THE USE OF MULTIDETECTOR COMPUTED TOMOGRAPHY IN DENTISTRY: A BIBLIOMETRIC ANALYSIS.

Abstract:

The aim of this study was to perform a bibliometric analysis of research on the use of multidetector computed tomography in dentistry. Data were retrieved from the Web of Science Core Collection and included English-language articles and reviews published between 2005 and 2025. Bibliometric analyses included annual scientific production, three-field plot, keywords co-occurrence network, thematic map, and thematic evolution analyses. Scientific production increased until 2012 and fluctuated thereafter. Research focused mainly on imaging accuracy, dental implants, the maxillary sinus, the temporomandibular joint, and forensic odontology. Overall, multidetector computed tomography remains an important imaging modality in dentistry.

Key words: Bibliometric analysis, Dentistry, Imaging, Multidetector computed tomography, Research trends

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Introduction: Multidetector computed tomography is an imaging modality that enables the acquisition of three-dimensional images in different sections using X-rays. Unlike conventional computed tomography systems, which incorporate a single detector, this imaging system contains multiple detectors. The presence of multiple detectors enables the acquisition of higher-resolution images with thinner slice thicknesses in a shorter scanning time compared with conventional computed tomography systems. In dentistry, multidetector computed tomography is used for the evaluation of traumatic injuries, planning of orthognathic surgical procedures, assessment of temporomandibular joint pathologies, investigation of bone infections, evaluation of cystic lesions, and assessment of benign and malignant tumors. One of the major advantages of multidetector computed tomography is its high contrast resolution, which allows simultaneous evaluation of both hard and soft tissues. In addition, the use of contrast agents enables the assessment of vascular structures. Therefore, it can also be used in dentistry for airway evaluation and tumor characterization. Although multidetector computed tomography, which has an isotropic voxel structure, can be used as an alternative to cone-beam computed tomography, it also has several disadvantages. These include higher radiation exposure, greater equipment cost, the potential for allergic reactions associated with contrast agents, and lower spatial resolution than cone-beam computed tomography in the evaluation of certain dentoalveolar structures. Consequently, although cone-beam computed tomography is generally considered the first-line imaging modality for dental applications, multidetector computed tomography remains valuable in dentistry for the evaluation of pathologies involving extensive anatomical regions and for the simultaneous assessment of hard and soft tissues (1-11). Although numerous studies have investigated the use of multidetector computed tomography in dentistry, there is still limited knowledge regarding the conceptual structure and research trends of this field in the literature. Furthermore, evaluating the evolution of this research area and its thematic developments over time has become increasingly challenging (12, 13). Therefore, it is necessary to evaluate the

current status of this research field, its trends, and the performance of scientific production. Bibliometric analysis enables the evaluation of the performance of scientific production, conceptual structure, research trends, and thematic evolution within a specific research field. For this purpose, annual scientific production, three-field plot analysis, keywords co-occurrence network analysis, thematic map analysis, and thematic evolution analysis can be used to quantitatively evaluate the literature (14, 15)

The aim of this study was to perform a bibliometric analysis of research on the use of multidetector computed tomography in dentistry and to provide insights into the current status, research trends, conceptual structure, and thematic evolution of this field over time.

Materials and Methods: As this study was designed as a bibliometric analysis of the use of multidetector computed tomography in dentistry, no human participants or animals were involved. Therefore, ethical approval was not required.

The dataset for this study was retrieved from the Web of Science Core Collection (WoSCC) database using the advanced search function with the following search query: (("multidetector computed tomography" OR "multi-detector computed tomography" OR "multislice computed tomography" OR "multi-slice computed tomography" OR "multirow computed tomography" OR "multi-row computed tomography" OR "multidetector CT" OR "multi-detector CT" OR "multislice CT" OR "multi-slice CT" OR "multirow CT" OR "multi-row CT" OR MDCT OR MSCT) AND (dent* OR oral OR tooth OR teeth OR maxillofacial OR craniofacial OR mandible OR mandibular OR maxilla* OR temporomandibular OR TMJ OR implant* OR orthodont* OR endodont* OR periodont* OR prosthodont*)). Within the scope of this study, articles and review papers published between 2005 and 2025 were included, whereas conference proceedings and editorial letters were excluded. In addition, only publications published in English were considered. To ensure the homogeneity of the dataset, publications in languages other than English and studies unrelated to the use of multidetector computed tomography in dentistry were excluded.

