

BIBLIOMETRIC ANALYSIS of CRANIOFACIAL DEFORMITIES in DENTOMAXILLOFACIAL RADIOLOGY: THEMATIC TRENDS and EVOLUTION of RESEARCH AREAS

Manuscript Info

Manuscript History

Received: xxxxxxxxxxxxxxxx

Final Accepted: xxxxxxxxxxxx

Published: xxxxxxxxxxxxxxxx

Key words: Bibliometric analysis, Cephalometry, Cone-beam computed tomography, Craniofacial deformities, Dentomaxillofacial radiology, Orthognathic surgery.

Abstract

This study aimed to evaluate the bibliometric structure of the literature on craniofacial deformities in dentomaxillofacial radiology. Publications indexed in the Web of Science Core Collection were analyzed using bibliometric methods. Scientific productivity, thematic structure, and research trends were investigated. The findings showed a notable increase in publications after 2012. Orthognathic surgery, cephalometry, and computed tomography were identified as major research themes. Additionally, Japan and other Asian countries contributed significantly to the scientific literature in this field.

Introduction: It is known that there are hundreds of syndromes associated with craniofacial anomalies. These syndromes generally present with morphological manifestations that may lead to morphological defects in the head and facial region and cause functional impairments in the affected area(1, 2). The etiology of these disorders is generally associated with heredity (2, 3). The manifestations caused by craniofacial anomalies are not limited to the head and facial region, and findings may also be observed throughout the body (1, 4, 5). In addition to affecting many organs such as the feet, hands, heart, and kidneys, these manifestations also involve dentomaxillary structures that are within the field of dentistry(6). Therefore, a multidisciplinary approach in addition to dental treatment is also necessary for patients with craniofacial deformities(1, 7). Imaging modalities play an essential role in the evaluation of craniofacial anomalies. Particularly with the introduction of three-dimensional imaging methods in dentistry, a new era has emerged in the assessment of craniofacial deformities, leading to a substantial increase in related studies (8, 9). However, publications in this rapidly developing field involve numerous disciplines and syndromes(10-12).

When the literature is examined, evaluating the main research themes, the major contributors in the field, and the thematic evolution of the research area has become challenging in terms of oral and maxillofacial radiology, as each disease group has generally been analyzed separately (13, 14). Bibliometric analysis provides a quantitative solution to overcome this challenge. Through this method, phenomena such as thematic development and scientific productivity can be quantitatively identified. Bibliometric analysis enables the evaluation of annual scientific production, the most relevant authors and countries, major research clusters, thematic structures, and the evolution of research topics within the field(15-17).

The aim of this study is to perform a bibliometric analysis of craniofacial anomalies in the field of oral and maxillofacial radiology. By examining the scientific productivity, concepts, thematic structure, and thematic development of the field, this study aims to provide a general

overview of the development and current landscape of research related to craniofacial structures in oral and maxillofacial radiology.

Materials and Methods: This study was designed as a bibliometric analysis covering research on craniofacial deformities within the field of oral and maxillofacial radiology. The aim of the study was to investigate the concepts, relationship networks, core themes, and thematic evolution related to craniofacial deformities from the perspective of oral and maxillofacial radiology. Due to the nature of bibliometric analysis, no human or animal subjects were included in this study; therefore, ethical approval was not required.

To obtain the data for bibliometric analysis, the advanced search option in the Web of Science Core Collection (WoSCC) database was used with the following search query: (("dentofacial deformity" OR "craniofacial anomaly" OR "jaw deformity") AND ("radiology" OR "radiography" OR "imaging" OR "cephalometric" OR CBCT)). Among the retrieved records, editorial letters, conference proceedings, publications unrelated to oral and maxillofacial radiology, and studies not associated with craniofacial deformities were excluded. In addition, due to standardization problems in scientific publications before 1995, a dataset was created using publications published between 1995 and 2025. Subsequently, bibliometric analyses were performed using the bibliometrix package (version 5.3.0) through Biblioshiny in RStudio with R software (version 4.6.0).

