ODOVTOS
International Journal of Dental Sciences

UNIVERSIDAD DE COSTA RICA FOd Facultad de Odontología

https://revistas.ucr.ac.cr/index.php/Odontos

LITERATURE REVIEW:

Artificial Intelligence in Endodontic Diagnosis and Treatment: A Bibliometric and Science-Mapping Analysis

Inteligencia artificial en el diagnóstico y tratamiento endodóntico: análisis bibliométrico y de mapeo científico

María Mihaela Iuga[1] https://orcid.org/0000-0002-1168-428X
Tatiana Ramírez-Mora[2] https://orcid.org/0000-0002-1837-0590
Fernando Mauricio Espada Salgado[3] https://orcid.org/0000-0002-9655-6593

[1]Faculty of Health Sciences, Jorge Basadre Grohmann National University, Tacna, Peru.
[2]Restorative Department, Faculty of Dentistry, University of Costa Rica, San José, Costa Rica.
[3]Faculty of Health Sciences, Private University of Tacna, Tacna, Peru.

Correspondence to: Fernando Mauricio Espada Salgado - ferespada@virtual.upt.pe

Received: 24-II-2026 Accepted: 18-III-2026

ABSTRACT: This study aimed to map global research trends, intellectual structure, and emerging themes in artificial intelligence (AI) applications for endodontic diagnosis and treatment using bibliometric and science-mapping approaches. A comprehensive search of the Web of Science Core Collection was performed on July 20, 2025, without time restrictions. Records were independently screened by two reviewers according to predefined inclusion and exclusion criteria. Bibliometric data were analyzed using Microsoft Excel, RStudio (bibliometrix package), VOSviewer, and CiteSpace. Indicators assessed included annual scientific production, citation impact, leading journals and countries, collaboration networks, keyword co-occurrence, co-citation clusters, and citation bursts. Of the 121 records identified, 72 articles met the inclusion criteria. Scientific production increased markedly after 2022, with more than half of the publications appearing during 2024-2025. The Journal of Dentistry and the Journal of Endodontics demonstrated the highest citation impact. China, the United States, Germany, India, and Turkey were the most productive countries, with China leading in total citations. Four principal thematic clusters were identified, including review-based evidence synthesis, methodological workflows, convolutional neural network–based imaging applications, and future research perspectives. Citation burst analysis revealed emerging interest in segmentation techniques, cone-beam computed tomography–based diagnosis, and deep learning applications. Research on AI applications in endodontics has expanded rapidly, with a strong focus on imaging-driven diagnostic and clinical applications. Future research should emphasize multicenter validation, standardized methodological frameworks, and ethical integration into clinical practice.

KEYWORDS: Artificial intelligence; Bibliometrics; Cone-Beam computed tomography; Deep learning; Endodontic.

RESUMEN: Este estudio tuvo como objetivo mapear las tendencias globales de investigación, la estructura intelectual y los temas emergentes en las aplicaciones de la inteligencia artificial (IA) en el diagnóstico y tratamiento endodóntico, mediante enfoques bibliométricos y de mapeo científico. Se realizó una búsqueda exhaustiva en la base de datos Web of Science Core Collection el 20 de julio de 2025, sin restricciones temporales. Los registros fueron evaluados de manera independiente por dos revisores de acuerdo con criterios de inclusión y exclusión. Los datos bibliométricos se analizaron con Microsoft Excel, RStudio (paquete bibliometrix), VOSviewer y CiteSpace. Los indicadores evaluados incluyeron la producción científica anual, el impacto de citación, las principales revistas y países, las redes de colaboración, la coocurrencia de palabras clave, los clústeres de co-citación y los picos de citación. De los 121 registros identificados, 72 artículos cumplieron con los criterios de inclusión. La producción científica aumentó notablemente después de 2022, con más de la mitad de las publicaciones apareciendo durante el período 2024-2025. Journal of Dentistry y Journal of Endodontics mostraron el mayor impacto de citación. China, Estados Unidos, Alemania, India y Turquía fueron los países más productivos. Se identificaron cuatro clústeres temáticos principales, que incluyeron síntesis de evidencia basada en revisiones, flujos de trabajo metodológicos, aplicaciones de imágenes basadas en redes neuronales convolucionales y perspectivas futuras de investigación. El análisis de picos de citación reveló un interés emergente en técnicas de segmentación, diagnóstico basado en CBCT y aplicaciones de aprendizaje profundo. La investigación sobre el uso de IA en endodoncia ha experimentado un rápido crecimiento, con un fuerte enfoque en aplicaciones diagnósticas y clínicas basadas en imágenes. Las futuras investigaciones deberían enfatizar la validación multicéntrica, el desarrollo de marcos metodológicos estandarizados y la integración ética en la práctica clínica.

PALABRAS CLAVE: Inteligencia artificial; Bibliometría; Tomografía computarizada de haz cónico; Aprendizaje profundo; Endodoncia.

INTRODUCTION

Artificial intelligence (AI) has emerged as a transformative technology across medical and dental disciplines, offering new opportunities to enhance diagnostic accuracy, optimize treatment planning, and improve patient care outcomes. In dentistry, AI-driven systems are increasingly used to support clinical decision-making, automate image interpretation, and standardize diagnostic workflows. Within endodontics, where clinical judgments rely heavily on complex radiographic interpretation and integration of heterogeneous data, AI is particularly well-suited to augment clinician performance and accelerate research translation (1).

Early proof-of-concept investigations and subsequent systematic reviews have demonstrated that convolutional neural networks (CNNs) and other deep learning (DL) architectures can match or even exceed human performance in several image-centric tasks relevant to endodontic practice (2). These advances have positioned AI as a powerful tool for improving diagnostic reliability and reducing interobserver variability.

Across the endodontic workflow, AI applications have been explored for detecting periapical lesions on panoramic radiographs and cone-beam computed tomography (CBCT) images, identifying vertical root fractures, estimating working length, characterizing root canal anatomy, predicting

post-operative pain, and forecasting treatment outcomes (3). Collectively, these studies demonstrate the versatility of AI techniques, including machine learning (ML), deep learning, computer vision, convolutional neural networks, and support vector machines, in addressing diverse diagnostic and prognostic challenges in endodontics (4,5).

Driven by these promising clinical and technical findings, research output on AI in endodontics has expanded rapidly in both volume and methodological sophistication. As the field grows, there is an increasing need for structured, quantitative approaches to evaluate research productivity, collaboration patterns, thematic evolution, and scientific impact. Bibliometric analysis has therefore gained prominence in medical and dental research as a rigorous and reproducible method for mapping scientific knowledge, identifying influential contributors, and uncovering emerging research trends. Existing bibliometric studies in dentistry have predominantly addressed broader dental domains or imaging-focused specialties, with limited emphasis on endodontics and minimal focus on AI-specific applications (6).