Bibliometric analyses were performed using the bibliometrix package (version 5.3.0) through R (version 4.6.0), RStudio, and Biblioshiny. Within the scope of performance analysis, annual scientific production was evaluated, whereas three-field plot analysis, keywords co-occurrence network analysis, thematic map analysis, and thematic evolution analysis were evaluated as part of science mapping analysis.

Within the scope of three-field plot analysis, the leading countries, keywords, and sources were examined. The conceptual structure of the literature in this field was investigated using network-based clustering approaches. In the resulting network, node size represented the frequency of keyword occurrence, colors indicated different thematic clusters, and line thickness represented the strength of co-occurrence. Keyword co-occurrence analysis was performed exclusively based on author keywords. In thematic map analysis, thematic clusters were

classified into basic themes, niche themes, motor themes, and emerging/declining themes. Thematic evolution analysis was performed to identify changes in the prominent themes of the research field over time.

Results: A total of 590 publications published between 2005 and 2025 were included in this study. According to the annual scientific production analysis, the annual number of publications increased markedly between 2005 and 2012. After 2012, annual scientific production exhibited a fluctuating pattern, with the highest number of publications recorded in 2017, when a total of 45 publications were published (Figure 1).

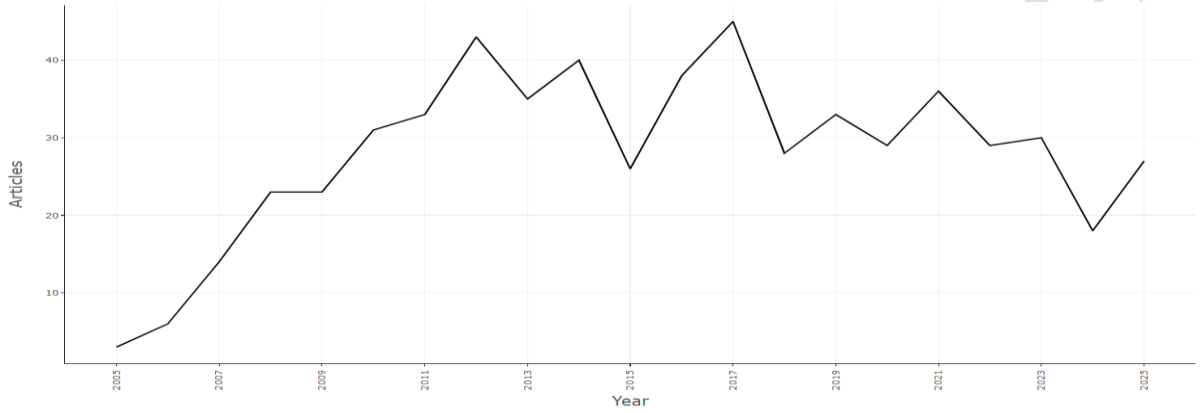

Figure 1.Annual scientific production analysis of the use of multidetector computed tomography in dentistry.

According to the three-field plot analysis**,** the most frequently used keywords in studies on the use of multidetector computed tomography in dentistry were "multidetector computed tomography", "CT", "computed tomography", "computed-tomography", "tomography", "cone-beam computed tomography", "accuracy", "CBCT", "surgery", and "replacement". Germany, Brazil, Japan, the United States, China, Austria, Türkiye, South Korea, Switzerland, and Italy were identified as the leading contributors to the literature in this field. The journals with the highest number of publications were Dentomaxillofacial Radiology**,** Imaging Science in Dentistry**,** Journal of Craniofacial Surgery**,** Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology**,** International Journal of Oral and Maxillofacial Surgery**,** International Journal of Legal Medicine**,** Clinical Oral Implants Research**,** andJournal of Oral and Maxillofacial Surgery(Figure 2).