Within the scope of descriptive bibliometric indicators, annual scientific production, the most productive authors, and the most productive countries were evaluated. In addition, citation analyses were performed to investigate the scientific impact within the literature. Network-based clustering approaches were used to examine the conceptual structure of the literature. By analyzing author keywords in the dataset, a keyword co-occurrence analysis was conducted to investigate the main research clusters in the literature. In the constructed network structure, node size represented keyword frequency, edge thickness represented the co-occurrence strength between keywords, and colors represented different thematic clusters. A thematic map analysis was performed to investigate the thematic structure and major research areas within the literature. In this analysis, motor themes, basic themes, niche themes, and emerging/declining themes were evaluated. Furthermore, thematic evolution analysis was applied to investigate the evolution of research topics over time.

Results: A total of 178 publications were included in this study. A marked increase in the number of studies in this field was observed after 2012. Although fluctuations were noted over the years, the overall trend demonstrated a continuous upward trajectory (Figure 1).

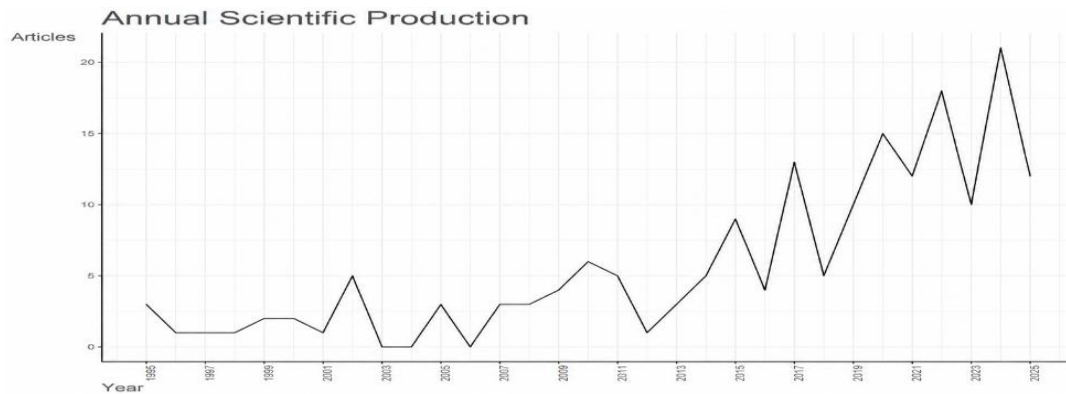


Figure 1. Number of publications related to the imaging of craniofacial deformities by year.

The most productive author in the related field was Choi Jong Wo with 6 publications, followed by Moroi Akinori, Ueki Koichiro, and Yoshizawa Kunio, each with 5 publications. The most productive institution was Shanghai Jiao Tong University with a total of 19 publications. Japan was the country contributing the most to this field with 44 publications, followed by the United States with 26 publications. According to the citation analysis, the study by Arnett et al. (18) had the highest number of global citations in the field, followed by the study conducted by Ngan and Moon (19).

Evaluation of the keyword co-occurrence analysis related to the present topic demonstrated that the conceptual structure of the literature was shaped around different thematic clusters. The keyword “orthognathics surgery” was identified as the largest node, occupying a central position and showing connections with numerous other keywords. This node demonstrated strong associations with the keywords “dentofacial deformity,” “cephalometric analysis,” and “cephalometry.” In addition, clustering patterns related to cephalometry and temporomandibular joint terms were observed within the network structure (Figure 2).

