**EAS Journal of Dentistry and Oral Medicine**
*Abbreviated Key Title: EAS J Dent Oral Med*
ISSN: 2663-1849 (Print) & ISSN: 2663-7324 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-7 | Issue-5 | Sep-Oct-2025 | DOI: https://doi.org/10.36349/easjdom.2025.v07i05.002

Review Article

# Artificial Intelligence and Digital Dentistry: Bridging Innovation and Clinical Outcomes

Dr. Jayeesha Kothapalle[1], Dr. Varsha Vangapalli[2]*, Dr. Afolake Ajayi[3], Dr. Rajvir Kaur Malait[4], Dr. Rana Rakha[5], Dr. Latifa Elbanna[6], Dr. Sandeep Singh[7], Dr. Ridhi Bhola[7]

[1]BDS, MPH, AECS Maaruti Dental College and Research Centre, Bangalore, India
[2]BDS, Kamineni Institute of Dental Science (affiliated with Dr. NTRUHS), Andhra Pradesh, India
[3]BDS, University of Lagos, Nigeria
[4]BDS, Baba Farid University of Health Sciences, Punjab, India
[5]BDS, Dentistry & Oral Surgery, Misr University for Science & Technology (MUST), Giza, Egypt
[6]BDS, MDS, PhD Prosthodontics, Faculty of Dental Medicine - AlAzhar University, Cairo, Egypt
[7]MDS, Postgraduate Institute of Dental Sciences, Rohtak, India

**Article History**
**Received:** 24.07.2025
**Accepted:** 20.09.2025
**Published:** 30.09.2025

**Journal homepage:**
https://www.easpublisher.com

**Quick Response Code**

**Abstract:** The integration of artificial intelligence with digital dentistry represents a transformative shift in contemporary oral healthcare. Over the past two decades, digital technologies such as intraoral scanning, cone-beam computed tomography, computer-aided design/computer-aided manufacturing, and 3D printing have revolutionized diagnostics, treatment planning, and prosthetic fabrication. Parallel advancements in AI, particularly machine learning and deep learning, have expanded dentistry's potential for enhanced diagnostic precision, predictive analytics, and personalized care. This review provides a comprehensive overview of AI applications across major dental specialties, including caries detection, orthodontic planning, prosthodontic design, implantology, endodontics, periodontology, and forensic odontology. Further, the paper highlights synergies between AI and digital workflows such as intraoral scanning, 3D printing, and tele-dentistry, underscoring their role in improving efficiency, reducing chairside time, and enhancing patient outcomes. While AI offers significant benefits, challenges related to data privacy, standardization, accessibility, and clinician acceptance remain barriers to widespread adoption. Future directions emphasize integration with robotics, predictive analytics, cloud-based platforms, and robust ethical frameworks to ensure equitable, evidence-based practice. Collectively, AI is poised to serve as a collaborative partner in dentistry, augmenting clinician expertise and driving the transition toward a predictive, preventive, and patient-centered model of care.

**Keywords:** Artificial Intelligence, Digital Dentistry, Machine Learning, 3D Printing, CAD/CAM, Teledentistry.

**Copyright © 2025 The Author(s):** This is an open-access article distributed under the terms of the Creative Commons Attribution **4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

## 1. INTRODUCTION

The past two decades have witnessed a paradigm shift in dental practice with the emergence of digital technologies, collectively termed *digital dentistry*. Digital workflows now encompass a wide range of innovations including intraoral scanning, cone-beam computed tomography (CBCT), computer-aided design/computer-aided manufacturing (CAD/CAM), and three-dimensional (3D) printing, all of which have enhanced diagnostic accuracy, treatment planning, and prosthetic fabrication [1, 2]. These advancements have led to improved efficiency, reduced chairside time, and enhanced patient comfort compared to traditional analog techniques [2].

Parallel to the rise of digital dentistry, artificial intelligence (AI) has gained substantial traction across healthcare. AI applications, particularly those utilizing machine learning (ML) and deep learning (DL), are being increasingly adopted in radiology, oncology, cardiology, and pathology, demonstrating superior performance in image recognition, disease classification, and predictive analytics [3, 4]. Dentistry is now following this trajectory, with AI emerging as a transformative tool for clinical decision support,

***Corresponding Author:** Dr. Varsha Vangapalli
BDS, Kamineni Institute of Dental Science (affiliated with Dr. NTRUHS), Andhra Pradesh, India

diagnostic accuracy, and personalized treatment planning [5].

