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Artificial Intelligence Applications in Oral and Maxillofacial Radiology: A Bibliometric Analysis

Nurbanu Sahin

Harran University, Faculty of Dentistry, Department of Dentomaxillofacial Radiology, Sanliurfa, Turkey

ABSTRACT: Artificial intelligence (AI) has increasingly shaped research and clinical practice in oral and maxillofacial radiology, particularly with the widespread use of digital imaging modalities. The rapid growth of AI-related publications has resulted in an expanding body of literature, making it difficult to comprehensively evaluate research trends and thematic developments in the field. This study aimed to conduct a bibliometric analysis of scientific publications focusing on artificial intelligence applications in oral and maxillofacial radiology. A literature search was performed using the Web of Science Core Collection database, covering publications from 1994 to 2025. Bibliometric analyses were carried out using the bibliometrix package and Biblioshiny to assess publication trends, citation patterns, leading journals, authors, countries, institutions, and keyword-based conceptual structures. Artificial intelligence–supported analytical methods were applied to examine thematic structures within the literature.

The results showed a marked increase in AI-related research output after 2018, with China, the United States, and South Korea emerging as the most productive countries. Keyword co-occurrence analysis identified dominant thematic clusters related to artificial intelligence, deep learning, machine learning, and classification, highlighting the prominence of data-driven approaches in image analysis and diagnosis.

Overall, this bibliometric analysis provides a structured overview of the evolution and current landscape of artificial intelligence research in oral and maxillofacial radiology, emphasizing the growing integration of AI-driven methodologies within the field.

KEYWORDS: Artificial Intelligence, Deep Learning, Bibliometrics, Radiology.

INTRODUCTION: Artificial intelligence (AI) has become one of the most important technological advancements in modern medical research (1). It is changing diagnostic workflows, data interpretation, and decision-making processes (2). The quick development of machine learning and deep learning algorithms has allowed for automated image analysis, pattern recognition, and predictive modeling in various medical imaging areas (1,3).

In dentistry, especially in oral and maxillofacial radiology, the widespread use of digital imaging methods like panoramic radiography and cone-beam computed tomography has created a suitable environment for integrating AI-based methods. AI-assisted systems have shown promising results in tasks such as image segmentation, lesion detection, anatomical structure identification, and diagnostic classification (4). This positions AI as a crucial part of today's radiological practice (5-7).

The growing amount of research on AI in oral and maxillofacial radiology shows an increased interest in using computational methods to improve diagnostic accuracy and efficiency. However, this fast-growing body of literature has significant methodological diversity, covering various algorithms, imaging techniques, and clinical applications (8). As a result, the literature has become fragmented, making it hard to evaluate the evolution, main research themes, and key contributors in the field (9,10).

Bibliometric analysis provides a systematic and quantitative way to tackle this challenge. It maps scientific productivity, intellectual structure, and thematic development within a research domain. When used for literature focused on AI, bibliometric methods can identify publication trends, influential journals and authors, productive countries and institutions, and emerging thematic clusters related to AI research (10,11).

This study aimed to conduct a bibliometric analysis of the scientific literature on AI in oral and maxillofacial radiology. By evaluating publication trends, citation patterns, leading journals, authors, countries, institutions, and keyword-based conceptual structures, this study seeks to offer a complete overview of the development and current landscape of AI-assisted research in this specialty.

MATERIAL METHOD

Study Design

This study was conducted as a bibliometric analysis focusing on research related to AI in the field of oral and maxillofacial radiology. The main objective was to examine the evolution, impact, and thematic structure of AI–driven approaches, including machine learning and deep learning techniques, within radiological applications in dentistry.

Search Strategy

The literature search was performed using the Web of Science Core Collection (WoSCC) database to identify studies applying AI techniques in oral and maxillofacial radiology. Publications indexed between 1994 and 2025 were retrieved using topic-based search terms related to AI (e.g., AI, machine learning, deep learning, neural networks), combined with terms associated with oral and maxillofacial radiology through Boolean operators.

Only peer-reviewed articles and reviews published in English were included in the analysis. Conference proceedings, editorials, non-AI-based studies, and non-English publications were excluded to ensure that the dataset accurately reflected scientific output focused on AI applications.

Data Analysis

Bibliometric analyses were carried out using the bibliometrix package (version 5.2.1) in R (version 4.5.2) and its web-based interface, Biblioshiny, with particular emphasis on publications explicitly related to AI applications (11). Descriptive indicators included annual scientific production, average citations per publication, and the most relevant journals, authors, countries, and institutions contributing to AI-assisted research in oral and maxillofacial radiology. In addition to conventional bibliometric indicators, AI–supported analytical approaches, including network-based clustering and natural language processing techniques, were employed to explore the conceptual structure of the literature (12,13).