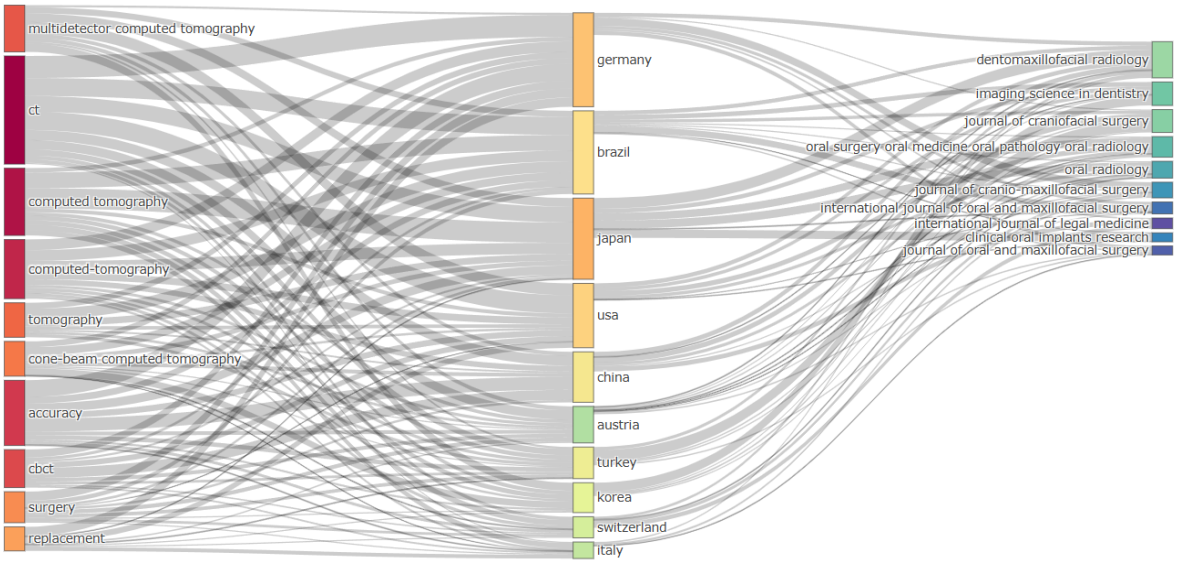

Figure 2.Three-field plot analysis of the use of multidetector computed tomography in dentistry.

According to the keywords co-occurrence network analysis, the largest node sizes were observed for the keywords "multidetector computed tomography", "CT", and "CBCT". The network consisted of several thematic clusters. The red cluster included the keywords "CT", "accuracy", "maxillary sinus", "forensic anthropology", "forensic dentistry", "forensic science", and "dental implants". The blue cluster comprised the keywords "multidetector computed tomography", "CBCT", "dental implant", "image quality", "bone density", "temporomandibular joint", "diagnosis", and "anthropology". The green cluster contained the keywords "imaging" and "mandible", whereas the purple cluster included the keywords "dental" and "radiography" (Figure 3).

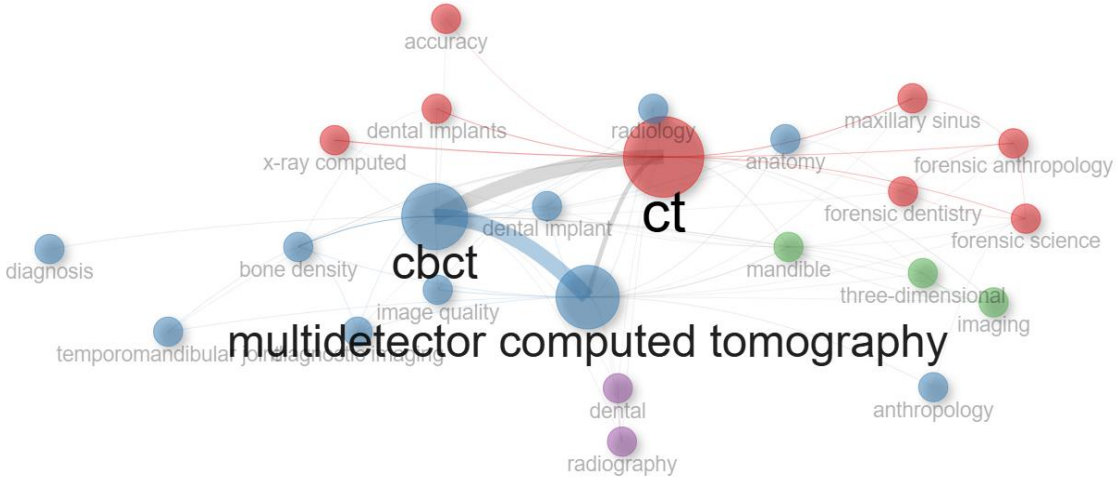

Figure 3. Keywords co-occurrence network analysis of the use of multidetector computed tomography in dentistry.