The rationale for integrating AI into dentistry is multifold. First, dentistry is highly reliant on imaging and pattern recognition, domains in which AI excels. Second, the volume of digital data generated from intraoral scans, radiographs, and electronic health records necessitates automated systems for efficient interpretation. Finally, AI has the potential to bridge gaps in accessibility by supporting remote diagnostics and tele-dentistry, particularly in underserved regions [7, 8].

Given these emerging trends, this review aims to provide an overview of current AI applications in digital dentistry, assess their impact on clinical outcomes and patient care, examine the challenges and limitations associated with AI adoption, and explore future directions that may shape the next phase of digital dental practice.

## 2. Fundamentals of AI in Dentistry

### 2.1 Basic Concepts

Artificial intelligence (AI) is broadly defined as the ability of computer systems to perform tasks that typically require human intelligence, including pattern recognition, decision-making, and problem-solving [9]. Within AI, machine learning (ML) refers to algorithms that enable systems to improve their performance through data exposure without explicit programming [10]. Deep learning (DL), a subset of ML, uses multi-layered artificial neural networks (ANNs) to process complex, high-dimensional data such as medical images, facilitating superior performance in image classification and feature extraction [11]. ANNs are computational models inspired by biological neural networks, consisting of interconnected nodes (neurons) that simulate the learning processes of the human brain [12].

### 2.2 Evolution of AI in Medicine vs. Dentistry

The adoption of AI in medicine has been relatively rapid, particularly in radiology, pathology, dermatology, and oncology, where AI-based systems have achieved diagnostic accuracy comparable to expert clinicians [13, 14]. For instance, convolutional neural networks (CNNs) have demonstrated exceptional capabilities in detecting lung nodules on CT scans and classifying skin lesions [15].

In dentistry, AI adoption has been more gradual but steadily increasing. Early applications focused on caries detection and orthodontic cephalometric analysis, with more recent studies extending into implantology, periodontology, prosthodontics, and oral pathology [6-16]. Unlike medicine, where large centralized datasets are often available, dentistry has faced challenges due to fragmented data sources and smaller case volumes, which have slowed the development of robust AI models [16]. Nevertheless, the evolution of digital dentistry technologies, such as intraoral scanners, CBCT imaging, CAD/CAM systems, and electronic dental records, has accelerated the generation of structured datasets that can be leveraged for AI training [7].

### 2.3 Data Requirements and Digital Workflows

The effectiveness of AI systems depends largely on the quality and quantity of data available for training and validation. High-resolution radiographs, CBCT images, intraoral scans, and annotated clinical datasets are essential to build reliable AI models [17]. In addition, integration of multimodal data, including patient demographics, clinical notes, and medical histories, enhances the predictive power of AI algorithms [18].

Digital workflows in dentistry, which include scanning, digital design, and additive or subtractive manufacturing, generate vast amounts of standardized data. These workflows not only support clinical efficiency but also create the foundation for AI integration by producing consistent, machine-readable datasets [19]. Cloud-based platforms and interoperability standards further facilitate data sharing across practices and institutions, enabling the development of large-scale AI models capable of generalization across diverse patient populations [20].

## 3. Applications of AI in Dentistry

Artificial intelligence has found applications across multiple dental specialties, offering enhanced diagnostic precision, treatment planning, and clinical efficiency. The following subsections outline the major domains of AI integration in dentistry.

### 3.1 Diagnostics

Dentistry is inherently dependent on imaging for diagnosis, and AI-based image analysis has demonstrated promising results. In caries detection, CNNs have achieved accuracy levels comparable to those of experienced clinicians when analyzing bitewing and periapical radiographs [21, 22]. Similarly, AI tools are being developed for the early detection of oral cancer by analyzing photographic, histopathological, and autofluorescence images, thus supporting timely intervention [23]. Radiographic interpretation using AI has also extended to CBCT and panoramic images, enabling automated tooth segmentation, detection of periapical pathology, and identification of anatomical landmarks [17-24]. These systems reduce inter-observer variability and improve diagnostic consistency.

### 3.2 Orthodontics

AI has been extensively applied in orthodontics, particularly in cephalometric analysis. Automated landmark detection using CNNs reduces the time and effort required for manual tracing while maintaining high accuracy [25]. AI-based treatment planning platforms facilitate virtual simulations and prediction of tooth movement, allowing more precise aligner design and outcome forecasting. Moreover, AI enhances the design and customization of clear aligners, optimizing both aesthetics and function [26]. A systematic review by Khanagar *et al*., highlighted that AI applications in orthodontics are not limited to landmark detection but also extend to predicting orthodontic extractions, treatment needs, and treatment outcomes. The authors analyzed 43 studies published over two decades and reported that AI models, primarily based on CNNs and artificial neural networks ANNs, were able to predict treatment requirements and aid in decision-making with high precision. Notably, some AI-based systems matched or even outperformed specialists in diagnostic accuracy and treatment planning scenarios. This suggests that AI can serve as a valuable adjunct for orthodontists, improving efficiency, consistency, and personalized care [27].