Although bibliometric methods have been applied to various endodontic topics (7), including regenerative endodontics, endodontic-periodontal lesions, Biodentine, and the GentleWave System, no study to date has systematically and quantitatively evaluated the literature specifically related to AI in endodontics. This gap limits the ability to contextualize current research efforts and identify strategic directions for future investigation. By utilizing tools such as RStudio Bibliometrix, VOSviewer, and CiteSpace, bibliometric analysis enables the construction of visual and quantitative maps that reveal relationships among authors, institutions, keywords, and cited references (8). These analyses provide insight into the intellectual structure and temporal development of a research field while highlighting influential journals, geographic contributions, and thematic clusters. Consequently, bibliometric approaches play a critical role in tracking research evolution and informing evidence-based research planning.

Given the accelerating growth of AI-related research in endodontics and the absence of a dedicated bibliometric synthesis, a comprehensive and up-to-date quantitative assessment is warranted. This study addresses this gap by conducting a bibliometric analysis of global research output on AI in endodontic diagnosis and treatment using the Web of Science Core Collection (WoSCC). By systematically examining publication trends, authorship and institutional collaborations, thematic clusters, and citation impact, this analysis aims to elucidate the intellectual landscape, evolving research hotspots, and future directions of AI-driven endodontic research. The findings are intended to guide researchers, clinicians, and policymakers and to support the evidence-based integration of AI technologies into endodontic practice.

MATERIALS AND METHODS

STUDY DESIGN

The study was designed as a descriptive, retrospective bibliometric analysis of scientific publications addressing the application of AI in endodontic diagnosis and treatment. The methodology followed the bibliometric research guidelines proposed by Donthu *et al*. (9) and adhered to recommended reporting standards for bibliometric studies in dental research.

DATA SOURCE AND SEARCH STRATEGY

The WoSCC was selected as the sole data source due to its standardized indexing, high-quality citation data, and widespread use in bibliometric and scientometric analyses. WoSCC ensures consistency in citation tracking and metadata structure, which is essential for co-citation, collaboration, and temporal analyses.

Although databases such as Scopus and PubMed provide broader coverage, they were excluded to avoid data duplication, inconsistencies in citation metrics, and challenges in harmonizing records across platforms.

The search was conducted on 20 July 2025 using the following Boolean query applied to the Topic field (title, abstract, and keywords): ("artificial intelligence" OR "machine learning" OR "deep learning" OR "computer vision" OR "knowledge representation") AND ("endodontics" OR "root canal therapy" OR "tooth diseases"). No time restrictions were applied to ensure a longitudinal assessment of research trends. A total of 121 records were retrieved.

STUDY SELECTION

Two independent reviewers screened titles and abstracts to identify studies meeting the inclusion criteria: (i) original research or review articles applying AI techniques, including machine learning and deep learning, to endodontic diagnosis or treatment; (ii) peer-reviewed publications in English; (iii) full-text availability. Editorials, letters, conference abstracts, studies without direct AI application, and duplicate records were excluded. Disagreements during screening were resolved through discussion. After full-text assessment, 72 articles met the eligibility criteria and were included in the final analysis. Inter-rater agreement between the two reviewers was assessed using Cohen's kappa coefficient, which demonstrated substantial agreement.

DATA EXTRACTION AND CLEANING

Full bibliographic records of the included studies were exported from WoSCC in CSV format. Extracted variables included title, authors, affiliations, country of origin, year of publication, journal, citation count, author keywords, and Keywords Plus. Additionally, study type (original research, review, or proof-of-concept) and AI technique employed were recorded. Data cleaning was performed prior to analysis to ensure consistency and accuracy. Author name variations and institutional name inconsistencies were manually standardized. Keyword unification was conducted by merging synonyms and closely related terms (e.g., "deep learning" and "DL"; "cone-beam computed tomography" and "CBCT") to improve the reliability of keyword co-occurrence and thematic analyses.

BIBLIOMETRIC AND NETWORK ANALYSIS

Descriptive analyses of annual publication output and citation trends were conducted using Microsoft Excel (Office 365). Advanced bibliometric analyses were performed using RStudio (version 2023.03.0) with the bibliometrix R package (version 4.2.1), enabling assessment of author productivity, collaboration networks, thematic evolution, and citation impact.

Visualization and network analyses were conducted using VOSviewer (version 1.6.19) and CiteSpace (version 6.1.R3). In VOSviewer, co-authorship, institutional, country, and keyword co-occurrence networks were generated using a minimum occurrence threshold of five for keywords and authors to ensure network clarity and interpretability. CiteSpace was employed for co-citation analysis, citation burst detection, and timeline visualization using yearly time slicing, cosine link strength, and pathfinder pruning. Cluster robustness was evaluated using modularity (Q) and silhouette (S) values. Key bibliometric indicators, including prolific authors, leading journals, country contributions, citation impact, keyword clusters, and emerging research fronts, were systematically reported.

RESULTS

STUDY SELECTION

The literature search followed a structured study selection process consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. A search of the WoSCC using predefined artificial intelligence- and endodontics-related terms identified 121 records Figure 1. No duplicate records were found. Following title and abstract screening, 49 records were excluded. The remaining 72 reports were retrieved in full, assessed for eligibility, and included in the final quantitative bibliometric synthesis.

ANNUAL SCIENTIFIC PRODUCTION

Annual publication output remained limited between 2019 and 2021, with two publications in 2019, none in 2020, and three in 2021. A marked increase was observed from 2022 onward, with 13 publications in 2022, seven in 2023, 20 in 2024, and 27 in 2025. Collectively, publications from 2024 and 2025 accounted for 47 of the 72 included studies (65.3%), indicating a rapid acceleration of research activity in recent years Figure 2.

JOURNAL PRODUCTIVITY AND CITATION IMPACT

The 72 included articles were distributed across 28 peer-reviewed journals. International Endodontic Journal published the highest number of articles (n=10), followed by the Journal of Dentistry (n=9), Journal of Endodontics (n=7), Diagnostics (n=6), and BMC Oral Health (n=4) Figure 3.A. Original research articles constituted approximately three-quarters of the total output. In terms of citation impact, the Journal of Dentistry (445 citations) and the Journal of Endodontics (415 citations) ranked highest, followed by the International Endodontic Journal (233 citations) and Diagnostics (169 citations). Notably, journals with fewer publications, including Cureus: Journal of Medical Science and Acta Anatomica Sinica, contributed highly cited individual articles, highlighting that citation influence was not confined to high-volume journals Figure 3.B, Table 1.