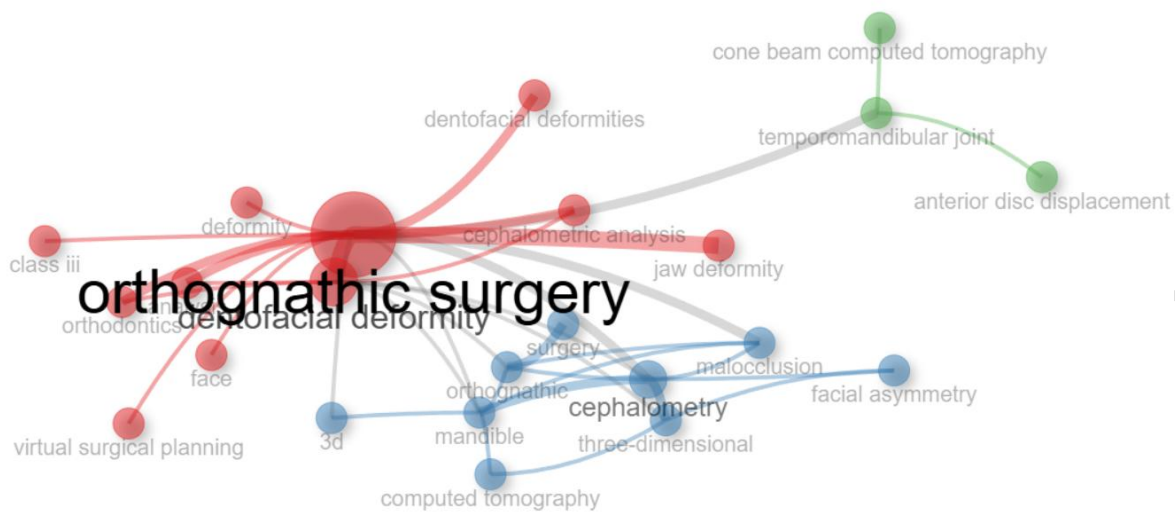


Figure 2. Keyword co-occurrence network analysis of the included publications.

Thematic map analysis revealed that the terms “orthognathic surgery,” “osteotomy,” “stability,” “malocclusion,” “cephalometric analysis,” and “face” were located within the motor themes quadrant. The terms “management,” “deformity,” and “distraction osteogenesis” were identified within the niche themes. In addition, the terms “lip,” “palate,” “repositioning,” “facial asymmetry,” “accuracy,” and “cephalometry” were positioned within the emerging or declining themes quadrant. Furthermore, the terms “morphology” and “temporomandibular joint” were located in the boundary region between motor and basic themes on the thematic map (Figure 3).

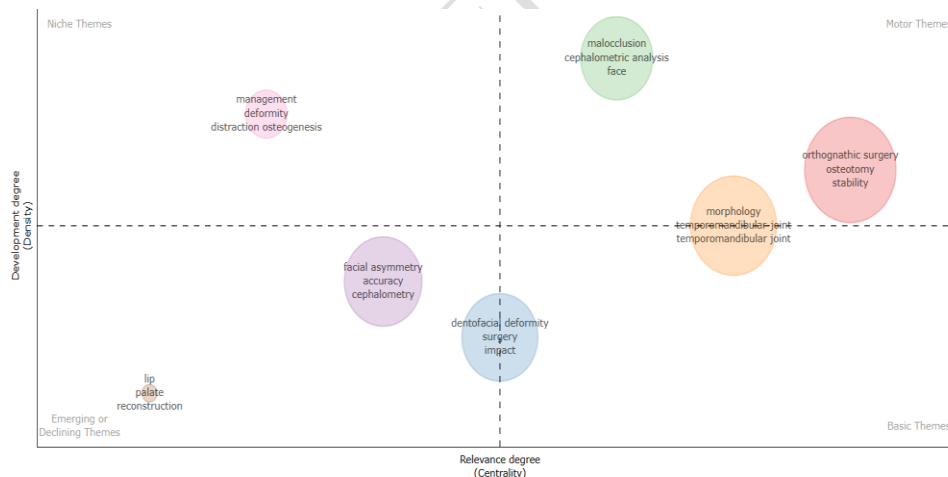


Figure 3. Thematic map analysis of the publications in the literature.

Thematic evolution analysis demonstrated that the themes of “orthognathic surgery” and “dentofacial deformity” were predominant in the early period, whereas “cephalometry,”

“facial asymmetry,” and “computed tomography” became more prominent in later years (Figure 4).