According to the thematic map analysis, the basic themes included the keywords "bone", "reconstruction", and "head"; the motor themes comprised "ct", "cbct", and "accuracy"; the niche themes included "identification", "maxillary sinus", and "dimensions"; and the emerging/declining themes consisted of "multidetector computed tomography", "surgery", and "replacement" (Figure 4).

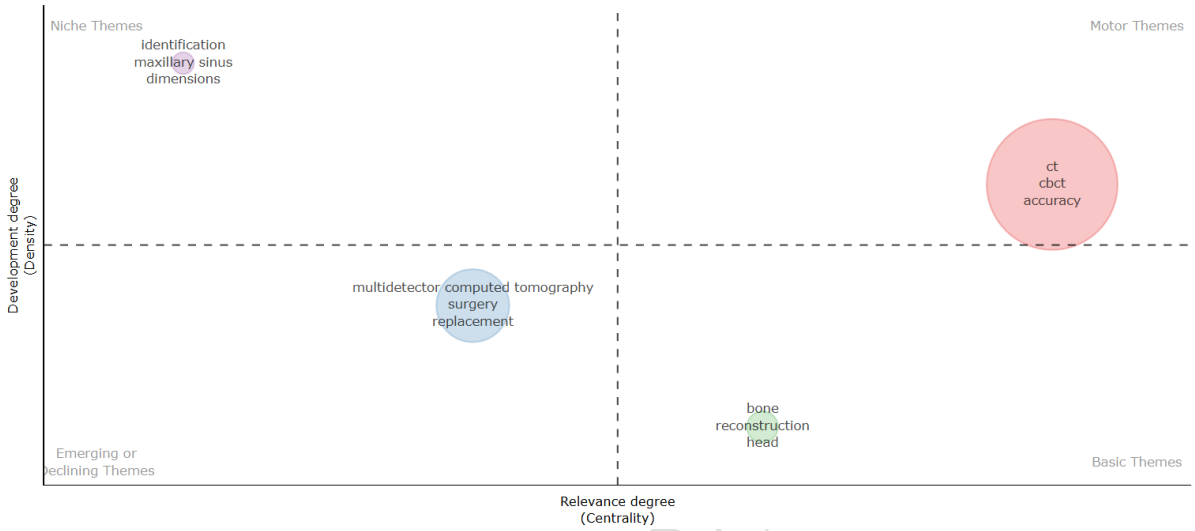

Figure 4.Thematic map analysis of the use of multidetector computed tomography in dentistry.

According to the thematic evolution analysis, studies on the use of multidetector computed tomography in dentistry were primarily focused on the themes "3d", "mandible", "implants", "radiography", and "forensic science" during the 2005–2015 period. In contrast, the themes "image quality", "temporomandibular joint", "imaging", and "maxillary sinus" became more prominent during the 2016–2025 period. In addition, the themes "multidetector computed tomography" and "ct" persisted throughout both periods. Furthermore, the "3d" theme identified in the first period was found to be linked to the "temporomandibular joint" theme in the second

period (Figure 5).