AUTHORSHIP PATTERNS AND CITATION INFLUENCE

A total of 259 authors contributed to the analyzed corpus. Mohammad-Rahimi H. was the most prolific author with six publications, followed by Nosrat A. and Aminoshariae A., each with five publications. Several other authors, including Dianat O., Dummer P.M.H., Fontenele R.C., Jacobs R., Nagendrababu V., and Setzer F.C., contributed four publications each, whereas Ourang S.A. contributed three (Figure 4). Author-level citation analysis identified Falk Schwendicke as the most influential author, with 475 citations. Tatiana Golla, Joachim Krois, and Martin Dreher followed, each with 257 citations Figure 5, Table 2.

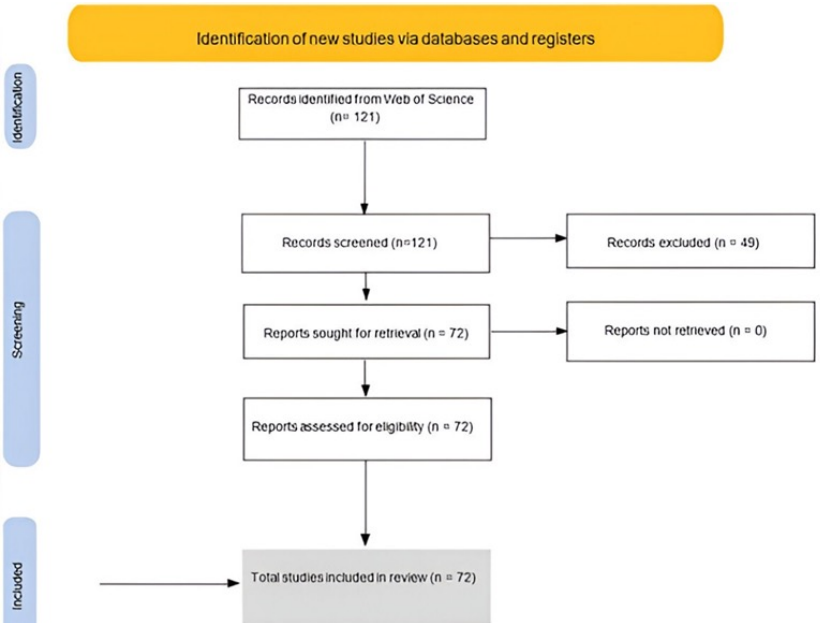

Figure 1. PRISMA 2020 flow diagram of study selection.

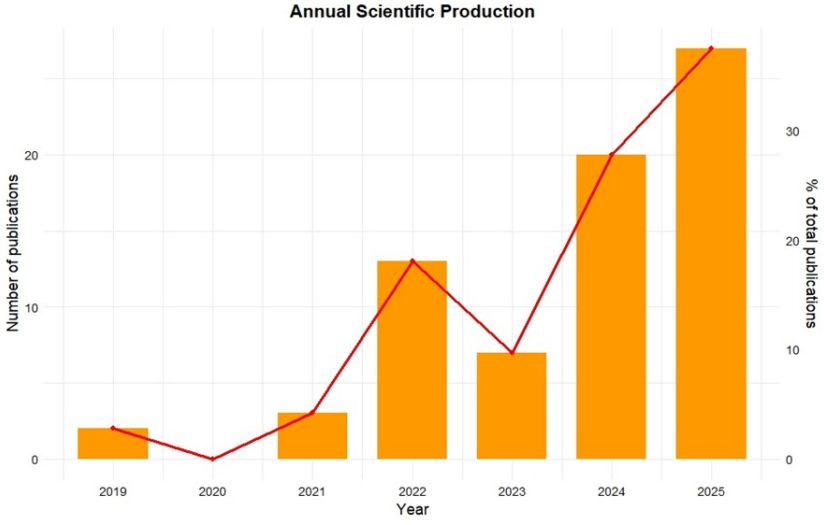

Figure 2. Annual publication trend from 2019 to 2025. Bars represent the absolute number of publications, and the red line indicates the percentage share of total publications.

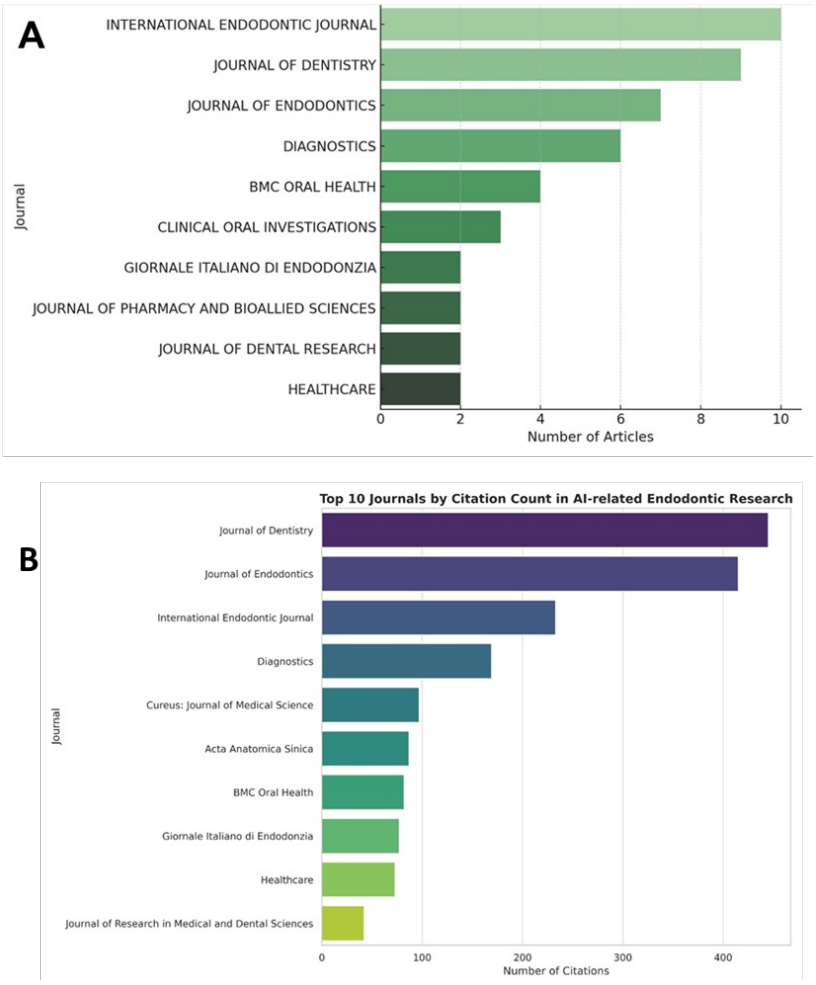

Figure 3. Journal productivity and citation impact in AI-related endodontic research. A) Top 10 journals by number of published articles. B) Top 10 journals ranked by total citation count. International Endodontic Journal led in productivity, whereas Journal of Dentistry led in citation impact.

Table 1. Leading journals publishing on artificial intelligence in endodontics and their citation metrics.