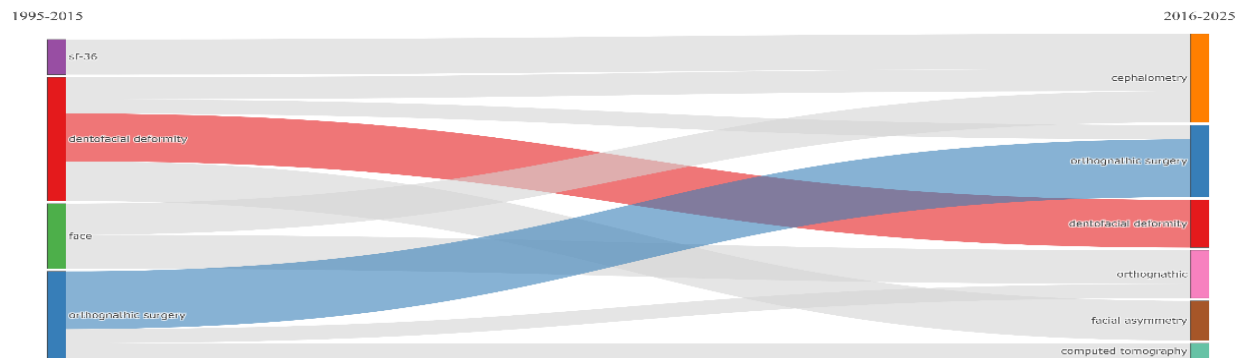


Figure 4. Thematic evolution analysis of the publications in the literature.

Discussion: Craniofacial anomalies are defined as abnormalities that arise from errors occurring during the developmental stages of the head and neck region in intrauterine life, resulting in morphological and functional disorders. Since these anomalies affect the morphology and functions of the head and neck region, their impact on the teeth and related structures is inevitable (1, 20, 21).

In this study, the bibliometric structure of publications related to craniofacial deformities was evaluated from the perspective of oral and maxillofacial radiology. The bibliometric analysis demonstrated an increasing trend in scientific production on this topic after 2012. This increase may be associated with the widespread use of three-dimensional imaging modalities, such as cone-beam computed tomography, in dentistry (22, 23). In particular, the ability of cone-beam computed tomography to provide detailed information about the hard tissue components of craniofacial structures may have contributed to the increase in studies in this field within the literature (24).

The fact that Japan was identified as the most productive country in this field indicates that the country has made substantial scientific contributions to the existing literature. The high level of scientific production in developed countries such as Japan and the United States may be associated with technological advancements in dental imaging modalities and three-dimensional radiological techniques. (25, 26). The authors contributing most prominently to the literature were identified as Choi Jong Woo, Moroi Akinori, Ueki Koichiro, and Yoshizawa Kunio. Among these researchers, Choi Jong Woo was affiliated with an institution in South Korea, whereas the other researchers were associated with institutions based in Japan. These findings suggest that Asian countries possess strong scientific activity in the fields of craniofacial deformity imaging and dentomaxillofacial radiology. Similarly, the identification of Shanghai Jiao Tong University as the most productive institution, with its China-based affiliation, further supports the central role of Asian countries in this research area.

According to the citation analysis related to the present topic, the study by Arnett et al.(18)was identified as the most globally cited publication, followed by the study conducted by Ngan and Moon(19)The high number of global citations received by these studies indicates that they occupy a central position in the literature and serve as fundamental reference sources in the field. It may be suggested that these publications have contributed significantly to the evolution of concepts related to cephalometric evaluation and orthognathic surgery.

Evaluation of the keyword co-occurrence analysis demonstrated that the term “orthognathic surgery” occupied a central position within the network structure, indicating that it represents a major focal point in studies related to craniofacial deformities(27). The strong associations between this term and the keywords “dentofacial deformity,” “cephalometric analysis,” and “cephalometry” suggest that cephalometric imaging methods and radiological examinations play a critical role in the evaluation of craniofacial deformities. In particular, the frequent use of cephalometric imaging techniques during orthognathic surgery planning may explain this network structure(28, 29). In addition, the terms “cone-beam computed tomography,” “three-dimensional,” and “computed tomography” formed distinct focal points within the network structure, suggesting that three-dimensional imaging modalities occupy an important position in this field. This finding may indicate that three-dimensional imaging techniques have a significant impact on the evaluation and surgical planning of craniofacial deformities(25).