**3.3 Prosthodontics**

Digital prosthodontics benefits significantly from AI integration. AI supports the evaluation of intraoral scans and digital impressions, improving accuracy in margin detection and occlusal relationship analysis [7]. In CAD/CAM workflows, AI algorithms assist in optimizing crown and bridge designs by predicting material thickness and functional stability. Furthermore, occlusion analysis using AI-based models helps predict interferences, ensuring functional restorations with minimal adjustments [28]. A recent systematic review by Bernauer *et al*., provided a comprehensive overview of the applications and performance of AI in prosthodontics. The authors screened 560 titles and included seven studies that investigated AI-driven tools for automated diagnostics, predictive modeling, and classification tasks. Six of the included studies reported the training and validation of stand-alone AI systems, while one explored the intrinsic AI functionality of a commercial CAD software. The review concluded that despite the relatively small number of available studies, AI has demonstrated promising potential for individualized treatment planning, dataset management, and automation of prosthodontic workflows. These technologies are expected to streamline clinical processes, reduce chairside adjustments, and improve overall patient-centered care in the future [29].

**3.4 Implantology**

AI contributes to implantology by enhancing treatment planning and risk assessment. Machine learning models analyze CBCT data for bone density evaluation and identification of optimal implant sites. AI-assisted software supports surgical guide design, improving the precision of implant placement. Additionally, predictive models have been developed to estimate implant success and identify patient-specific risk factors such as peri-implantitis susceptibility [30]. Macrì *et al*., systematically reviewed the role of AI in implant planning and found that AI systems improve precision and predictability compared to conventional methods. However, they noted challenges such as the need for high-quality training datasets and standardization. Overall, AI shows strong potential to optimize patient-specific treatment planning and outcomes [31].

**3.5 Endodontics**

Endodontics has seen AI applied in root canal morphology analysis and lesion detection. CNNs trained on radiographs and CBCT scans enable accurate classification of root canal systems, facilitating treatment planning. AI also improves the detection of periapical lesions, often identifying abnormalities that might be missed by clinicians. These applications contribute to more predictable endodontic outcomes [32]. Boreak systematically reviewed 10 studies and concluded that AI systems achieve accuracy comparable to experienced endodontists, and in some cases outperform specialists. These systems hold promise as decision-support tools, particularly for less experienced clinicians, enhancing diagnostic consistency and prognosis prediction [33].

**3.6 Periodontology**

AI has been used for periodontal disease diagnosis, prognosis, and treatment monitoring. Algorithms analyzing radiographs can detect bone loss patterns and classify disease severity. Furthermore, predictive models integrate clinical and demographic data to estimate progression risk, enabling personalized treatment approaches. AI is also being explored in monitoring post-treatment healing through image-based evaluations [34, 35]. Revilla-León *et al*., systematically reviewed 24 studies and reported AI model accuracies ranging from 73-99% for plaque detection and alveolar bone loss assessment, 67-78% for gingivitis diagnosis, and 47-81% for periodontal disease detection from intraoral images. These findings highlight the potential of AI to support periodontal screening and diagnosis, although variability in performance underscores the need for standardized datasets and model validation before routine clinical adoption.

**3.7 Forensic Dentistry**

Forensic odontology benefits from AI through advanced pattern recognition. Bite mark analysis, which traditionally suffers from subjectivity, can be standardized using machine learning algorithms. Additionally, AI supports automated dental age estimation and human identification from dental records, improving the reliability of forensic investigations [37]. Khanagar *et al*., systematically reviewed studies published between 2000 and 2020 and found that AI models performed comparably to trained forensic experts in accuracy and precision. These tools are especially valuable in mass disaster victim identification and medico-legal investigations, offering rapid, objective, and reproducible results (Figure 1) [38].