Journal	Journal Impact Factor	Journal Citation Indicator	Number of studies	Number of citations
Journal of Dentistry	4.4	1.530	9	445
Journal of Endodontics	3.6	1.229	8	415
International Endodontic Journal	7.1	2.335	9	233
Diagnostics	3.3	0.773	6	169
Cureus: Journal of Medical Science	1.3	0.270	1	97
Acta Anatomica Sinica	–	0.124	1	87
BMC Oral Health	3.1	0.843	4	82
Giornale Italiano di Endodonzia	0.8	0.201	2	77
Healthcare	2.7	0.754	2	73
Journal of Research in Medical and Dental Sciences	–	0.103	1	42

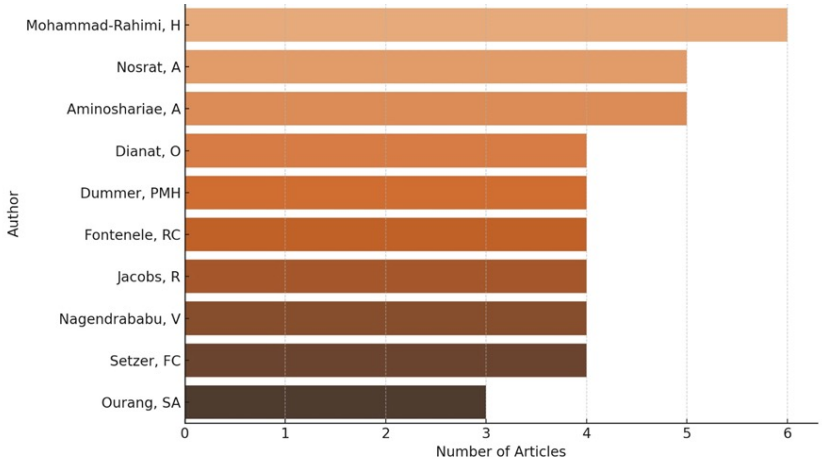

Figure 4. Top 10 most prolific authors in AI-related endodontic research, ranked by number of published articles.

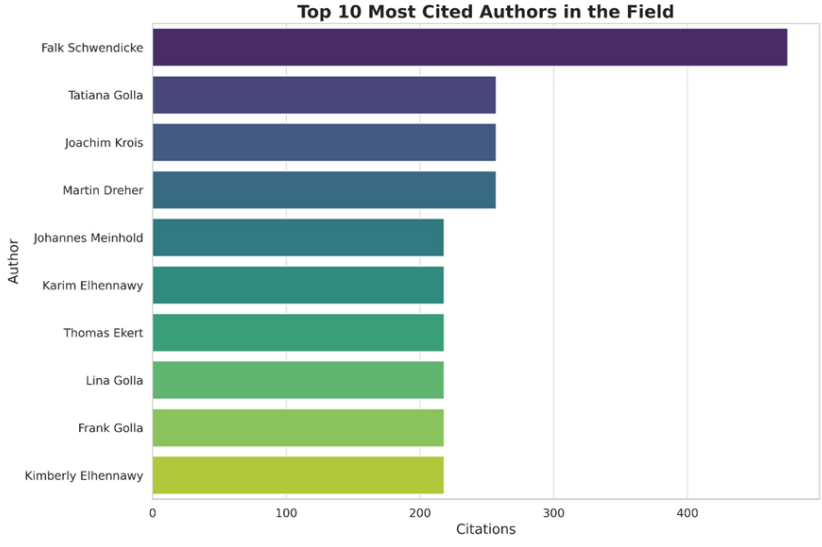

Figure 5. Top 10 most cited authors in AI-related endodontic research, ranked by total citation count.

Table 2. Authors with the highest number of publications and total citations.

Author	Number of studies	Citations
Falk Schwendicke	2	475
Tatiana Golla	1	257
Joachim Krois	1	257
Martin Dreher	1	257
Johannes Meinhold	1	218
Karim Elhennawy	1	218
Thomas Ekert	1	218
Lina Golla	1	218
Frank Golla	1	218
Kimberly Elhennawy	1	218

COUNTRY CONTRIBUTIONS AND INTERNATIONAL COLLABORATION

The United States ranked first in publication output (12 studies), followed by China and India (11 studies each), and Turkey (9 studies). Other contributing countries included Saudi Arabia, Germany, the United Arab Emirates, and the United Kingdom, each contributing two to five studies Figure 6.A. A density visualization highlighted the concentration of country-level research activity around the United States, China, Germany, and the United Kingdom Figure 6.B. Citation-based analysis identified China as the most influential country, with more than 400 citations, followed by Germany and the United States, each exceeding 300 citations (Figure 7.A). Country collaboration network analysis showed that the United States acted as a major collaboration hub, with notable links to China, while Germany and the United Kingdom appeared as secondary bridging nodes connecting different country clusters Figure 7.B.

KEYWORD CO-OCCURRENCE AND THEMATIC STRUCTURE

VOSviewer keyword co-occurrence analysis identified artificial intelligence as the dominant central term connecting the main thematic areas of the field Figure 8. One major thematic area focused on imaging-based diagnosis and included terms such as deep learning, convolutional neural network, radiography, and cone-beam computed tomography. A second thematic area emphasized working-length estimation and root canal-related applications, including terms such as working length, root canal filling, and CBCT. A smaller emerging area was associated with educational and digital-assistance applications, including chatbot, 3D guided software, and dental education.

CiteSpace clustering analysis identified four major thematic clusters, labeled comprehensive overview, fundamental principles workflow, using convolutional neural network, and future perspective, suggesting the intellectual development and thematic diversification of the field Figure 9.

TEMPORAL EVOLUTION OF RESEARCH THEMES

CiteSpace temporal keyword mapping showed that early research activity between 2019 and 2020 was primarily centered on CNN-based radiographic diagnosis and conventional artificial intelligence approaches Figure 10. From 2021 onward, the emergence of terms such as segmentation, apical foramen, and 3D reconstruction suggested increasing methodological sophistication. In the most recent period (2024-2025), newer terms such as large language models, workflow automation, and dental education became more prominent, indicating a thematic expansion beyond imaging-centered applications toward broader clinical and educational use cases.

RELATIONSHIPS BETWEEN JOURNAL METRICS

Correlation analysis revealed positive relationships between journal impact metrics and research output. The number of publications was strongly correlated with Journal Impact Factor ($r=0.84$) and Journal Citation Indicator ($r=0.91$), and also with total citations ($r=0.87$). Journal Impact Factor and Journal Citation Indicator were themselves highly correlated ($r=0.98$). The association between Journal Impact Factor and citation count was moderate ($r=0.52$), whereas Journal Citation Indicator showed a stronger correlation with citations ($r=0.68$), indicating that highly cited studies were not exclusively concentrated in journals with the highest impact factor values Figure 11.

