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REVIEW

Applications of Artificial Intelligence in the field of dentistry

Aplicaciones de la Inteligencia Artificial en el campo de la estomatología

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ABSTRACT

Artificial intelligence (AI) is transforming dentistry by introducing diagnostic and treatment planning support tools with unprecedented accuracy and efficiency. This review aims to analyze the current impact of AI, evaluating its applications, challenges, and ethical considerations for responsible integration. In the diagnostic field, algorithms demonstrate high accuracy in caries detection, periodontal disease quantification, and lesion identification, reducing interobserver variability. In treatment planning, AI optimizes orthodontics through digital simulations and remote monitoring, guides implant placement with maximum precision, and customizes aesthetic restorations. However, its implementation faces barriers such as cost, learning curve, and technical challenges. Critical issues such as professional responsibility, data privacy, and algorithmic bias require robust ethical frameworks. It is concluded that AI does not replace the professional, but rather enhances their capabilities, requiring a balanced adoption that prioritizes patient safety and equity in access to these innovations.

Keywords: Dentistry; Artificial Intelligence; Patient Care Planning; Orthodontics.

RESUMEN

La inteligencia artificial (IA) está transformando la Estomatología al introducir herramientas de apoyo al diagnóstico y planificación de tratamientos con una precisión y eficiencia sin precedentes. Esta revisión tiene como objetivo analizar el impacto actual de la IA, evaluando sus aplicaciones, desafíos y consideraciones éticas para una integración responsable. En el ámbito diagnóstico, los algoritmos demuestran una elevada precisión en la detección de caries, cuantificación de la enfermedad periodontal e identificación de lesiones, reduciendo la variabilidad interobservador. En la planificación de tratamientos, la IA optimiza la ortodoncia mediante simulaciones digitales y seguimiento remoto, guía la colocación de implantes con máxima precisión y personaliza restauraciones estéticas. Sin embargo, su implementación enfrenta barreras como el coste, la curva de aprendizaje y desafíos técnicos. Cuestiones críticas como la responsabilidad profesional, la privacidad de datos y el sesgo algorítmico exigen marcos éticos robustos. Se concluye que la IA no sustituye al profesional, sino que potencia sus capacidades, requiriendo una adopción equilibrada que priorice la seguridad del paciente y la equidad en el acceso a estas innovaciones.

Palabras clave: Odontología; Inteligencia Artificial; Planificación de Atención al Paciente; Ortodoncia.

INTRODUCTION

Artificial Intelligence (AI) in Stomatology is defined as the ability of computer systems to perform tasks that traditionally require human cognition.[1] These tasks include analyzing diagnostic images, assisting with clinical decision-making, planning complex treatments, and using natural language processing to improve patient interaction.

Although its clinical application is a recent phenomenon, the theoretical foundations of AI date back to 19th- and 20th-century visionaries such as Ada Lovelace and Leonardo Torres Quevedo.[1] However, the practical realization of these concepts has been made possible by the convergence of three technological factors over the last decade: the development of more sophisticated deep learning algorithms, the availability of large digitized data sets, and access to unprecedented computing power through graphics processing units (GPUs).

Academic and clinical interest in this field has grown exponentially. A recent bibliometric analysis[2] reveals that the number of scientific publications on AI in dentistry increased 16-fold in just five years, demonstrating an unprecedented acceleration in research and development, driven by continuous improvements in algorithms and access to larger volumes of data.

The development of an effective dental AI solution follows a well-defined life cycle that depends on the synergy between three essential components. First, the availability of high-quality data is critical, as the system's performance is directly proportional to the quality and quantity of the training data, which must be anonymized and meticulously labeled by experts. The quality of the source image is a determining factor, as low-resolution images or artifacts can lead to inaccurate results.

Second, the development of robust and generalizable algorithms, predominantly based on deep learning, is required to maintain accuracy when faced with new data from different populations and equipment.[3] Finally, the algorithms must be implemented in integrated clinical platforms that are intuitive, offer real-time results, and connect with existing practice management systems (PMS) and digital radiology systems to maximize their usefulness and efficiency.[4]

This interdependence underscores that AI in dentistry is not simply software, but a complex system. Its successful implementation requires a robust data infrastructure, advanced algorithmic science, and careful integration into the clinical environment.