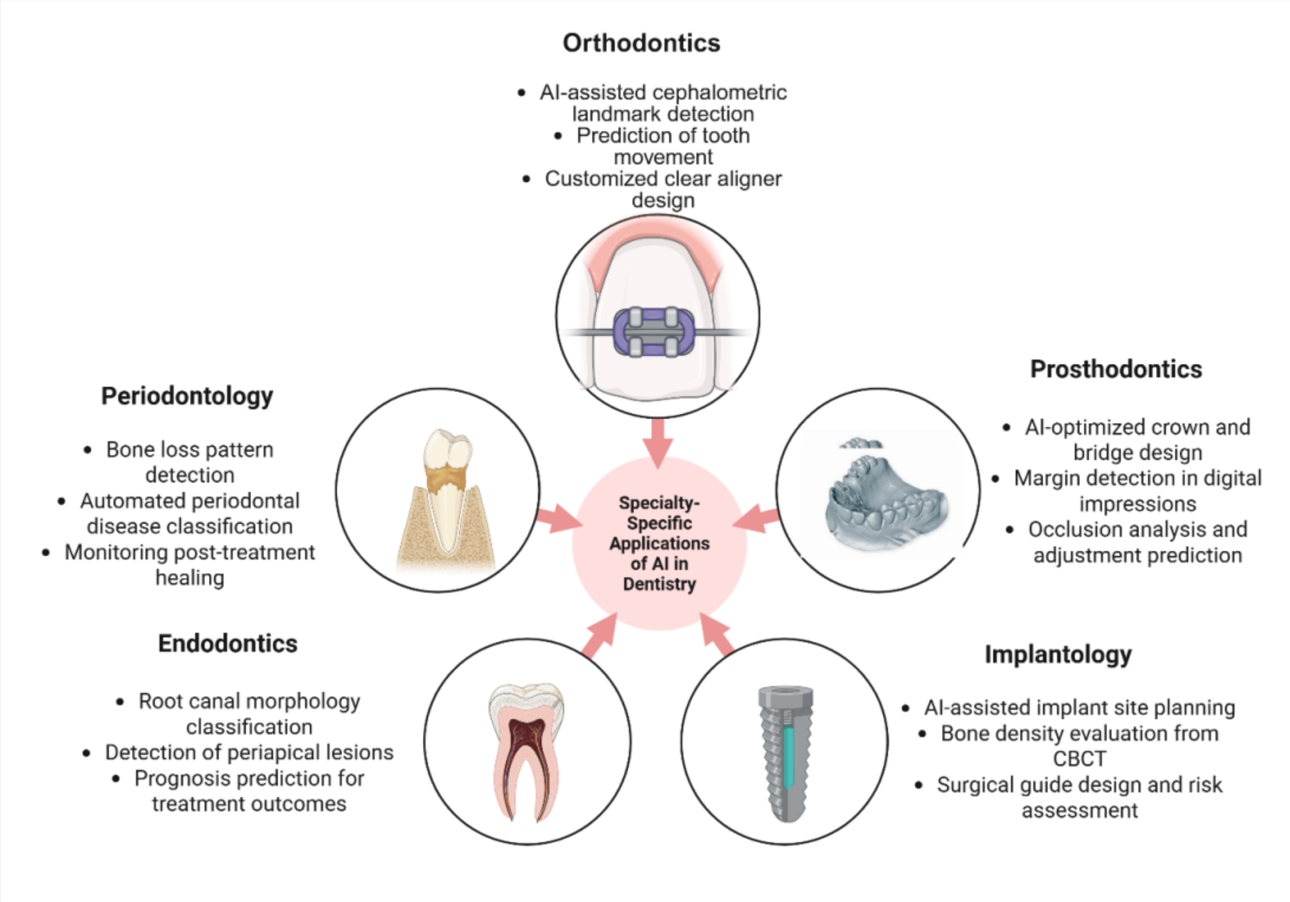


**Figure 1: Applications of AI in dentistry**

### 4. Integration with Digital Dentistry Tools

AI achieves its greatest clinical value when integrated with the broader ecosystem of digital dentistry. Rather than functioning as a stand-alone tool, AI complements existing technologies, streamlining workflows, increasing precision, and enabling personalized care.

### 4.1 AI with Intraoral Scanners

Intraoral scanners have become a cornerstone of modern restorative and prosthetic dentistry. When coupled with AI, they can automatically detect preparation margins, identify undercuts, and flag incomplete scans in real time. AI-powered software can also assist in early caries detection and monitor tooth wear or gingival recession over time using sequential scans. This significantly reduces chairside time, minimizes operator error, and improves the reproducibility of digital impressions [39].