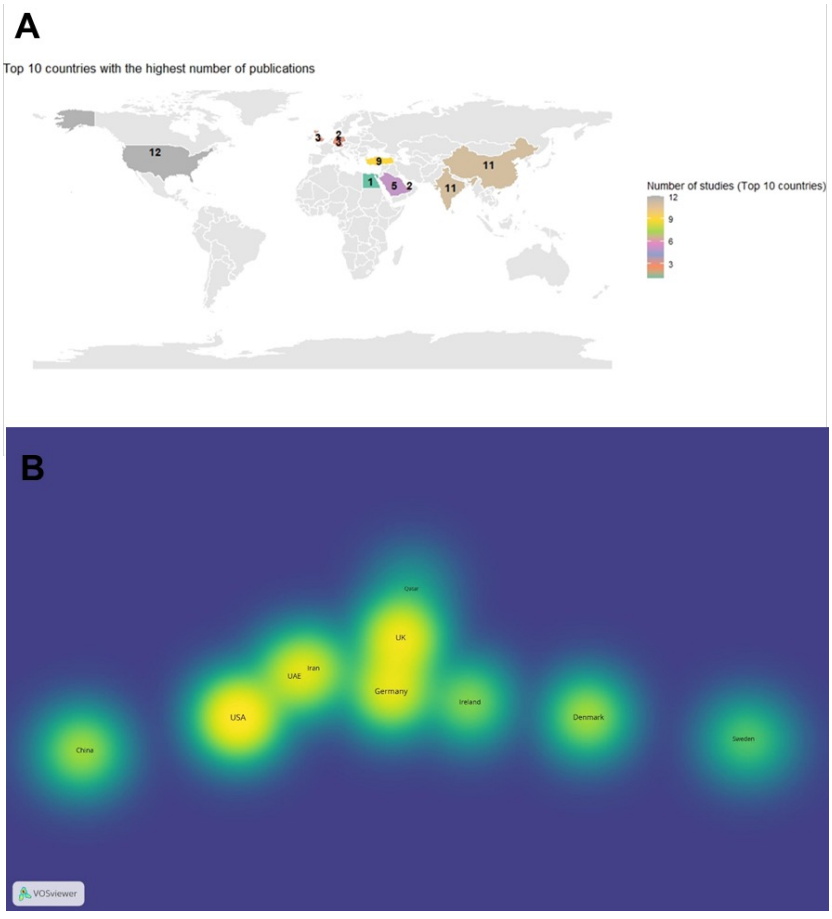

Figure 6. Global distribution of AI-related endodontic research by country. A) Top 10 contributing countries by number of publications. B) Density visualization showing the concentration of country-level research activity.

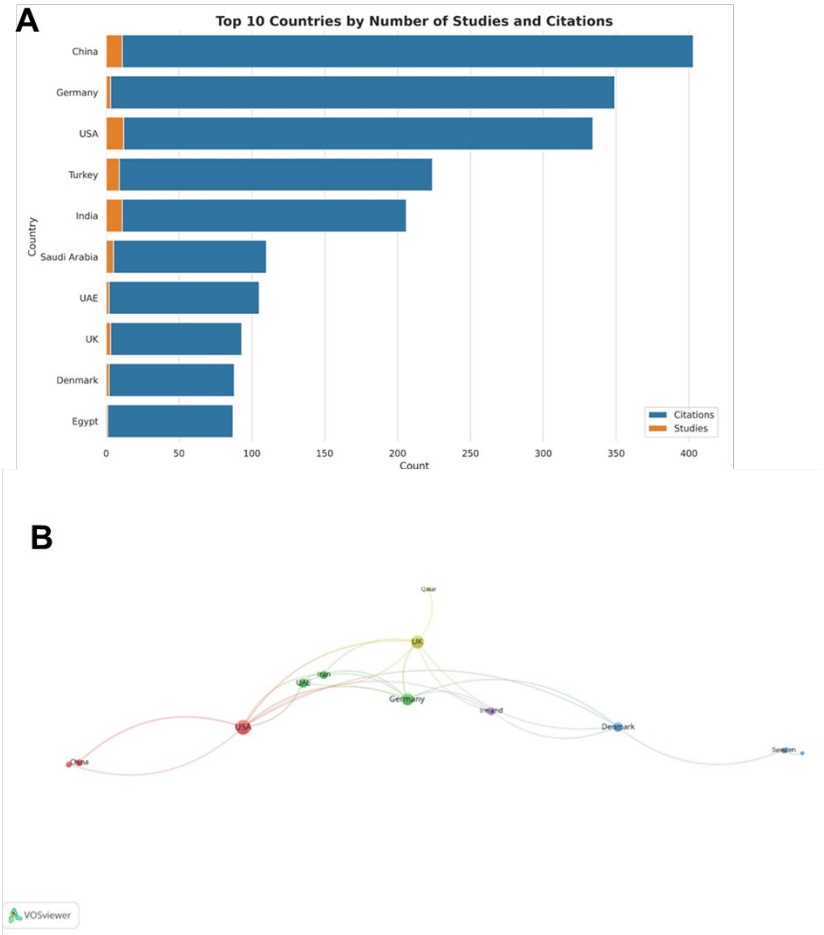

Figure 7. Citation impact and collaboration patterns of leading countries in AI-related endodontic research. A) Top 10 countries ranked by total citations, with the number of studies shown for reference. B) VOSviewer network map of collaboration among leading countries.

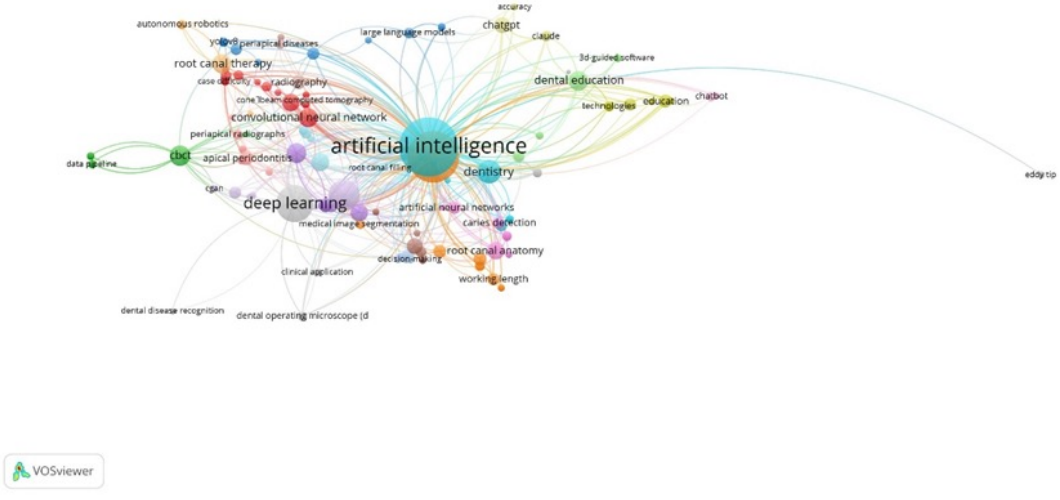

Figure 8. Term co-occurrence network and thematic clusters in the field of artificial intelligence and endodontics.