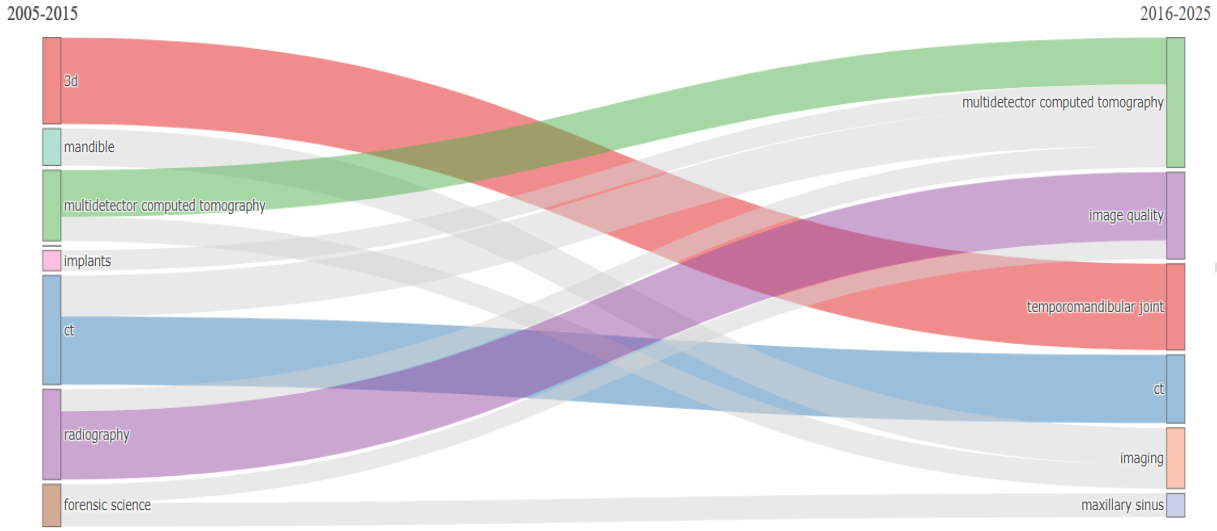

Figure 5.Thematic evolution analysis of the use of multidetector computed tomography in dentistry.

Discussion: Unlike conventional computed tomography, multidetector computed tomography incorporates multiple detectors within the imaging system. This imaging modality enables the acquisition of high-resolution three-dimensional cross-sectional images. In dentistry, multidetector computed tomography is used for the evaluation of traumatic injuries, assessment of various pathologies including benign and malignant tumors, examination of the morphology and pathologies of anatomical structures such as the temporomandibular joint and maxillary sinus, dental implant planning, and preoperative anatomical assessment. The principal advantages of multidetector computed tomography, which has an isotropic voxel structure, include the ability to evaluate large anatomical regions, provide high-contrast visualization of both hard and soft tissues, and assess vascular and soft tissues following contrast agent administration. However, compared with cone-beam computed tomography, it has several disadvantages, including relatively higher radiation exposure, higher cost, and lower spatial resolution. Although cone-beam computed tomography is more commonly preferred in dental practice, multidetector computed tomography remains the imaging modality of choice in cases requiring the evaluation of extensive anatomical regions, complex maxillofacial pathologies, and the simultaneous assessment of hard and soft tissues. Despite the large number of publications on the use of multidetector computed tomography in dentistry, there is still limited knowledge regarding the conceptual structure of this research field and the evolution of its research trends over time (2, 13, 16-21). Bibliometric analysis can overcome this limitation by revealing the quantitative characteristics of scientific production within a specific research field and enabling the evaluation of research trends, conceptual structure, and thematic evolution over time. This approach provides researchers with a comprehensive overview of a research field, including its developmental trajectory, major research topics, and overall conceptual structure (14, 15).

Therefore, the present study was designed as a bibliometric analysis of the use of multidetector computed tomography in dentistry.

According to the annual scientific production analysis, studies on the use of multidetector computed tomography in dentistry demonstrated a marked upward trend until 2012, followed by fluctuations in annual scientific production. The highest publication output was recorded in 2017, with a total of 45 publications, whereas the annual number of publications ranged from 18 to 36 in the subsequent years. This trend may be attributed to the widespread adoption of cone-beam computed tomography in dentistry in recent years, which may have relatively reduced the research focus on multidetector computed tomography (6, 22-24).

According to the three-field plot analysis, the keywords "multidetector computed tomography", "computed tomography", and "cone-beam computed tomography" were the most prominent. This finding suggests that the literature has primarily focused on studies comparing multidetector computed tomography with other imaging modalities or evaluating their combined use. Furthermore, the prominence of the keywords "accuracy", "surgery", and "replacement" indicates considerable academic interest in the measurement accuracy of multidetector computed tomography and its applications in surgical procedures (23, 25-27). The journals with the highest publication output were predominantly related to oral and maxillofacial surgery and oral and maxillofacial radiology. This finding indicates that research on multidetector computed tomography has mainly evolved around radiological and surgical applications. Moreover, Germany, Brazil, and Japan were identified as the leading contributors to scientific production in this field, suggesting that research activity is concentrated within specific research centers.