Despite this rapid development and obvious potential, the effective integration of AI into daily dental practice faces substantial challenges that have not been adequately addressed in a comprehensive manner.

There is a critical gap between the technical capabilities demonstrated in research settings and routine clinical application, marked by practical, ethical, and adoption barriers. Therefore, this study aims to describe the current landscape of AI use in dentistry.

DEVELOPMENT

Application of AI in diagnosis

Diagnostic imaging

The application of AI in diagnostic imaging is one of the most significant advances in modern dentistry. By acting as a clinical decision support system, this technology enhances professionals' ability to detect, analyze, and quantify pathologies with unprecedented accuracy and consistency.

AI algorithms are applied to the entire spectrum of dento-maxillofacial imaging modalities, including panoramic, periapical, bitewing radiographs, and cone beam computed tomography (CBCT).[5] Using computer vision techniques, these systems perform complex tasks that are traditionally time-consuming and subject to human variability. These tasks include segmentation, which enables precise identification and delineation of anatomical structures such as individual teeth or the inferior alveolar nerve canal; classification, for the diagnosis of pathological

conditions such as caries or periapical lesions; and landmark localization, which is essential for cephalometric analysis in orthodontics and for planning orthognathic surgery.[3] AI›s ability to analyze 3D CBCT images is particularly transformative, as it allows for detailed volumetric assessment of the patient›s anatomy, which is indispensable for specialties such as implantology and oral surgery.[6,7]

Caries detection

Caries detection is the area where AI has demonstrated the most immediate and robust clinical value. Its main advantage lies in identifying incipient lesions, especially interproximal ones, which, because of their subtlety, can go unnoticed by the human eye in the early stages.[7] The scientific evidence supporting this capability is solid: a systematic review and meta-analysis evaluating 14 studies concluded that AI systems, predominantly based on Convolutional Neural Networks (CNNs), demonstrate high accuracy, sensitivity, and specificity for caries detection.[8] Individual studies have reported an accuracy of 97,1 % for root caries.[9]

A revealing finding comes from direct comparative research, where one study[10] demonstrates that artificial intelligence (AI) significantly improves accuracy in caries treatment planning. The AI system alone achieved an accuracy score (F1-score) of 0,71, outperforming dental students, whose average was 0,586. Crucially, when students used AI as a second opinion, their performance increased markedly. This collaborative framework was especially beneficial for participants with lower initial performance, highlighting the potential of AI as a support and standardization tool in dental training and practice.

Therefore, the value of AI in this field lies not only in increased detection sensitivity but also in standardizing the diagnostic threshold, leading to more consistent and equitable treatment decisions.[11]

Periodontal disease assessment

AI is transforming the assessment of periodontal disease by facilitating the transition from qualitative assessment to quantitative, data-driven analysis. Algorithms can analyze X-rays to measure alveolar bone loss, a key indicator of periodontitis progression, with millimeter precision. This objective quantification represents a paradigm shift, allowing clinicians to obtain precise metrics (e.g., “3,2 mm bone loss”) rather than subjective descriptions, facilitating accurate monitoring of treatment response over time.[12] Beyond radiographic analysis, AI is applied to the examination of clinical images; one study showed that an AI model could detect signs of gingivitis in intraoral photographs with 92 % sensitivity and 94 % specificity.[13] This application opens the door to remote monitoring of gingival health.

Identification of oral lesions and support in oncology

The diagnostic scope of AI extends to the identification of a wide range of oral lesions, including periapical lesions, root fractures, cysts, tumors, and soft-tissue lesions with precancerous potential. In oral oncology, where early detection is critical, AI shows immense potential. Deep learning models trained on histopathological images or clinical photographs are being developed to assist in classifying lesions and differentiating between benign and malignant ones.[14,15] By analyzing subtle patterns imperceptible to the human eye, these systems can serve as effective screening tools, facilitating early detection of oral cancer and risk prediction for patients.[16] AI›s ability to process and correlate vast amounts of data makes it a powerful ally in the management of complex and potentially life-threatening oral diseases.