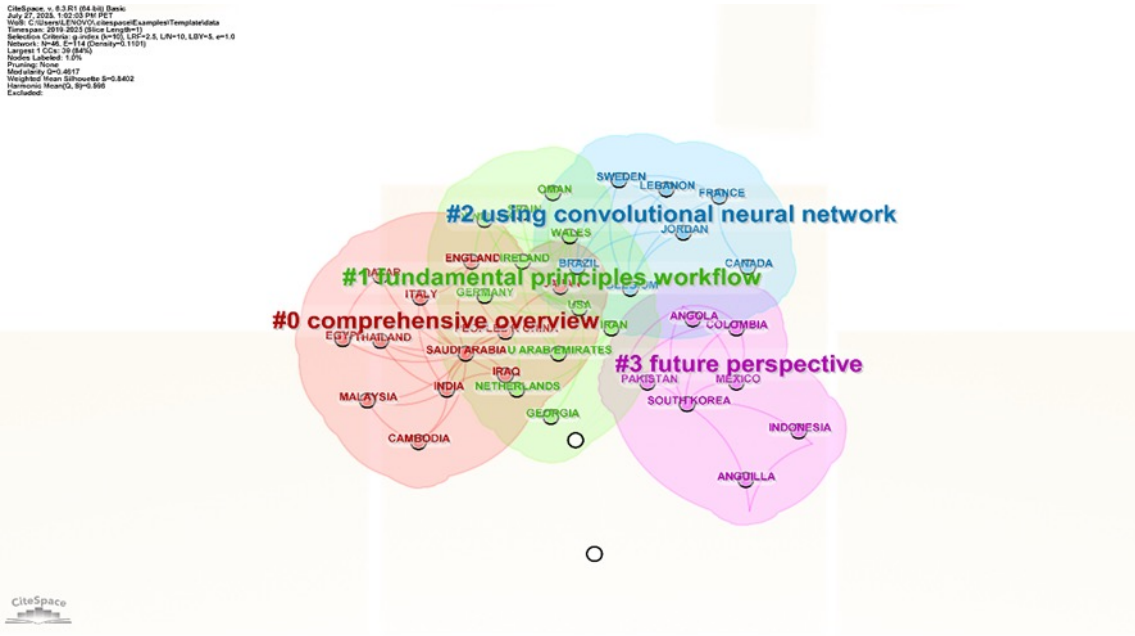

Figure 9. CiteSpace clustering map showing the main thematic clusters in AI-related endodontic research.

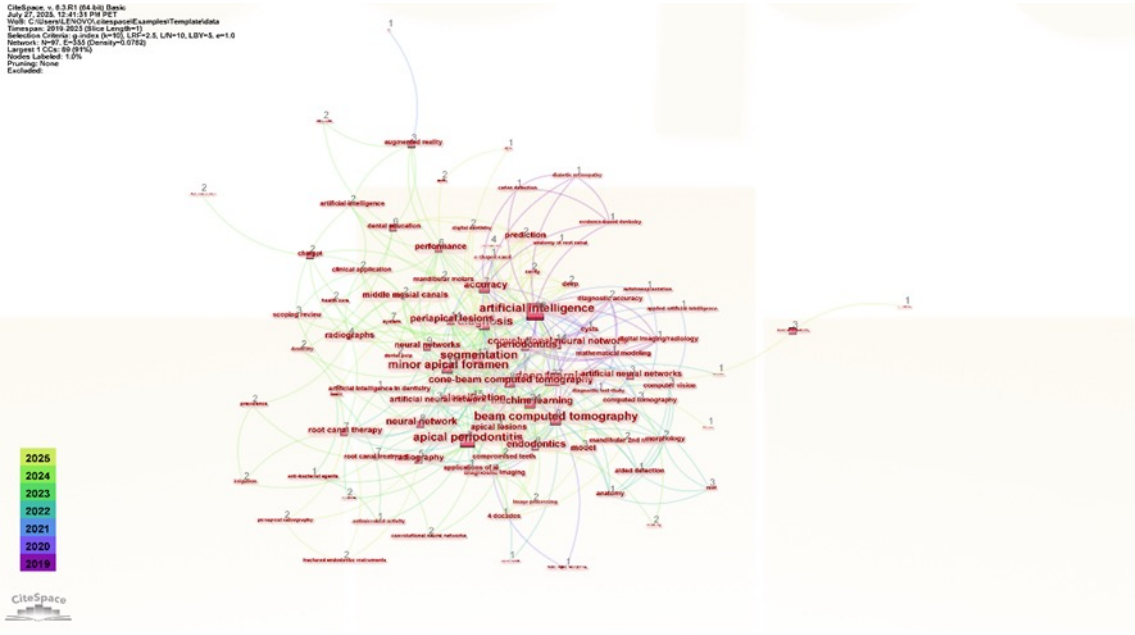

Figure 10. Temporal overlay map of keyword co-occurrence in AI-related endodontic research (2019-2025).

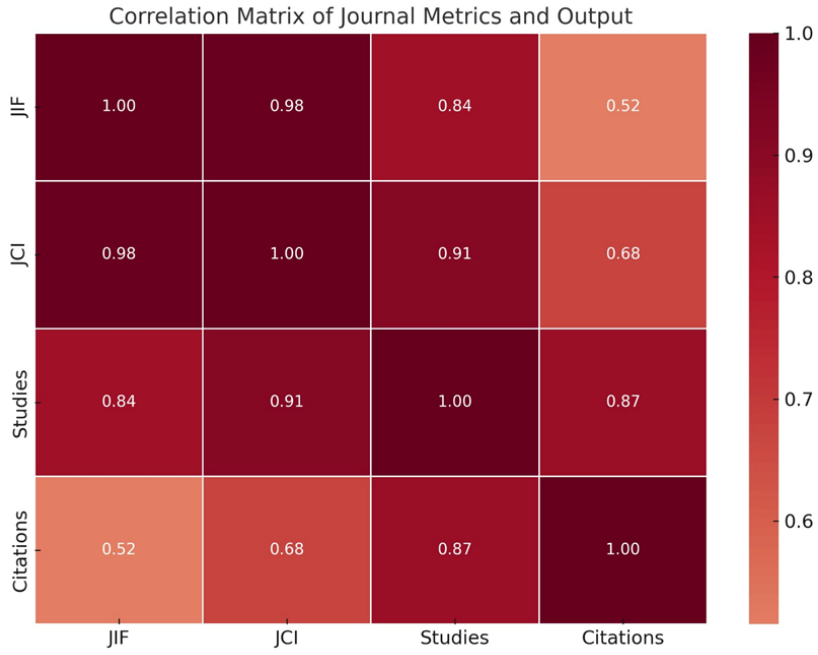

Figure 11. Correlation matrix of journal-level metrics and research output, including Journal Impact Factor, Journal Citation Indicator, number of studies, and total citations. Darker red indicates stronger positive correlations.