Keyword co-occurrence analysis was performed using author-provided keywords to explore the conceptual organization of the literature. A network-based clustering algorithm was applied to identify dominant AI-related research themes, such as deep learning–based image analysis, machine learning–assisted diagnosis, and automated classification systems. In the resulting network, node size represents keyword frequency, edge thickness indicates the strength of co-occurrence, and colors denote distinct AI-driven thematic clusters.

Countries and institutions were analyzed based on authors' institutional affiliations using a full counting approach, whereby each country or institution represented in a publication was counted once per article.

RESULT

Publications related to AI applications in oral and maxillofacial radiology indexed in the Web of Science database between 1994 and 2025 were included in the bibliometric analysis.

Annual scientific production remained relatively low until the mid-2010s, after which a clear and sustained increase was observed from 2018 onward, reaching its highest level in 2025 (Figure 1). This upward trend reflects the growing integration of AI–based approaches into oral and maxillofacial radiology research in recent years.

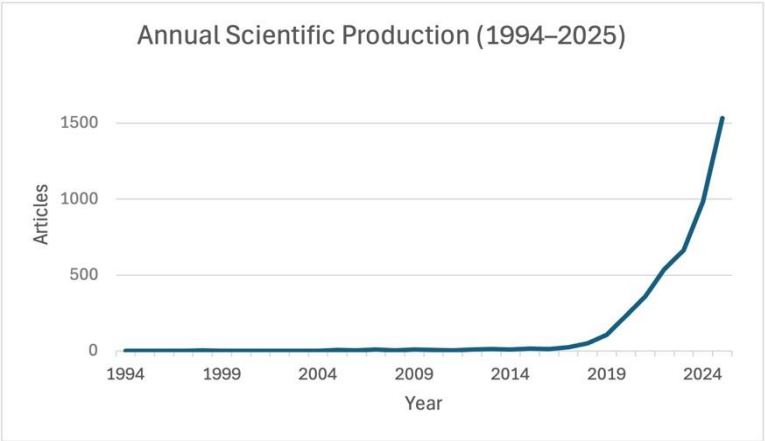

Figure 1. Annual scientific production related to artificial intelligence in oral and maxillofacial radiology from 1994 to 2025 based on Web of Science data.

The pattern of average citations per publication exhibited noticeable fluctuations over time. Higher citation averages were particularly evident between 2018 and 2020, whereas a gradual decrease was observed in more recent years, most likely due to the shorter citation window associated with newly published studies (Figure 2).

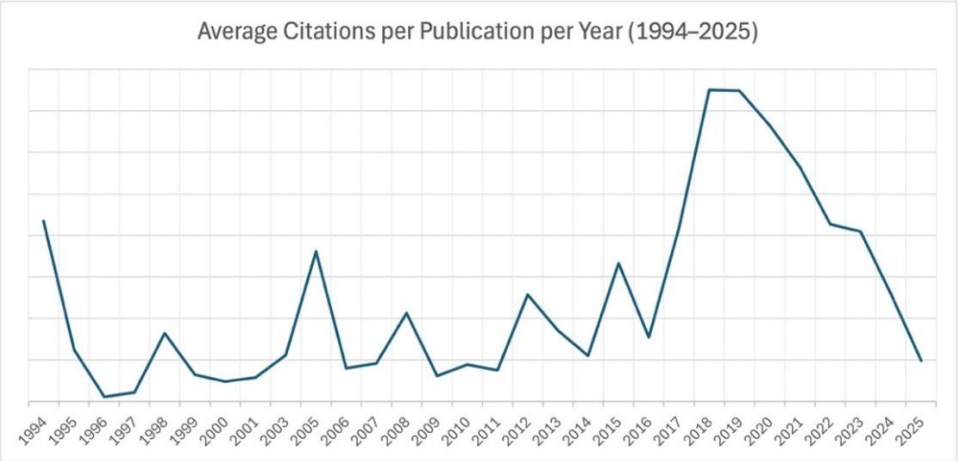

Figure 2. Average citations per publication related to artificial intelligence in oral and maxillofacial radiology from 1994 to 2025 based on Web of Science data

With respect to publication sources, BMC Oral Health, Scientific Reports, and the Journal of Dentistry emerged as the most productive journals, followed by Diagnostics and IEEE Access (Figure 3). These journals constitute the main publication platforms for AI–oriented research within the field.