### 4.2 AI-Powered 3D Printing and Milling

Additive (3D printing) and subtractive (milling) manufacturing are integral parts of the digital workflow. AI algorithms can optimize nesting, reduce material waste, and predict print or milling errors before production starts. For example, AI can suggest ideal build orientations for 3D-printed surgical guides to reduce support structures, improving accuracy and saving time. Similarly, tool-path optimization through machine learning minimizes wear on milling burs and enhances the fit of restorations [7].

### 4.3 Virtual and Augmented Reality Supported by AI

Virtual reality (VR) and augmented reality (AR) platforms are increasingly used for treatment planning, clinician training, and patient education. AI enhances these technologies by creating data-driven simulations, such as predicting occlusal contacts after prosthesis placement or simulating surgical outcomes. This allows clinicians to visualize complex cases, communicate treatment plans more effectively, and practice in a risk-free virtual environment before actual clinical execution [40].

### 4.4 AI-Enhanced Tele-Dentistry

Tele-dentistry has gained traction as a means to provide remote consultations and improve access to oral care. Integrating AI enables automated triage systems that classify cases based on urgency, detect carious lesions or periodontal changes from patient-submitted images, and guide patients toward appropriate care pathways. This reduces unnecessary in-person visits, improves early disease detection, and enhances access to care for patients in rural or underserved communities [41].

Collectively, the integration of AI with intraoral scanning, digital manufacturing, VR/AR, and tele-dentistry represents a paradigm shift toward a fully digital, patient-centered workflow. Such synergy not only enhances clinical accuracy but also reduces treatment time, improves patient communication, and supports a more preventive, predictive, and personalized approach to oral healthcare.

## 5. Clinical Outcomes, Patient Benefits, and Limitations of AI in Dentistry

**Tab. 1**

| Aspect | Key Points | Implications |
|---|---|---|
| **Clinical Outcomes & Patient Benefits** | Accuracy & Efficiency Improvements - AI enhances diagnostic precision (e.g., caries detection, cephalometric analysis) and reduces human error [36-38]. | Leads to earlier disease detection and improved clinical decision-making [38]. |
| | Reduced Chairside Time - Automated margin detection, scan validation, and optimized workflows save significant clinical time [7-38]. | Improves productivity, allowing clinicians to treat more patients with less fatigue. |
| | Improved Patient Communication & Satisfaction - AI-driven visualizations (VR/AR) help explain treatment plans clearly [36]. | Increases patient understanding, compliance, and overall satisfaction with care. |
| | Personalized Treatment Plans - Predictive analytics tailor treatment based on patient-specific data [33]. | Promotes precision dentistry and better long-term outcomes. |
| **Challenges & Limitations** | Data Privacy & Ethical Concerns- Patient data used to train AI systems may raise security and confidentiality issues [41]. | Requires strict adherence to data protection regulations (e.g., HIPAA, GDPR). |
| | Variability in AI Accuracy - Bias from limited or non-representative datasets may affect generalizability [38]. | Calls for standardized datasets and multicenter validation before routine clinical adoption. |
| | Cost and Accessibility Barriers - High costs of AI-powered hardware/software may limit adoption in low-resource settings [38]. | Could widen the gap between well-equipped and resource-limited dental practices. |
| | Clinician Acceptance & Learning Curve- Some practitioners may resist integrating AI tools into their workflow [41]. | Highlights the need for training programs and user-friendly interfaces. |

## 6. Future Directions

The future of AI in dentistry lies in deeper integration with emerging technologies, expanded predictive capabilities, and robust ethical oversight.

### 6.1 AI Integration with Robotics in Dentistry

Combining AI with robotic systems promises precise, minimally invasive procedures, such as automated implant placement, endodontic access, and guided surgical interventions. Robotics guided by AI could enhance accuracy while reducing human error and fatigue [42].

### 6.2 Predictive Analytics for Personalized Care

AI-driven predictive models can analyze patient-specific datasets, including genetic, radiographic, and behavioral information, to forecast disease progression, optimize preventive strategies, and tailor individualized treatment plans. This approach aligns with precision dentistry and value-based care principles [43].

### 6.3 Cloud-Based AI Platforms and Interoperability

Cloud computing facilitates centralized data storage, cross-platform interoperability, and real-time AI updates. Cloud-based AI can enable multi-center learning, where models continuously improve by learning from diverse datasets while maintaining patient privacy through secure protocols [44].

### 6.4 Regulatory and Ethical Frameworks

As AI becomes more integrated into clinical workflows, regulatory guidance and ethical frameworks will be critical. Policies must address data privacy, informed consent, algorithm transparency, bias mitigation, and accountability to ensure safe and equitable deployment of AI technologies. Collectively, these future directions indicate a shift toward a highly connected, predictive, and patient-centered dental ecosystem, where AI complements clinical expertise rather than replacing it [45].