Treatment planning and execution

Artificial intelligence is redefining workflows across multiple dental specialties, transforming treatment planning from a process predominantly based on clinical experience to one guided by

data, accurate simulations, and an unprecedented degree of personalization.

Precision Orthodontics

Orthodontics stands out as one of the pioneering specialties in the cross-cutting integration of AI across all phases of treatment.[3] In the diagnosis and planning stage, AI has fully automated cephalometric analysis, performing tasks that required meticulous manual tracing in seconds with accuracy comparable to that of experts. By analyzing X-rays and 3D models, AI accurately identifies skeletal and dental problems, laying the foundation for a robust treatment plan.[17] In the design and simulation phase, algorithms predict with high precision the sequence of tooth movements for clear aligners, with the creation of a «digital avatar» of the patient being a powerful tool that not only improves planning accuracy but also facilitates communication and treatment acceptance by previewing the final result.[18] Finally, in follow-up, AI-based platforms catalyze a teleodontology model;[19] by analyzing images captured by the patient with their smartphone, progress is monitored, deviations are detected, and in-person visits are reduced, laying the foundation for a proactive and predictive care paradigm.

AI-Guided Implantology

In the field of implantology, where precision is crucial, artificial intelligence delivers a level of accuracy and safety unattainable with traditional methods.[19] Optimal planning begins with the analysis of CBCT scans to generate a detailed 3D model of the patient›s anatomy, allowing the ideal position, angle, and depth of the implant to be determined, taking into account bone density, proximity to vital structures, and prosthetic requirements.[20]

Based on this digital planning, AI designs customized surgical guides manufactured via 3D printing and directs the surgeon's drill to the exact position planned during the procedure, minimizing invasiveness, reducing surgical time, and dramatically increasing the predictability of the outcome.[21] At the forefront of this specialty, synergy with assisted robotics uses AI planning to guide a robotic arm that provides haptic feedback to the surgeon, promising to minimize human error and standardize excellence in complex procedures.[22]

Restorative and Cosmetic Dentistry

Artificial intelligence is democratizing access to high-end results in restorative and cosmetic dentistry through automation and personalization.[23,24] In the aesthetic field, smile design is being revolutionized by AI software that uses photographs and facial scans to generate realistic simulations of different treatments (veneers, crowns), allowing patients to actively participate in the design of their smile through a «digital avatar» that improves final satisfaction.[25]

For dental laboratories, generative AI automates CAD/CAM design; platforms such as 3Shape Automate® can automatically design an anatomically functional crown or bridge in minutes from an intraoral scan, increasing productivity and standardizing design quality 24 hours a day.[26] Algorithms also analyze 3D scans to customize prosthetics (crowns, bridges, dentures) with exceptional precision, adapting to each patient's individual morphology and improving aesthetics, function, and comfort while reducing the need for manual adjustments in the chair.[27]

Challenges, limitations, and ethical considerations

Despite its enormous potential, the integration of artificial intelligence in dentistry faces significant challenges and profound ethical considerations that require critical analysis for responsible adoption. This technological transformation entails technical, financial, legal, and moral barriers that must be addressed systematically.

Barriers to adoption

The implementation of AI in daily clinical practice faces significant practical obstacles that hinder its widespread adoption. The cost of implementation represents a considerable financial barrier, including not only software (often via subscription) but also specialized hardware and staff training, which can be prohibitive for small clinics compared to large dental organizations.[28,29] At the same time, the learning curve requires adequate training for professionals to understand the capabilities of the system, interpret its results, and effectively integrate it into their workflows, with the risk of over-reliance or misuse if the technology is not thoroughly understood.[30] In addition, technical and data challenges persist where the maxim «garbage in, garbage out» is particularly relevant, as the effectiveness of algorithms critically depends on the quality of input data; radiographic images with artifacts or low resolution generate unreliable analyses, compounded by false positives and interoperability challenges between software systems that can create data silos.[3,31]

Responsibility, legal implications, and the role of clinical judgment

The introduction of a non-human agent into clinical decision-making raises complex questions about professional and legal responsibility.[32] There is overwhelming consensus that AI should be considered a tool to support diagnosis and planning, never a substitute for the clinical judgment, experience, and empathy of the professional.[33] However, the ultimate responsibility lies unequivocally with the dentist, who must supervise, interpret, and, if necessary, override the system›s suggestions.[34,35] This dynamic creates a legal dilemma that has not yet been fully resolved by case law: in the event of a diagnostic error by the algorithm that causes harm to the patient, who is liable?