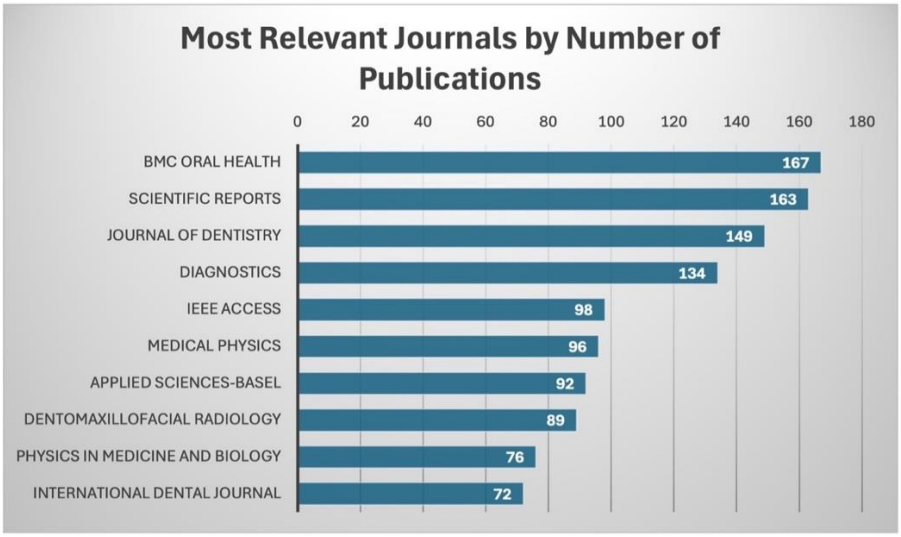

Figure 3. Most relevant journals publishing articles on artificial intelligence in oral and maxillofacial radiology based on Web of Science data (1994–2025).

Analysis of author productivity showed that Zhang Y was the most prolific contributor, followed by Schwendicke F and Li Y. Other authors, including Wang Y and Liu Y, also demonstrated notable publication outputs, indicating the presence of a relatively concentrated group of researchers contributing substantially to the development of AI applications in oral and maxillofacial radiology (Figure 4).

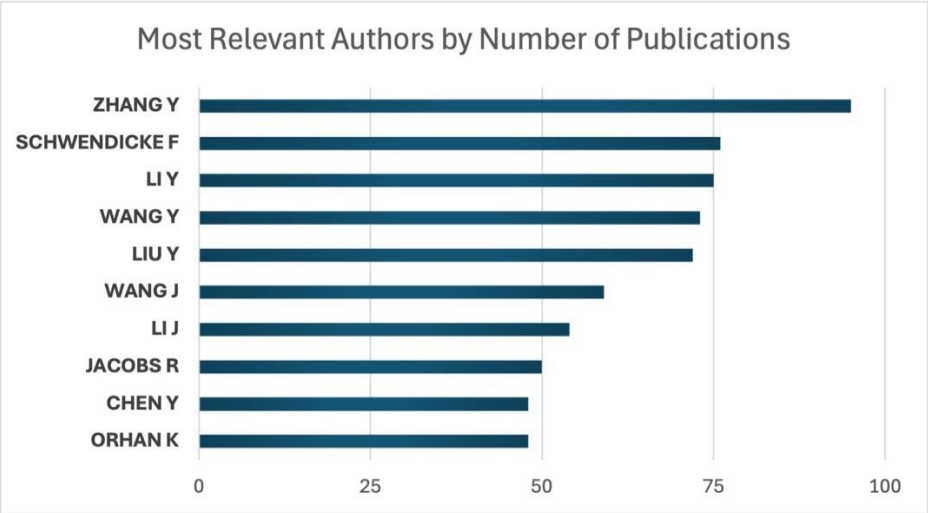

Figure 4. Most relevant authors in artificial intelligence–related oral and maxillofacial radiology research, ranked by number of publications based on Web of Science data (1994–2025).

At the country level, China ranked first in terms of publication volume, followed by the United States and South Korea. India and Germany were also among the leading contributors, highlighting a geographically diverse and internationally distributed research landscape (Figure 5).