According to the keywords co-occurrence network analysis, the largest node sizes were observed for the keywords "multidetector computed tomography", "CT", and "CBCT". This finding suggests that the literature has largely focused on either the combined use of different imaging modalities or comparisons between them (23, 26, 28). The presence of the keywords "forensic anthropology", "forensic dentistry", and "forensic science" within the network suggests that multidetector computed tomography is a widely utilized imaging modality in the fields of forensic odontology and forensic anthropology (29-31). The presence of the keywords "maxillary sinus", "temporomandibular joint", and "diagnosis" within the network suggests that multidetector computed tomography has been widely used in studies evaluating the anatomical structures and pathologies of the maxillary sinus and temporomandibular joint. This may be attributed to the ability of multidetector computed tomography to image large anatomical regions with high spatial resolution and its effectiveness in the assessment of osseous structures and sinus pathologies (13, 32-35). The presence of the keywords "image quality" and "bone density" within the network suggests that studies focusing on the spatial resolution, image quality, and assessment of bone density using multidetector computed tomography constitute a significant area of research in the literature (36-38). Finally, the presence of the keyword "dental implants" within the network indicates that multidetector computed tomography has been a major focus of research in the planning of dental implant procedures (23, 39).

According to the thematic map analysis, the placement of the keywords "bone", "reconstruction", and "head" within the basic themes cluster suggests that the evaluation and reconstruction of hard tissues in the head and neck region constitute one of the fundamental research areas regarding the use of multidetector computed tomography in dentistry (40). The keywords "CT", "CBCT", and "accuracy" were identified within the motor themes cluster. This finding indicates that comparing the diagnostic accuracy of different imaging modalities represents a current and highly active area of research in the literature (41). The presence of the keywords "identification", "maxillary sinus", and "dimensions" within the niche themes cluster suggests that studies on forensic identification, evaluation of the maxillary sinus, and anatomical measurements represent well-developed yet relatively specialized research areas that have more limited connections with the broader literature on multidetector computed tomography in dentistry (29, 42, 43).

According to the thematic evolution analysis, a clear shift in research themes was observed over time. During the first period, the prominent themes "3d", "mandible", "implants", "radiography", and "forensic science" indicate that research was primarily focused on three-dimensional imaging, dental implant applications, evaluation of mandibular anatomy, and forensic odontology. In the second period, the emergence of the themes "image quality", "temporomandibular joint", "imaging", and "maxillary sinus" suggests that research shifted toward more specific topics, including image quality assessment and the evaluation of the anatomy and pathologies of the temporomandibular joint and maxillary sinus. Furthermore, the connection between the "3d" theme in the first period and the "temporomandibular joint" theme in the second period indicates a transition from general three-dimensional volumetric imaging toward the investigation of more specific anatomical structures, such as the temporomandibular joint.

This study has several limitations. First, only publications published in English were included, and the dataset was compiled exclusively from the WoSCC database. However, the high indexing standards of the WoSCC database and the widespread use of English as the dominant language of scientific communication enhance the reliability of the present study. Furthermore, although bibliometric analysis can reveal the quantitative characteristics of scientific production and research trends within the literature, it does not evaluate the methodological quality or clinical impact of the included studies.

Conclusion: The findings of this study demonstrated that scientific production on the use of multidetector computed tomography in dentistry increased markedly between 2005 and 2012, followed by a fluctuating trend in annual publication output after 2012. The literature has primarily focused on imaging accuracy, dental implants, the maxillary sinus, the temporomandibular joint, forensic odontology, and comparisons among different imaging modalities. Over time, research has shifted from general three-dimensional imaging applications toward more specific clinical topics, including image quality, the temporomandibular joint, and the maxillary sinus. These findings indicate that multidetector computed tomography continues

to play an important role, particularly in the evaluation of extensive anatomical regions and complex maxillofacial pathologies. Future studies should be designed to include publications from multiple databases and articles published in different languages.

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