Data privacy and cybersecurity

The training and operation of AI systems require the processing of large volumes of extremely sensitive health data, which demands the highest standards of privacy and cybersecurity.[36] It is imperative to ensure the confidentiality of patient data throughout the entire AI lifecycle, including transparent communication about its use and obtaining explicit consent.[35] At the same time, dental clinics, especially smaller ones, are vulnerable targets for cyberattacks due to often less robust security infrastructures, where a data breach can compromise patient privacy and lead to serious legal and reputational consequences, making compliance with regulations such as HIPAA or GDPR a non-negotiable requirement.[37]

Algorithmic Bias

Algorithmic bias represents one of the most subtle and dangerous ethical challenges, with direct implications for healthcare equity.[3] AI algorithms learn from the data they are trained on, so if these datasets are not representative of the diversity of the population (underrepresenting, for example, certain ethnic groups, genders, or socioeconomic conditions), the algorithm may be less accurate for those groups,[38] perpetuating and even amplifying existing inequalities in care.[39] Additionally, there is the risk of automation bias, a cognitive bias whereby professionals tend to rely excessively on the recommendations of the automated system, accepting them without adequate critical scrutiny, which can lead to algorithm errors going undetected and propagating into patient care.[40]

Recommendations for the responsible integration of AI into dental clinical practice

To reap the benefits of AI and mitigate its risks, it is imperative to develop strategic recommendations for the different actors in the dental ecosystem. Successful implementation requires a coordinated approach that addresses educational, technical, and ethical aspects comprehensively.

Dental professionals must take a proactive role in preparing for the digital age.[41] AI literacy is the fundamental basis, so professionals must acquire basic knowledge about the functioning, capabilities, and limitations of these systems, integrating continuing education in digital dentistry as a professional priority.[42] On this basis, it is crucial to adopt a «trust but verify» stance, using AI as an assistant for decision-making while maintaining critical oversight of its recommendations, remembering that the ultimate responsibility always lies with human clinical judgment. Complementarily, AI-generated visualizations should be used as educational tools to improve communication with patients, explain clinical conditions, and facilitate their informed participation in therapeutic decisions.

For their part, dental service organizations have a responsibility to create an environment conducive to the safe and ethical integration of these technologies.[43,44] This begins with investing in a robust technological infrastructure that includes high-quality imaging systems, interoperable software, and, critically, robust cybersecurity measures to protect sensitive patient data. At the same time, they must develop clear ethical and governance protocols that systematically address informed consent, data privacy, legal liability management, and periodic auditing for potential algorithmic biases. Finally, before any implementation, a comprehensive cost-benefit analysis must be conducted that evaluates not only the financial return on investment (operational efficiency, case acceptance), but also tangible clinical benefits, such as improved diagnostic quality and patient outcomes.

CONCLUSIONS

Artificial intelligence is emerging as a transformative technology in dental practice, redefining the paradigms of diagnosis, treatment planning, and patient follow-up. The evidence reviewed demonstrates its ability to increase diagnostic accuracy, particularly in the detection of caries and periodontal disease, as well as to improve procedures in orthodontics, implantology, and restorative stomatology through personalization and predictive simulation. However, this integration is not without significant challenges. Responsible adoption requires overcoming technical, financial, and training barriers while critically addressing fundamental ethical issues such as data privacy, algorithmic fairness, and delineating professional responsibility. The future of AI in dentistry does not lie in replacing the clinician, but in enhancing their capabilities and establishing a synergistic collaboration in which human judgment retains its central role. Successful implementation will depend on a collective commitment to continuing education, the development of robust ethical frameworks, and the prioritization of equity in access to these innovations, ensuring that the benefits translate into tangible and equitable improvements in oral health.