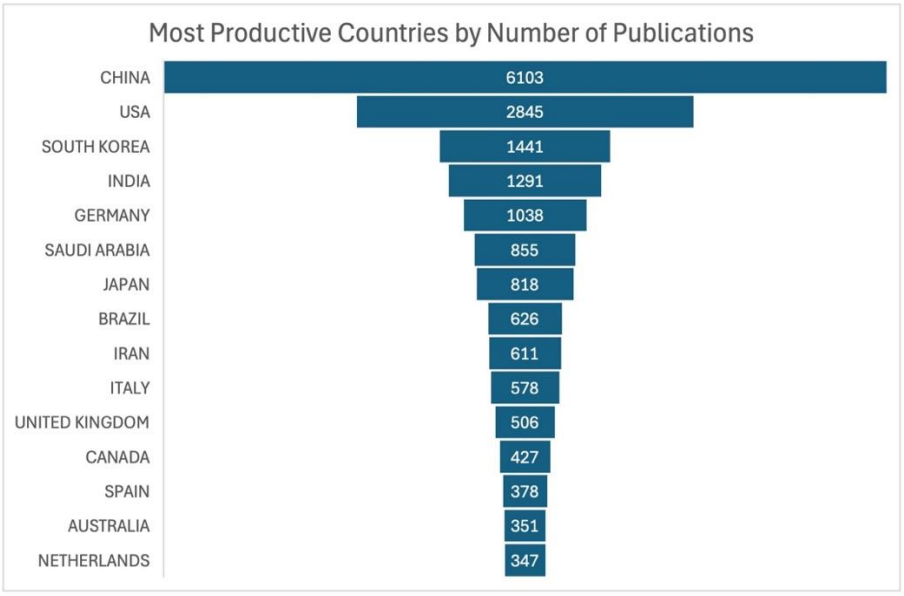

Figure 5. Most productive countries in artificial intelligence–related research in oral and maxillofacial radiology based on Web of Science data (1994–2025), using a full counting approach.

Keyword co-occurrence analysis identified several distinct thematic clusters that define the conceptual structure of the literature. Prominent clusters were centered on terms such as “artificial intelligence,” “deep learning,” “machine learning,” and “classification,” reflecting the dominance of data-driven approaches for image analysis, diagnostic tasks, and automated decision-making. Strong connections among clusters indicate a high level of integration between methodological development and clinical applications (Figure 6).

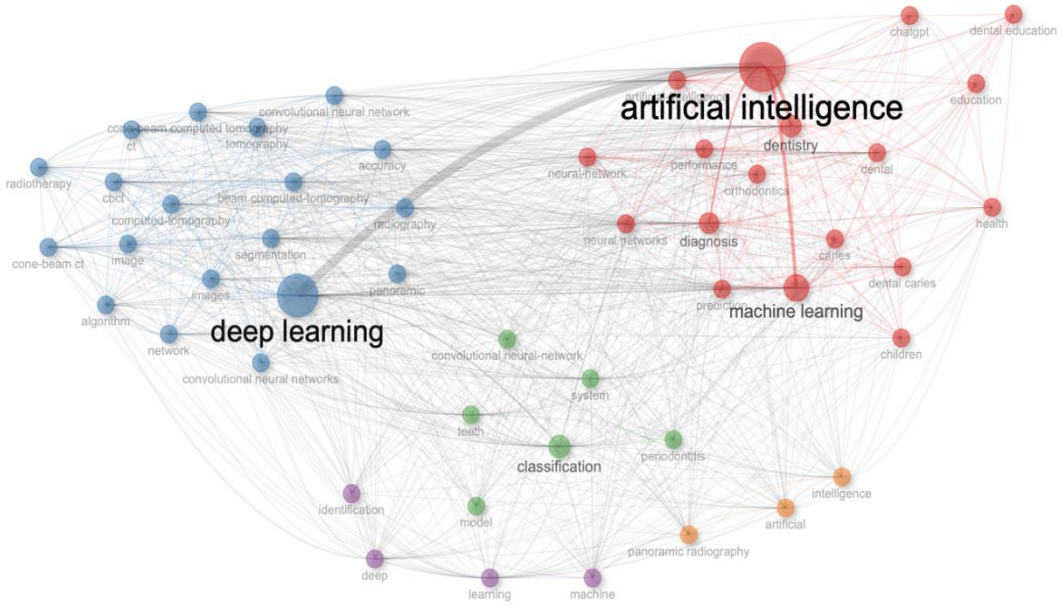

Figure 6. Keyword co-occurrence network illustrating the conceptual structure of artificial intelligence research in oral and maxillofacial radiology.