DISCUSSION

The present bibliometric analysis provides a comprehensive and up-to-date synthesis of global research on artificial intelligence (AI) applications in endodontic diagnosis and treatment. By analysing publications indexed in the WoSCC using established bibliometric tools, this study elucidates the intellectual structure, thematic evolution, and collaborative patterns that have shaped this rapidly developing field.

The sharp rise in publications since 2019 reflects the broader acceleration of AI research across dentistry and endodontics (6, 10). However, beyond simple growth, the bibliometric patterns observed in this study suggest that AI research in endodontics remains at an early translational stage, characterised predominantly by exploratory and proof-of-concept investigations (11). Deep learning approaches, particularly convolutional neural networks (CNNs), emerged as the dominant methodological paradigm, underscoring their capacity to automatically extract complex diagnostic features from radiographic data (12). This dominance mirrors trends reported in broader dental and medical AI literature, where CNN-based image analysis has become the primary driver of innovation (13).

The thematic focus of the literature is strongly centred on image-based diagnostic tasks, including periapical lesion detection, vertical root fracture identification, and working length estimation using panoramic radiographs and CBCT (14,15,16,17). This concentration reflects both the availability of imaging data and the technical suitability of CNNs for such applications. Systematic reviews in endodontics similarly report that CBCT-driven deep learning models form the backbone of current AI research in this specialty (13). Nevertheless, the relative scarcity of studies incorporating non-imaging clinical variables highlights a significant knowledge gap, as real-world endodontic decision-making is inherently multimodal and context dependent.

Geographically, research output was concentrated within a limited number of countries. The United States, China, and India produced the highest number of publications, while authors affiliated with German institutions achieved the greatest citation impact per article. This imbalance suggests that scientific influence in AI-driven endodontic research is shaped by a small number of highly productive research hubs. Comparable patterns have been reported in previous bibliometric studies of dental AI, where knowledge production tends to be geographically clustered with limited international collaboration (6). Such concentration may accelerate methodological development locally but risks slowing global standardisation and external validation of AI models.

Journal and authorship analyses further reinforce this observation. A small group of journals, notably the Journal of Endodontics, Journal of Dentistry, and International Endodontic Journal, accounted for a disproportionate share of publications and citations. Similarly, a limited number of authors contributed repeatedly and attracted high citation counts, indicating the presence of influential research clusters. While this concentration can foster expertise and continuity, it also underscores the need for broader participation and cross-institutional collaboration to improve generalisability and reproducibility.

From a clinical performance perspective, reported outcomes were promising but heterogeneous. CNN-based models for periapical lesion detection achieved high mean average precision and F1 scores, often approaching or exceeding expert clinician performance (12). Transfer learning models for vertical root fracture detection reported accuracies of approximately 80 percent (18). Despite these encouraging results, most studies relied on small, homogeneous datasets and retrospective designs, with limited external or prospective validation. Consequently, the reported performance metrics may overestimate real-world effectiveness.

The predominance of retrospective and proof-of-concept studies highlights a critical gap between technical feasibility and clinical applicability. Few investigations assessed model robustness across diverse populations, imaging devices, or clinical settings, and none evaluated long-term clinical outcomes. Moreover, issues of transparency and explainability were largely unaddressed, despite their importance for clinician trust and regulatory approval. As CNN-based systems increasingly influence diagnostic decisions, the lack of interpretable outputs and explainable decision pathways represents a substantial barrier to adoption.

Keyword and co-citation analyses revealed both persistent and emerging research themes, including automated radiographic interpretation, CNN integration into clinical workflows, and educational applications of AI. These trends parallel developments in the wider medical AI literature, where diagnostic support systems remain the primary focus (19). Importantly, the evolution from traditional machine learning to more complex deep learning architectures reflects increasing methodological sophistication and data availability. At the same time, emerging keywords related to education and workflow automation suggest a gradual expansion beyond purely diagnostic tasks.

Compared with prior bibliometric studies in dentistry, which often focused on general imaging or digital dentistry trends, this analysis provides a focused and quantitative synthesis of AI research specifically within endodontics. The combined use of VOSviewer and CiteSpace enabled detailed mapping of collaboration networks, thematic clusters, and citation dynamics, consistent with best practices in bibliometric research (20, 21,22). This approach offers a more nuanced understan-

ding of how research priorities have evolved and where future efforts may be most impactful.

Ethical, regulatory, and data governance considerations remain underrepresented in the current literature. Most studies did not address algorithmic bias, data representativeness, or fairness, despite the reliance on datasets that may not reflect diverse patient populations. Regulatory pathways for clinical deployment were rarely discussed, and issues related to accountability, informed consent, and data privacy received minimal attention. As AI systems transition from experimental tools to clinical decision aids, adherence to ethical principles, transparent reporting standards, and regulatory frameworks will be essential (23).

This bibliometric analysis also has implications for research quality. The emphasis on technical performance metrics often overshadowed critical appraisal of study design, dataset quality, and risk of bias. Strengthening methodological rigour through prospective validation, multicentre collaboration, and standardized reporting will be crucial to ensure that future AI applications are clinically meaningful and safe.

Several limitations should be acknowledged. Restricting the analysis to the WoSCC may have excluded relevant studies indexed in Scopus or PubMed, and no sensitivity analysis comparing databases was performed. The inclusion of only English-language publications introduces potential language bias. Citation-based metrics may favour older publications and be influenced by self-citation. Additionally, overlap between Keywords Plus and author-provided keywords may affect thematic interpretation, and visual cluster labelling involves a degree of subjectivity despite quantitative validation measures. Finally, as AI research in endodontics is rapidly evolving, publication counts for 2025 may be incomplete due to indexing delays and should be interpreted with caution (24).

Future research should integrate multiple bibliographic databases, incorporate altmetric indicators, and prioritise high-quality clinical validation studies. Particular emphasis should be placed on multimodal datasets, explainable AI frameworks, and ethical governance models tailored to endodontic practice. Addressing these gaps will be critical for translating AI innovations into safe, effective, and widely accepted clinical tools.