BIBLIOGRAPHICAL REFERENCES

1. Baños G. El sueño de la Inteligencia Artificial: El proyecto de construir máquinas pensantes: una historia de la IA. Shackleton Books; 2024. 346 p.

2. Artificial Intelligence–Related Dental Research: Bibliometric and Altmetric Analysis. International Dental Journal. 2025 Feb 1;75(1):166-75. https://www.sciencedirect.com/science/article/pii/S0020653924014151

3. Suazo Galdames I. Applications of Artificial Intelligence in Dentomaxillofacial Diagnosis. Revista Cubana de Estomatología. 2024;61. http://scielo.sld.cu/scielo.php?script=sci_abstract&pid=S0034-75072024000100008&lng=es&nrm=iso&tlng=en

4. Caicedo Villabona CY, Gómez Carrillo DA, Suárez Torres KL, Pinto Galvis KJ, Taborda Ospina K. Inteligencia artificial para la optimización de parámetros de RM en Esclerosis

Múltiple: impacto en diagnóstico y seguimiento. 2025 May 26. http://repository.unad.edu.co/handle/10596/68983

5. Oropeza AO, Gaona E, Frechero NM, Pinto GR, Castaneira EC. Inteligencia artificial, usos de software y sus aplicaciones en radiología dental. Revista de la Asociación Dental Mexicana. 2024 Oct 31;81(5):271-9. https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=118110

6. Galdames ICS. Aplicaciones de la inteligencia artificial en el diagnóstico dentomaxilofacial. Revista Cubana de Estomatología. 2024 Apr 10;61:e4934. https://revestomatologia.sld.cu/index.php/est/article/view/4934

7. Gémez C, Cañahuaray-Martínez G, Gómez-Meza D, et al. Aplicación de la inteligencia artificial en Odontología: revisión de la literatura. Odontología sanmarquina. 2021 Jul 1;24(3):243-54. https://go.gale.com/ps/i.do?p=IFME&sw=w&issn=15609111&v=2.1&it=r&id=GALE%7CA668006542&sid=googleScholar&linkaccess=abs

8. Luke AM, Rezallah NNF. Accuracy of artificial intelligence in caries detection: a systematic review and meta-analysis. Head and Face Medicine. 2025 Apr 4;21:24. https://pmc.ncbi.nlm.nih.gov/articles/PMC11969992/

9. Al-Khalifa KS, Ahmed WM, Azhari AA, Qaw M, Alsheikh R, Alqudaihi F, et al. The Use of Artificial Intelligence in Caries Detection: A Review. Bioengineering (Basel). 2024 Sep 18;11(9):936. https://pmc.ncbi.nlm.nih.gov/articles/PMC11428802/

10. Dascalu T, Ramezanzade S, Bakhshandeh A, Bjørndal L, Ibragimov B. AI-initiated second opinions: a framework for advanced caries treatment planning. BMC Oral Health. 2024 Jul 10;24:772. https://pmc.ncbi.nlm.nih.gov/articles/PMC11238353/

11. González González L, Vega Jiménez J, Lorente Leyva LL, González González L, Vega Jiménez J, Lorente Leyva LL. Odontología e inteligencia artificial. Revista Cubana de Medicina Militar. 2023 Dec;52(4). http://scielo.sld.cu/scielo.php?script=sci_abstract&pid=S0138-65572023000400043&lng=es&nrm=iso&tlng=pt

12. Romero Méndez BR. La inteligencia artificial en ayuda a la investigación odontológica. Una revisión bibliográfica-informática. Revista de la Asociación Dental Mexicana. 2024;81(6):321-4. https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=118778

13. Chau RCW, Li GH, Tew IM, Thu KM, McGrath C, Lo WL, et al. Accuracy of Artificial Intelligence-Based Photographic Detection of Gingivitis. International Dental Journal. 2023 Apr 26;73(5):724-30. https://pmc.ncbi.nlm.nih.gov/articles/PMC10509417/