Evaluation of the thematic map analysis demonstrated that the terms “orthognathic surgery,” “osteotomy,” “stability,” “malocclusion,” “cephalometric analysis,” and “face” were positioned within the motor themes quadrant, indicating that these topics possess high levels of development and centrality within the literature. The term “distraction osteogenesis” was identified within the niche themes, suggesting that it represents a specialized research area that may increase in thematic importance in the future. This situation may be related to the complex approaches required for this procedure(30). Considering the position of the terms “facial asymmetry,” “accuracy,” and “cephalometry” on the thematic map, these terms appear to demonstrate stronger conceptual associations with other research areas within the literature. In particular, the prominent role of cephalometry may be explained by the applicability of various analytical methods in orthognathic surgery, which is one of the treatment approaches used for craniofacial deformities(28, 31). Finally, the positioning of the term “temporomandibular joint” on the boundary between motor and basic themes indicates that it both continues to develop within the literature and maintains an important level of centrality. The close relationship of the temporomandibular joint with orthognathic surgery and dentofacial deformities may explain this finding(32, 33).

Evaluation of the thematic evolution analysis demonstrated that the early literature was mainly shaped around the themes of “orthognathic surgery” and “dentofacial deformity,” whereas in later periods, “cephalometry” and “computed tomography” became more prominent. This shift may be explained by the influence of advancements in imaging modalities on changing research trends.

The use of publications indexed only in the WoSCC database, the preference for exclusively English keywords in the search strategy, and the inability of bibliometric analyses to directly evaluate the methodological and clinical characteristics of studies despite assessing quantitative trends in the literature represent the main limitations of the present study. Nevertheless, the highly standardized indexing structure of the WoSCC database and the widespread use of English as the dominant language in scientific literature support the reliability of the current study.

Conclusion: The literature on imaging of craniofacial deformities has shown a remarkable development, particularly in recent years. Orthognathic surgery, cephalometric analyses, and three-dimensional imaging methods were identified as central themes within this research field. In particular, advancements in advanced imaging techniques such as cone-beam computed tomography may have contributed to shifts in research trends within the literature. Additionally, Asian countries, especially Japan, were found to hold an important position in scientific production in this field. The present study comprehensively reveals the scientific structure, thematic development, and research trends of the literature related to the imaging of craniofacial deformities. Future bibliometric studies conducted using different databases and multilingual search strategies may contribute to a broader evaluation of the related literature.

References

1. Buchanan EP, Xue AS, Hollier Jr LH. Craniofacial syndromes. *Plastic and reconstructive surgery*. 2014;134(1):128e-53e.
2. Hart T, Hart P. Genetic studies of craniofacial anomalies: clinical implications and applications. *Orthodontics & craniofacial research*. 2009;12(3):212-20.
3. Wilkie AO, Morriss-Kay GM. Genetics of craniofacial development and malformation. *Nature Reviews Genetics*. 2001;2(6):458-68.
4. Munro IR. A description of craniofacial anomalies: the mechanism and rationale of surgery. *Craniofacial anomalies: Psychological perspectives*; Springer; 1995. p. 3-21.
5. Birgfeld CB, Heike C, editors. *Craniofacial microsomia*. *Seminars in plastic surgery*; 2012: Thieme Medical Publishers.
6. Alkış M, Aydın EM. Kraniyofasiyal Bölgeyi İlgilendiren Brankial Ark Sendromları ve Diş Hekimliği Açısından Önemi. *Uşak Üniversitesi Diş Hekimliği Fakültesi Dergisi*. 2022;1(1):2-7.
7. Bani AA, Türköz Ç. Sendromlar ve eşlik ettikleri kraniyofasiyal anomaliler. *European Annals of Dental Sciences*. 2012;39(1):35-47.
8. Anderson P, Yong R, Surman T, Rajion Z, Ranjitkar S. Application of three-dimensional computed tomography in craniofacial clinical practice and research. *Australian dental journal*. 2014;59:174-85.
9. Nagy L, Demke JC. Craniofacial anomalies. *Facial Plastic Surgery Clinics*. 2014;22(4):523-48.
10. Eker O, Demirtaş S, Yıldırım G, Tosun Z. Konjenital Anomalilere Yaklaşım. *Türkiye Klinikleri Plastic Surgery-Special Topics*. 2023;12(1):56-64.
11. Rice DP. Craniofacial anomalies: from development to molecular pathogenesis. *Current molecular medicine*. 2005;5(7):699-722.
12. Dar P, Gross SJ. Craniofacial and neck anomalies. *Clinics in perinatology*. 2000;27(4):813-37.
13. Liu Z, Teng L. Focuses, trends, and developments in craniofacial microsomia from 1992 to 2022: a bibliometric analysis. *Journal of Craniofacial Surgery*. 2023;34(8):2291-6.
14. Negi A, Katyal S, Yadav V, Vallala P. A Bibliometric Analysis of 100 Top-cited Articles on Cleft Orthodontics. *The Cleft Palate Craniofacial Journal*. 2025;62(12):2118-36.
15. Passas I. Bibliometric analysis: the main steps. *Encyclopedia*. 2024;4(2).