## 7. CONCLUSION

Artificial intelligence is reshaping the landscape of digital dentistry, from diagnostics and treatment planning to prosthodontics, orthodontics, and tele-dentistry. While AI offers unparalleled accuracy, efficiency, and personalized care, its implementation must balance technological innovation with evidence-based practice and human clinical judgment.

The future vision of dentistry positions AI as a collaborative partner, augmenting clinician skills, improving patient outcomes, and enhancing workflow efficiency, rather than a replacement for professional expertise. As the field evolves, the synergy between human intelligence and artificial intelligence will define the next era of patient-centered, precision dental care.

**Source of Support**: Self

**Conflict of Interest**: Nil

## REFERENCES

1. Rathee M, Alam M, Malik S, Singh S, Wakure P. 3D Printing - A revolution in prosthetic dentistry. Sch J Dent Sci. 2021;8(11):327 34.
2. De Vries E, Deshpande S, Kalalota S, Manandhar S, Bhola R, Singh S. Digital dentistry: Evolution, current applications, and future directions. Int J Oral Health Dent. 2025;11(2):90–95.
3. Vishnu Govind Thekkumbad, Mounica Pinnamaneni, Sruthi Kalakota, Krishma Pandoh, Syeda Hussain, Ridhi Bhola, Sandeep Singh (2025). Artificial Intelligence: A Paradigm Shift in General Dental Practice. Saudi J Oral Dent Res, 10(5): 233-240.
4. Esteva A, Robicquet A, Ramsundar B, Kuleshov V, DePristo M, Chou K, Cui C, Corrado G, Thrun S, Dean J. A guide to deep learning in healthcare. Nat Med. 2019 Jan;25(1):24-29. doi: 10.1038/s41591-018-0316-z.
5. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019 Jan;25(1):44-56. doi: 10.1038/s41591-018-0300-7.
6. Schwendicke F, Samek W, Krois J. Artificial Intelligence in Dentistry: Chances and Challenges. J Dent Res. 2020 Jul;99(7):769-774. doi: 10.1177/0022034520915714.
7. Revilla-León M, Özcan M. Additive Manufacturing Technologies Used for Processing Polymers: Current Status and Potential Application in Prosthetic Dentistry. J Prosthodont. 2019 Feb;28(2):146-158. doi: 10.1111/jopr.12801.
8. Krutika Sangani, Amrit Kaur Gill, Manjiri Chakor, Hoorieh Sadat Alamolhoda, Kiranprasad Chileveru, Ridhi Bhola, Sandeep Singh. Teledentistry: A Comprehensive Review of Methods, Applications, and Future Directions. Sch J Dent Sci, 2025 Jun 12(5): 74-80.
9. Russell S, Norvig P. Artificial Intelligence: A Modern Approach. 4th ed. Pearson; 2020.
10. Jordan MI, Mitchell TM. Machine learning: Trends, perspectives, and prospects. Science. 2015 Jul 17;349(6245):255-60. doi: 10.1126/science.aaa8415. PMID: 26185243.
11. LeCun Y, Bengio Y, Hinton G. Deep learning. Nature. 2015 May 28;521(7553):436-44. doi: 10.1038/nature14539.