14. López Jiménez AJ. Inteligencia artificial como herramienta de soporte para el razonamiento clínico en odontología. 2024. https://hdl.handle.net/20.500.14330/TES01000865926

15. Gaytan Castillo FV. Inteligencia artificial en odontopediatría : redefiniendo el papel del odontólogo. 2025. https://hdl.handle.net/20.500.14330/TES01000869624

16. Olivos MAD, Águila HMHD, López FMS. Diagnosis of oral cancer using deep learning algorithms. Ingenius. 2024 Oct 7;(32):58-68. https://ingenius.ups.edu.ec/index.php/ingenius/

article/view/7318

17. Olawade DB, Leena N, Egbon E, Rai J, Mohammed APEK, Oladapo BI, et al. AI-Driven Advancements in Orthodontics for Precision and Patient Outcomes. Dentistry Journal. 2025 May;13(5):198. https://www.mdpi.com/2304-6767/13/5/198

18. Kapila S, Vora SR, Venugopalan SR, Elnagar MH, Akyalcin S. Connecting the dots towards precision orthodontics. Available from: https://onlinelibrary.wiley.com/doi/10.1111/ocr.12725

19. Batra P, Tagra H, Katyal S. Artificial Intelligence in Teledentistry. Discoveries (Craiova). 2022;10(3):153. https://pmc.ncbi.nlm.nih.gov/articles/PMC9748636/

20. Arteaga González A. Inteligencia artificial aplicada en periodoncia e implantología. 2024. https://hdl.handle.net/20.500.14330/TES01000866056

21. Nordblom NF, Büttner M, Schwendicke F. Artificial Intelligence in Orthodontics: Critical Review. Journal of Dental Research. 2024 Apr 29. https://journals.sagepub.com/doi/full/10.1177/00220345241235606

22. Huynh KP, Mangui G. From Tradition to Technology: Robotic Artificial Intelligence in Dental Implantology. Cureus. 2024 Nov 9. https://www.cureus.com/articles/310937-from-tradition-to-technology-robotic-artificial-intelligence-in-dental-implantology

23. Tabatabaian F, Vora SR, Mirabbasi S. Applications, functions, and accuracy of artificial intelligence in restorative dentistry: A literature review. Available from: https://onlinelibrary.wiley.com/doi/10.1111/jerd.13079

24. Artificial intelligence applications in restorative dentistry: A systematic review. The Journal of Prosthetic Dentistry. 2022 Nov 1;128(5):867-75. https://www.sciencedirect.com/science/article/abs/pii/S0022391321000871

25. Najeeb M, Islam S. Artificial intelligence (AI) in restorative dentistry: current trends and future prospects. BMC Oral Health. 2025 Apr 18;25(1):592. https://doi.org/10.1186/s12903-025-05989-1

26. Carrillo-Perez F, Pecho OE, Morales JC, Paravina RD, Bona AD, Ghinea R, et al. Applications of artificial intelligence in dentistry: A comprehensive review. Available from: https://onlinelibrary.wiley.com/doi/10.1111/jerd.12844

27. Kunz F, Stellzig-Eisenhauer A, Zeman F, Boldt J. Artificial intelligence in orthodontics. Journal of Orofacial Orthopedics. 2020 Jan 1;81(1):52-68. https://doi.org/10.1007/s00056-019-00203-8

28. Müller A, Mertens SM, Göstemeyer G, Krois J, Schwendicke F. Barriers and Enablers for Artificial Intelligence in Dental Diagnostics: A Qualitative Study. Journal of Clinical Medicine. 2021 Jan;10(8):1612. https://www.mdpi.com/2077-0383/10/8/1612

29. Ivanišević A, Tadin A. Artificial Intelligence and Modern Technology in Dentistry: Attitudes, Knowledge, Use, and Barriers Among Dentists in Croatia—A Survey-Based Study. Clinics and Practice. 2024 Dec;14(6):2623-36. https://www.mdpi.com/2039-7283/14/6/207