The network is based on author keywords retrieved from the Web of Science database. Node size represents keyword frequency, link thickness reflects the strength of co-occurrence, and colors indicate distinct thematic clusters identified through network-based clustering analysis.

In terms of institutional productivity, Sichuan University emerged as the leading institution, followed by Seoul National University and Yonsei University. Several other academic institutions from Asia and Europe also showed substantial contributions, underscoring the important role of established academic centers in advancing AI–based research in oral and maxillofacial radiology (Figure 7).

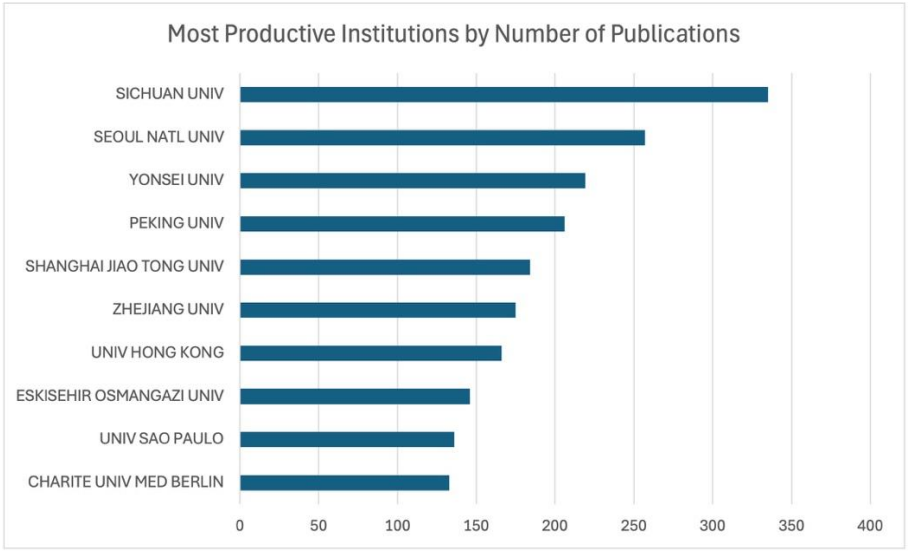

Figure 7. Institutional scientific production in artificial intelligence–related oral and maxillofacial radiology research based on Web of Science data (1994–2025).

DISCUSSION

The current bibliometric analysis provides a clear overview of the evolution and structure of research in oral and maxillofacial radiology driven by AI. The steady increase in scientific output seen in recent years shows how AI methods are becoming more integrated into radiological research and practice. This trend coincides with the broader growth of AI applications in medical imaging, highlighting the importance of data-driven methods in diagnostic radiology (14-16)

The keyword co-occurrence network (Figure 6) reveals valuable insights into the intellectual structure of the field. The presence of clusters focused on “artificial intelligence,” “deep learning,” and “machine learning” emphasizes the significant role of computational algorithms in current research (5). The strong connections between these clusters and clinically relevant terms

indicate that AI research in oral and maxillofacial radiology has moved beyond just developing methods; it now increasingly targets practical diagnostic and analytical uses (8,17-19). This shift suggests a movement toward meaningful, AI-assisted workflows instead of just isolated algorithmic tests (5,9).

Moreover, the concentration of publications in a small number of journals, authors, countries, and institutions points to the growth of a structured and collaborative research community (20-22). Leading academic centers and highly productive researchers seem to play a key role in promoting methodologies based on AI, fostering both innovation and clinical application (10,22). Overall, these findings show that AI has become a central research focus in oral and maxillofacial radiology, influencing not just the amount of scientific output but also its direction and organization within academia (23).

Clinical and Academic Relevance

From both clinical and academic perspectives, this bibliometric analysis illustrates the expanding role of AI in oral and maxillofacial radiology. The prominence of AI-driven themes, such as image analysis based on deep learning and machine learning-assisted diagnosis, reflects a shift toward data-driven, automated radiological workflows with direct clinical applicability (14,24). From an academic standpoint, the findings highlight the increasing need for expertise that integrates radiological knowledge with AI methodologies. This underscores AI as a core competency for contemporary research and training in oral and maxillofacial radiology (25).

CONCLUSION

This bibliometric analysis demonstrates a sustained increase in research output related to AI in oral and maxillofacial radiology over the past decade. The results show that AI-driven methodologies are now firmly embedded within the scientific literature, influencing both publication trends and the conceptual organization of the field. Overall, the findings provide a structured overview of the current landscape of AI research in oral and maxillofacial radiology and underline its growing importance for future clinical practice and academic development (23).

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