12. Schmidhuber J. Deep learning in neural networks: an overview. Neural Netw. 2015 Jan;61:85-117. doi: 10.1016/j.neunet.2014.09.003.
13. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019 Jan;25(1):44-56. doi: 10.1038/s41591-018-0300-7.
14. Esteva A, Robicquet A, Ramsundar B, Kuleshov V, DePristo M, Chou K, Cui C, Corrado G, Thrun S, Dean J. A guide to deep learning in healthcare. Nat Med. 2019 Jan;25(1):24-29. doi: 10.1038/s41591-018-0316-z.
15. Ardila D, Kiraly AP, Bharadwaj S, Choi B, Reicher JJ, Peng L, Tse D, Etemadi M, Ye W, Corrado G, Naidich DP, Shetty S. End-to-end lung cancer screening with three-dimensional deep learning on low-dose chest computed tomography. Nat Med. 2019 Jun;25(6):954-961. doi: 10.1038/s41591-019-0447-x.
16. Lee JH, Kim DH, Jeong SN, Choi SH. Diagnosis and prediction of periodontally compromised teeth using a deep learning-based convolutional neural network algorithm. J Periodontal Implant Sci. 2018 Apr 30;48(2):114-123. doi: 10.5051/jpis.2018.48.2.114.
17. Miki Y, Muramatsu C, Hayashi T, Zhou X, Hara T, Katsumata A, Fujita H. Classification of teeth in cone-beam CT using deep convolutional neural network. Comput Biol Med. 2017 Jan 1;80:24-29. doi: 10.1016/j.compbiomed.2016.11.003.
18. Chen JH, Asch SM. Machine Learning and Prediction in Medicine - Beyond the Peak of Inflated Expectations. N Engl J Med. 2017 Jun 29;376(26):2507-2509. doi: 10.1056/NEJMp1702071.
19. Joda T, Bornstein MM, Jung RE, Ferrari M, Waltimo T, Zitzmann NU. Recent Trends and Future Direction of Dental Research in the Digital Era. Int J Environ Res Public Health. 2020 Mar 18;17(6):1987. doi: 10.3390/ijerph17061987.
20. Ranschaert ER, Morozov S, Algra PR. Artificial Intelligence in Medical Imaging: Opportunities, Applications and Risks. Springer; 2019.
21. Lee JH, Kim DH, Jeong SN, Choi SH. Detection and diagnosis of dental caries using a deep learning-based convolutional neural network algorithm. J Dent. 2018 Oct;77:106-111. doi: 10.1016/j.jdent.2018.07.015.
22. Cantu AG, Gehrung S, Krois J, Chaurasia A, Rossi JG, Gaudin R, Elhennawy K, Schwendicke F. Detecting caries lesions of different radiographic extension on bitewings using deep learning. J Dent. 2020 Sep;100:103425. doi: 10.1016/j.jdent.2020.103425.
23. Khanagar SB, Naik S, Al Kheraif AA, Vishwanathaiah S, Maganur PC, Alhazmi Y, Mushtaq S, Sarode SC, Sarode GS, Zanza A, Testarelli L, Patil S. Application and Performance of Artificial Intelligence Technology in Oral Cancer Diagnosis and Prediction of Prognosis: A Systematic Review. Diagnostics (Basel). 2021 May 31;11(6):1004. doi: 10.3390/diagnostics11061004.
24. Putra RH, Astuti ER, Nurrachman AS, Putri DK, Ghazali AB, Pradini TA, Prabaningtyas DT. Convolutional neural networks for automated tooth numbering on panoramic radiographs: A scoping