CONCLUSIONS

This bibliometric analysis of 72 publications delineates the global research landscape of AI in endodontic diagnosis and treatment. Four major thematic clusters were identified, with research output led by the United States, China, and India, and the Journal of Endodontics, Journal of Dentistry, and International Endodontic Journal emerging as the most influential journals. Current research is largely centred on deep learning–based imaging applications, particularly periapical lesion detection, fracture identification, and working length estimation. Emerging hotspots include three-dimensional image reconstruction, workflow automation, and large language model–based educational and clinical support tools, although clinical validation remains limited. Future investigations should emphasise multicentre validation, multimodal data integration, and transparent AI frameworks to strengthen translational relevance and support evidence-based adoption in endodontic practice.

FUNDING: None

CONFLICTS OF INTEREST: The authors declare no potential conflicts of interest regarding this article's authorship and/or publication.

AUTHOR CONTRIBUTION STATEMENT: Conceptualization and Design, M.M.I. and F.M.E.S.; Literature Review, M.M.I. and F.M.E.S.; Methodology and Validation, M.M.I., F.M.E.S., and T.R.M.; Formal Analysis, M.M.I. and F.M.E.S.; Investigation and Data Collection, M.M.I. and F.M.E.S.; Resources, M.M.I. and F.M.E.S.; Data Analysis and Interpretation, M.M.I., F.M.E.S., and T.R.M.; Writing – Original Draft Preparation, M.M.I. and F.M.E.S.; Writing – Review & Editing, T.R.M., M.M.I., and F.M.E.S.; Supervision, M.M.I.; Project Administration, M.M.I. F.M.E.S. and T.R.M.

REFERENCES

1. Marwaha J. Artificial intelligence in conservative dentistry and endodontics: A game-changer. J Conserv Dent Endod 2023; 26: 514.
2. Marwaha J., Singla M., Nath A., Arya A. Revolutionizing the diagnosis of dental caries using artificial intelligence-based methods. J Conserv Dent Endod 2025; 28: 401.
3. Asgary S. Artificial Intelligence in Endodontics: A Scoping Review. Iran Endod J 2024; 19: 85-98.
4. Keina Kun, Nathaly Adriana Gonzalez, Gianella Malla . Artificial Intelligence in The Diagnosis, Treatment, and Prognostication in Endodontics: A Comprehensive Literature Review. Eur Endod J 2025; 10: 466-478.
5. Boy A.F., Akhyar A., Arif T.Y., Syahrial S. Artificial intelligence for dental caries detection: A mixup, fine-tuning, and quantization approach on the MobileNetV2 model. J Conserv Dent Endod 2025; 28: 764.
6. Xie B., Xu D., Zou X.Q., Lu M.J., Peng X.L., Wen X.J. Artificial intelligence in dentistry: A bibliometric analysis from 2000 to 2023. J Dent Sci 2024; 19: 1722-33.
7. Alfadley A., Alfouzan K., Arun Gopinathan P., Ul Haq I., Ahmed Alrumi F., Ali Alahmari H., et al. Mapping of Global Research in Endodontics From 2004 to 2023: A Bibliometric Analysis. Cureus 2024; 16: 75694.
8. Kemeç A., Altınay A.T. Sustainable Energy Research Trend: A Bibliometric Analysis Using VOSviewer, RStudio Bibliometrix, and CiteSpace Software Tools. Sustainability 2023; 15: 3618.
9. Donthu N., Kumar S., Mukherjee D., Pandey N., Lim W.M. How to conduct a bibliometric analysis: An overview and guidelines. J Bus Res 2021; 133: 285-96.
10. Karobari M.I., Adil A.H., Basheer S.N., Murugesan S., Savadamoorthi K.S., Mustafa M., et al. Evaluation of the Diagnostic and Prognostic Accuracy of Artificial Intelligence in Endodontic Dentistry: A Comprehensive Review of Literature. Comput Math Methods Med 2023; 2023: 7049360.
11. Iuga M.M., Romero-Carazas R., Espada-Salgado F., Oprea B., Stefanescu S.V., Lavado-García M. Role of biodentine in endodontics: a bibliometric and scientometric analysis. EAI Endorsed Trans Pervasive Health Technol 2023; 9.
12. Shirani M. Trends and Classification of Artificial Intelligence Models Utilized in Dentistry: A Bibliometric Study. Cureus 2025; 17: 81836.
13. Khanagar S.B., Alfadley A., Alfouzan K., Awawdeh M., Alaqla A., Jamleh A. Develo-

pments and Performance of Artificial Intelligence Models Designed for Application in Endodontics: A Systematic Review. Diagn 2023; 13: 414.
14. Choudhari S., Ramesh S., Shah T.D., Teja K.V. Diagnostic accuracy of artificial intelligence versus dental experts in predicting endodontic outcomes: A systematic review. Saudi Endod J 2024; 14: 153.
15. Ossareh A., Rosentritt M., Kishen A. Biomechanical studies on the effect of iatrogenic dentin removal on vertical root fractures. J Conserv Dent Endod 2018; 21: 290.
16. Rajasekhar R., Attur K., Bagda K.K., Soman S., Anroop A. Volumetric correlation of periapical lesion with Orstavik's periapical index: A retrospective cone-beam computed tomographic study. J Conserv Dent Endod 2024; 27: 1054.
17. Karobari M.I., Adil A.H., Mathur A., Snigdha N.T. Applications and clinical translation of artificial intelligence in CBCT-based detection of endodontic lesions: a scoping review. Oral Radiol. 2025: 4.
18. Ozsari S., Kamburoğlu K., Tamse A., Yener S.E., Tsesis I., Yılmaz F., et al. Automatic Vertical Root Fracture Detection on Intraoral Periapical Radiographs With Artificial Intelligence-Based Image Enhancement. Dent Traumatol Off Publ Int Assoc Dent Traumatol 2025; 41: 348-62.
19. Guo Y., Hao Z., Zhao S., Gong J., Yang F. Artificial intelligence in health care: bibliometric analysis. J Med Internet Res 2020; 22: 18228.
20. Allani H., Santos A.T., Ribeiro-Vidal H. Multidisciplinary Applications of AI in Dentistry: Bibliometric Review. Appl Sci. 2024; 14: 7624.
21. Eck N. van, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics 2009; 84: 523-38.
22. Chen B., Shin S., Wu M., Liu Z. Visualizing the Knowledge Domain in Health Education: A Scientometric Analysis Based on CiteSpace. Int J Environ Res Public Health 2022; 19: 6440.
23. Semerci Z.M., Yardımcı S. Empowering Modern Dentistry: The Impact of Artificial Intelligence on Patient Care and Clinical Decision Making. Diagnostics 2024; 14: 1260.
24. Pan Q., Zhou J., Yang D., Shi D., Wang D., Chen X., et al. Mapping Knowledge Domain Analysis in Deep Learning Research of Global Education. Sustainability 2023; 15: 3097.