidence on clinically relevant AI tools that can be realistically integrated into dental education and practice settings, moving beyond theoretical possibilities to actionable implementations.

AI-Powered Diagnostic Radiology: Enhancing Detection Accuracy

The most mature application of AI in dentistry is radiographic analysis, particularly for caries and periodontal disease detection. Convolutional neural networks (CNNs) have demonstrated remarkable diagnostic performance across multiple imaging modalities. A systematic review examining AI models for caries detection reported accuracy rates ranging from 73.4% to 99% across 20 studies utilizing periapical, bitewing, and panoramic radiographs [1]. These AI systems achieve diagnostic accuracy comparable to and, in some cases, exceed that of human clinicians [2].

For periodontal disease diagnosis, AI models analyzing panoramic radiographs have demonstrated accuracy rates between 76% and 98% for detecting alveolar bone loss [3]. A recent study employing the YOLOv8 architecture achieved 89.45% diagnostic accuracy in staging periodontitis, with results closely aligning with professional diagnoses [4]. Importantly, these AI-based diagnostic support systems have shown particular promise in resource-limited settings, where specialist availability remains constrained [4]. Multiple studies have

confirmed that AI models utilizing clinical and radiographic data can achieve remarkably high accuracy in staging periodontal disease, with deep learning frameworks often comparable to or exceeding specialist performance [5].

AI in Treatment Planning: Orthodontic Applications

Orthodontics is another domain in which AI has transitioned from research to clinical utility. AI applications have demonstrated high efficacy in cephalometric landmark identification, skeletal age determination, and treatment outcome predictions [6]. A comprehensive review identified seventy-one studies across three primary domains: diagnostics, landmark identification, and treatment planning, collectively demonstrating AI's ability to serve as a decision-support system within orthodontic digital workflows [7].

AI models show promising accuracy in predicting orthodontic treatment outcomes, although their efficacy diminishes in complex and nonstandard cases [8]. This highlights an important principle: AI should be utilized in conjunction with clinical expertise, rather than as a replacement [8]. Machine learning algorithms that analyze large datasets of dental records, radiographs, and three-dimensional scans enable highly individualized treatment plans that improve both clinical outcomes and patient satisfaction [9]. This technology has proven particularly valuable for automating routine tasks, such as landmark detection in lateral cephalograms, while providing decision support for extraction decisions and orthognathic surgery planning [10].

Transforming Dental Education: AI as a Teaching Tool

The integration of AI into dental education presents significant opportunities to enhance knowledge retention, clinical decision-making, and skills training. Generative AI technologies improve learning

outcomes through adaptive learning pathways and real-time feedback [11]. A worldwide survey of dental educators revealed an increasing acceptance of AI tools, although their implementation remains uneven across institutions [12].

AI-based educational platforms can assist with various pedagogical functions, from generating case scenarios to providing automated assessments of student performance. Research has demonstrated that AI models designed for dental education, particularly large language models, show promising performance in standardized dental examinations [13]. However, barriers to widespread adoption include limited faculty training, technical infrastructure deficits, and resistance from educators [11]. For Indian dental institutions, establishing a core AI education curriculum is imperative, as outlined by international consensus statements emphasizing foundational competencies in AI literacy for oral healthcare professionals [14].

Implementation Challenges and Ethical Considerations

Despite its promising applications, several challenges must be addressed for successful AI integration. Data quality remains paramount, as AI systems trained on biased or limited datasets may exhibit performance attrition owing to limited generalizability. The lack of standardized benchmarking datasets and uniform reporting metrics complicates the comparison and assessment of different AI applications [10].

Ethical considerations warrant careful attention, particularly regarding patient privacy, data protection, and the potential for algorithmic bias [15]. The complexity and unpredictability of AI algorithms necessitate their cautious implementation and regular manual validation [6]. Dental professionals must maintain responsibility for the final treatment decisions, fully understanding both the capabilities and limitations of AI systems [10]. In resource-constrained settings typical of many Indian institutions, considerations of cost-effectiveness, infrastructure requirements, and training needs become critical determinants of successful implementation [16].

Interoperability presents another fundamental challenge, as seamless integration into existing clinical workflows requires the standardization of data formats and communication protocols [10]. Faculty must receive adequate training not only in using AI tools but also in understanding fundamental AI concepts to make informed decisions regarding their application [15].

Conclusion

Artificial intelligence offers substantial potential to enhance dental diagnostics, treatment planning, and education. For Indian dental faculty, the evidence supports prioritizing AI applications in radiographic diagnosis, particularly for caries and periodontal disease detection, and exploring AI-assisted orthodontic treatment planning. Successful integration requires addressing challenges related to data quality, infrastructure, faculty training and ethical governance. Rather than a wholesale transformation, a measured approach focusing on well-validated applications with demonstrated clinical utility offers the most pragmatic path forward. As AI technologies continue to evolve, dental educators must cultivate both enthusiasm and critical evaluation skills to ensure that implementation augments rather than replaces clinical expertise and judgment.

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