16. Kokol P, Blažun Vošner H, Završnik J. Application of bibliometrics in medicine: a historical bibliometrics analysis. *Health Information & Libraries Journal*. 2021;38(2):125-38.
17. Kumar M, George RJ, PS A. Bibliometric analysis for medical research. *Indian journal of psychological medicine*. 2023;45(3):277-82.
18. Arnett GW, Jelic JS, Kim J, Cummings DR, Beress A, Worley Jr CM, et al. Soft tissue cephalometric analysis: diagnosis and treatment planning of dentofacial deformity. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1999;116(3):239-53.
19. Ngan P, Moon W. Evolution of Class III treatment in orthodontics. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2015;148(1):22-36.
20. Smart C. Craniofacial anomalies and the role of the dental therapist: the link between cleft lip, palate and alveolus, and periodontal disease. A literature review. *BDJ Team*. 2022;9(5):26-9.
21. Vig KW. Orthodontic considerations applied to craniofacial dysmorphology. *Cleft Palate Journal*. 1990;27(2):141-5.
22. Rios HF, Borgnakke WS, Benavides E. The use of cone-beam computed tomography in management of patients requiring dental implants: an American Academy of Periodontology best evidence review. *Journal of periodontology*. 2017;88(10):946-59.
23. Yoshikawa H, Tanikawa C, Ito S, Tsukiboshi Y, Ishii H, Kanomi R, et al. A three-dimensional cephalometric analysis of Japanese adults and its usefulness in orthognathic surgery: a retrospective study. *Journal of Cranio-Maxillofacial Surgery*. 2022;50(4):353-63.
24. Alamri HM, Sadrameli M, Alshalhooob MA, Alshehri MA. Applications of CBCT in dental practice: a review of the literature. *General dentistry*. 2012;60(5):390-400; quiz 1.
25. Kapila S, Conley R, Harrell Jr W. The current status of cone beam computed tomography imaging in orthodontics. *Dentomaxillofacial Radiology*. 2011;40(1):24-34.
26. Pauwels R, Araki K, Siewerdsen J, Thongvigitmanee SS. Technical aspects of dental CBCT: state of the art. *Dentomaxillofacial Radiology*. 2015;44(1):20140224.
27. Birbe J. Orthognathic surgery for aesthetic and functional outcomes: a multidisciplinary perspective. *Medical Research Archives*. 2025;13(4).
28. Kolokitha O-E, Topouzelis N. Cephalometric methods of prediction in orthognathic surgery. *Journal of maxillofacial and oral surgery*. 2011;10(3):236-45.
29. Johnston C, Burden D, Kennedy D, Harradine N, Stevenson M. Class III surgical-orthodontic treatment: a cephalometric study. *American journal of orthodontics and dentofacial orthopedics*. 2006;130(3):300-9.
30. Nada RM, Sugar AW, Wijdeveld MG, Borstlap WA, Clauser L, Hoffmeister B, et al. Current practice of distraction osteogenesis for craniofacial anomalies in Europe: a web based survey. *Journal of Cranio-Maxillofacial Surgery*. 2010;38(2):83-9.
31. Fattah AY, Caro C, Khechoyan DY, Tompson B, Forrest CR, Phillips JH. Cephalometric outcomes of orthognathic surgery in hemifacial microsomia. *Journal of Craniofacial Surgery*. 2014;25(5):1734-9.
32. Sarnat BG. Developmental facial abnormalities and the temporomandibular joint. *Dental Clinics of North America*. 1966;10(3):587-600.
33. Galea CJ, Dashow JE, Woerner JE. Congenital abnormalities of the temporomandibular joint. *Oral and Maxillofacial Surgery Clinics*. 2018;30(1):71-82.