30. Monill-González A, Rovira-Calatayud L, d'Oliveira NG, Ustrell-Torrent JM. Artificial intelligence in orthodontics: Where are we now? A scoping review. Available from: https://onlinelibrary.wiley.com/doi/10.1111/ocr.12517

31. Liu TY, Lee KH, Mukundan A, Karmakar R, Dhiman H, Wang HC. AI in Dentistry: Innovations, Ethical Considerations, and Integration Barriers. Bioengineering. 2025 Sep;12(9):928. https://www.mdpi.com/2306-5354/12/9/928

32. Attitude, perception and barriers of dental professionals towards artificial intelligence. Journal of Oral Biology and Craniofacial Research. 2023 Sep 1;13(5):584-8. https://www.sciencedirect.com/science/article/pii/S2212426823000854

33. Hoffman J, Wenke R, Angus RL, Shinners L, Richards B, Hattingh L. Overcoming barriers and enabling artificial intelligence adoption in allied health clinical practice: A qualitative study. DIGITAL HEALTH. 2025 Feb 3. https://journals.sagepub.com/doi/full/10.1177/20552076241311144

34. Hegde S, Nanayakkara S, Jordan A, Jeha O, Patel U, Luu V, et al. Attitudes and Perceptions of Australian Dentists and Dental Students Towards Applications of Artificial Intelligence in Dentistry: A Survey. Available from: https://onlinelibrary.wiley.com/doi/10.1111/eje.13042

35. Ali MA. The Role of Artificial Intelligence in Modern Dentistry: Applications, Challenges, and Future Directions. FDR. 2024 Dec 31;2(2):39-49. https://fdr.nabea.pub/fdr/article/view/14

36. Pedraza MCC, Salazar KJO, Visbal JHW. Impacto de la inteligencia artificial en la odontología: una reflexión. Ustasalud. 2024;23(1). https://revistas.ustabuca.edu.co/index.php/USTASALUD_ODONTOLOGIA/article/view/3142

37. Decision support systems for adoption in dental clinics: A survey. Knowledge-Based Systems. 2016 Jul 15;104:195-206. https://www.sciencedirect.com/science/article/abs/pii/S0950705116300740

38. Allareddy V, Oubaidin M, Rampa S, Venugopalan SR, Elnagar MH, Yadav S, et al. Call for algorithmic fairness to mitigate amplification of racial biases in artificial intelligence models used in orthodontics and craniofacial health. Available from: https://onlinelibrary.wiley.com/doi/10.1111/ocr.12721

39. Panch T, Mattie H, Atun R. Artificial intelligence and algorithmic bias: implications for health systems. Journal of Global Health. 2019;9(2):020318. https://pmc.ncbi.nlm.nih.gov/articles/PMC6875681/

40. Alfaraj A, Nagai T, AlQallaf H, Lin WS. Race to the Moon or the Bottom? Applications, Performance, and Ethical Considerations of Artificial Intelligence in Prosthodontics and Implant Dentistry. Dentistry Journal. 2025 Jan;13(1):13. https://www.mdpi.com/2304-6767/13/1/13

41. Roganović J, Radenković M, Miličić B. Responsible Use of Artificial Intelligence in Dentistry: Survey on Dentists' and Final-Year Undergraduates' Perspectives. Healthcare. 2023 Jan;11(10):1480. https://www.mdpi.com/2227-9032/11/10/1480

42. Eaton KA. The development of digital dentistry in the UK: An overview. Primary Dental

Journal. 2022 Dec 19. https://journals.sagepub.com/doi/full/10.1177/20501684221134198

43. Schnitzler C, Bohnet-Joschko S. Digital transformation in dentistry: A survey on trends and business implications. Heliyon. 2025 Jun 1;11(11). https://www.cell.com/heliyon/abstract/S2405-8440(25)01842-0

44. de Ahumada Servant P, Martín-Martín D, Romero I. Digital Transformation of Oral Health Care: Measuring the Digitalization of Dental Clinics. Social Indicators Research. 2025 Jul 1;178(3):1145-67. https://doi.org/10.1007/s11205-024-03366-z

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