review. Imaging Sci Dent. 2023 Dec;53(4):271-281. doi: 10.5624/isd.20230058.

25. Kunz F, Stellzig-Eisenhauer A, Zeman F, Boldt J. Artificial intelligence in orthodontics: Evaluation of a fully automated cephalometric analysis using a customized convolutional neural network. J Orofac Orthop. 2020 Jan;81(1):52-68. English. doi: 10.1007/s00056-019-00203-8.
26. Ahn HW, Moon SC, Baek SH. Morphometric evaluation of changes in the alveolar bone and roots of the maxillary anterior teeth before and after en masse retraction using cone-beam computed tomography. Angle Orthod. 2013 Mar;83(2):212-21. doi: 10.2319/041812-325.1.
27. Khanagar SB, Al-Ehaideb A, Maganur PC, Vishwanathaiah S, Patil S, Baeshen HA, Sarode SC, Bhandi S. Developments, application, and performance of artificial intelligence in dentistry - A systematic review. J Dent Sci. 2021 Jan;16(1):508-522. doi: 10.1016/j.jds.2020.06.019.
28. Joda T, Zarone F, Ferrari M. The complete digital workflow in fixed prosthodontics: a systematic review. BMC Oral Health. 2017 Sep 19;17(1):124. doi: 10.1186/s12903-017-0415-0.
29. Bernauer SA, Zitzmann NU, Joda T. The Use and Performance of Artificial Intelligence in Prosthodontics: A Systematic Review. Sensors (Basel). 2021 Oct 5;21(19):6628. doi: 10.3390/s21196628.
30. Vercruyssen M, Jacobs R, Van Assche N, van Steenberghe D. The use of CT scan based planning for oral rehabilitation by means of implants and its transfer to the surgical field: a critical review on accuracy. J Oral Rehabil. 2008 Jun;35(6):454-74. doi: 10.1111/j.1365-2842.2007.01816.x.
31. Macrì M, D'Albis V, D'Albis G, Forte M, Capodiferro S, Favia G, Alrashadah AO, García VD, Festa F. The Role and Applications of Artificial Intelligence in Dental Implant Planning: A Systematic Review. Bioengineering (Basel). 2024 Jul 31;11(8):778. doi: 10.3390/bioengineering11080778.
32. Orhan K, Bayrakdar IS, Ezhov M, Kravtsov A, Özyürek T. Evaluation of artificial intelligence for detecting periapical pathosis on cone-beam computed tomography scans. Int Endod J. 2020 May;53(5):680-689. doi: 10.1111/iej.13265. Epub 2020 Feb 3.
33. Boreak N. Effectiveness of Artificial Intelligence Applications Designed for Endodontic Diagnosis, Decision-making, and Prediction of Prognosis: A Systematic Review. J Contemp Dent Pract. 2020 Aug 1;21(8):926-934.
34. Krois J, Ekert T, Meinhold L, Golla T, Kharbot B, Wittemeier A, Dörfer C, Schwendicke F. Deep Learning for the Radiographic Detection of Periodontal Bone Loss. Sci Rep. 2019 Jun 11;9(1):8495. doi: 10.1038/s41598-019-44839-3.
35. Lee JH, Kim DH, Jeong SN, Choi SH. Diagnosis and prediction of periodontally compromised teeth using a deep learning-based convolutional neural network algorithm. J Periodontal Implant Sci. 2018 Apr 30;48(2):114-123. doi: 10.5051/jpis.2018.48.2.114.
36. Revilla-León M, Gómez-Polo M, Barmak AB, Inam W, Kan JYK, Kois JC, Akal O. Artificial intelligence models for diagnosing gingivitis and periodontal disease: A systematic review. J Prosthet Dent. 2023 Dec;130(6):816-824. doi: 10.1016/j.prosdent.2022.01.026.
37. T., Smitha. Artificial Intelligence in Forensic Odontology. Journal of Forensic Dental Sciences 13(1):p 1-2, Jan–Apr 2021. | DOI: 10.18311/jfds/13/1/2021.659.
38. Khanagar SB, Vishwanathaiah S, Naik S, A Al-Kheraif A, Devang Divakar D, Sarode SC, Bhandi S, Patil S. Application and performance of artificial intelligence technology in forensic odontology - A systematic review. Leg Med (Tokyo). 2021 Feb;48:101826. doi: 10.1016/j.legalmed.2020.101826.
39. Mangano FG, Veronesi G, Hauschild U, Mijiritsky E, Mangano C. Trueness and Precision of Four Intraoral Scanners in Oral Implantology: A Comparative in Vitro Study. PLoS One. 2016 Sep 29;11(9):e0163107. doi: 10.1371/journal.pone.0163107.
40. Lampropoulos, G. Intelligent Virtual Reality and Augmented Reality Technologies: An Overview. *Future Internet* 2025, *17*, 58. https://doi.org/10.3390/fi17020058
41. Estai M, Kanagasingam Y, Tennant M, Bunt S. A systematic review of the research evidence for the benefits of teledentistry. J Telemed Telecare. 2018 Apr;24(3):147-156. doi: 10.1177/1357633X16689433.
42. Saeed A, Alkhurays M, AlMutlaqah M, AlAzbah M, Alajlan SA. Future of Using Robotic and Artificial Intelligence in Implant Dentistry. Cureus. 2023 Aug 9;15(8):e43209. doi: 10.7759/cureus.43209.
43. Pitchika V, Büttner M, Schwendicke F. Artificial intelligence and personalized diagnostics in periodontology: A narrative review. Periodontol 2000. 2024 Jun;95(1):220-231. doi: 10.1111/prd.12586.
44. Elsonbaty S, Elgarba BM, Fontenele RC, Swaity A, Jacobs R. Novel AI-based tool for primary tooth segmentation on CBCT using convolutional neural networks: A validation study. Int J Paediatr Dent. 2025 Jan;35(1):97-107. doi: 10.1111/ipd.13204.
45. Kaur N, Jacob G, Singh A, Khan S, Dhir P, Kakarla G. Artificial Intelligence in dentistry: Balancing innovation with ethical responsibility. Bioinformation. 2025 Mar 31;21(3):489-494. doi: 10.6026/973206300210489.

**Cite This Article:** Jayeesha Kothapalle, Varsha Vangapalli, Afolake Ajayi, Rajvir Kaur Malait, Rana Rakha, Latifa Elbanna, Sandeep Singh, Ridhi Bhola (2025). Artificial Intelligence and Digital Dentistry: Bridging Innovation and Clinical Outcomes. *EAS J Dent Oral Med, 7*(5), 192-198.