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Bibliometric Analysis of Ultrasonographic Imaging Research in the Temporomandibular Joint

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ABSTRACT: Ultrasonography is a radiation-free, practical, relatively low-cost, and real-time imaging modality used in the evaluation of the temporomandibular joint, and numerous studies related to this topic have been reported in the literature. The aim of the present study was to evaluate the literature on ultrasonographic imaging of the temporomandibular joint using bibliometric analysis methods. The study data were obtained from the Web of Science Core Collection database using the search strategy ((ultrasound OR ultrasonography OR USG) AND (TMJ OR temporomandibular OR "temporomandibular joint")). R, RStudio, Biblioshiny, and the bibliometrix package were used to perform the bibliometric analyses, including Annual Scientific Production, Keywords Co-occurrence Network Analysis, Thematic Map Analysis, and Thematic Evolution Analysis. A total of 354 articles were evaluated, and an overall increasing trend in annual scientific production was observed. The terms "ultrasonography" and "temporomandibular joint" were located at the center of the constructed network structure, while thematic analyses revealed that themes related to "temporomandibular disorders," "masseter muscle," "arthritis," "magnetic resonance imaging," and "arthrocentesis" were prominent in the literature. Over time, the research focus in the literature shifted toward more specific research areas. It was determined that ultrasonographic imaging of the temporomandibular joint has maintained its academic importance over time.

KEYWORDS: Bibliometric analysis, Temporomandibular disorders, Temporomandibular joint, Ultrasonography, Ultrasound imaging

I. INTRODUCTION

Ultrasonography is an imaging modality that aims to obtain images using sound waves at frequencies that cannot be perceived by the human ear. The advantages of this method include the absence of ionizing radiation, relatively low cost, and its non-invasive nature (1, 2). In dentistry, ultrasonography is commonly used for the evaluation of lymphadenopathies, the tongue, salivary glands, periodontal defects, and soft tissues of the head and neck region, as well as for the assessment of the temporomandibular joint (3, 4).

The temporomandibular joint is a ginglymoarthrodial joint involved in functions such as speaking, mastication, and swallowing. Its primary hard tissue components consist of the glenoid fossa of the temporal bone and the condylar process of the mandible. Between these two structures lies an articular disc composed of dense fibrocartilaginous tissue (5-7). Magnetic resonance imaging is generally considered the gold standard for the evaluation of soft tissue-related disorders of the temporomandibular joint. However, this method has several disadvantages, including high cost, long imaging time, and difficulties in use among patients with cardiac pacemakers and those with claustrophobia (8). For this reason, ultrasonography, which provides real-time imaging capability, has emerged as a promising alternative imaging modality (9).

Although numerous studies on ultrasonographic imaging of the temporomandibular joint have been reported in the literature, information regarding the conceptual structure, scientific production, and thematic evolution of this research area remains limited (8, 10). As the number of publications in this field continues to increase, evaluating the current status and thematic evolution of the literature is becoming increasingly challenging. Therefore, investigating the conceptual structure, scientific production, and thematic evolution of this research area is necessary. Bibliometric analysis is a method that enables the evaluation of the conceptual structure, thematic evolution, and scientific production of a specific field and has the ability to quantitatively present the obtained findings (2, 11-13).

The aim of the present study was to evaluate the literature on ultrasonographic imaging of the temporomandibular joint using bibliometric analysis methods and to reveal the current status and research trends of the field through annual scientific production, author keyword network structure, thematic map, and thematic evolution analyses.

II. MATERIALS and METHODS

The present study was designed as a bibliometric analysis investigating studies related to ultrasonographic imaging of the temporomandibular joint. Due to the design of the study, no human or animal subjects were involved; therefore, ethical approval was not required. The study data were obtained from the Web of Science Core Collection (WoSCC) database using the advanced search query ((ultrasound OR ultrasonography OR USG) AND (TMJ OR temporomandibular OR "temporomandibular joint")). Only articles published between 1995 and 2025 were included in the study, while articles unrelated to the research topic, editorial letters, and conference proceedings were excluded.

R (version 4.6.0), RStudio, and the bibliometrix package (version 5.3.0) through Biblioshiny were used for bibliometric analysis. Annual Scientific Production was evaluated within the scope of performance analyses. In addition, Keywords Co-occurrence Network Analysis, Thematic Map Analysis, and Thematic Evolution Analysis were evaluated within the scope of science mapping analysis.

Network-based clustering approaches were used to examine the conceptual structure of the literature. Author-provided keywords were used for the Keywords Co-occurrence Network Analysis. In the constructed network structure, edge thickness represented co-occurrence strength, colors represented different thematic clusters, and node size indicated keyword frequency. In the thematic map analysis, basic themes, motor themes, niche themes, and emerging/declining themes were evaluated separately. The thematic changes within the research field were assessed using Thematic Evolution Analysis.

III. RESULTS

A total of 354 articles indexed in the WoSCC database were analyzed. Evaluation of the Annual Scientific Production revealed an overall increasing trend in scientific output, which became more pronounced in recent years. The lowest scientific production was observed in 1998, 1999, and 2004, whereas the highest scientific production was recorded in 2024 (Figure 1).

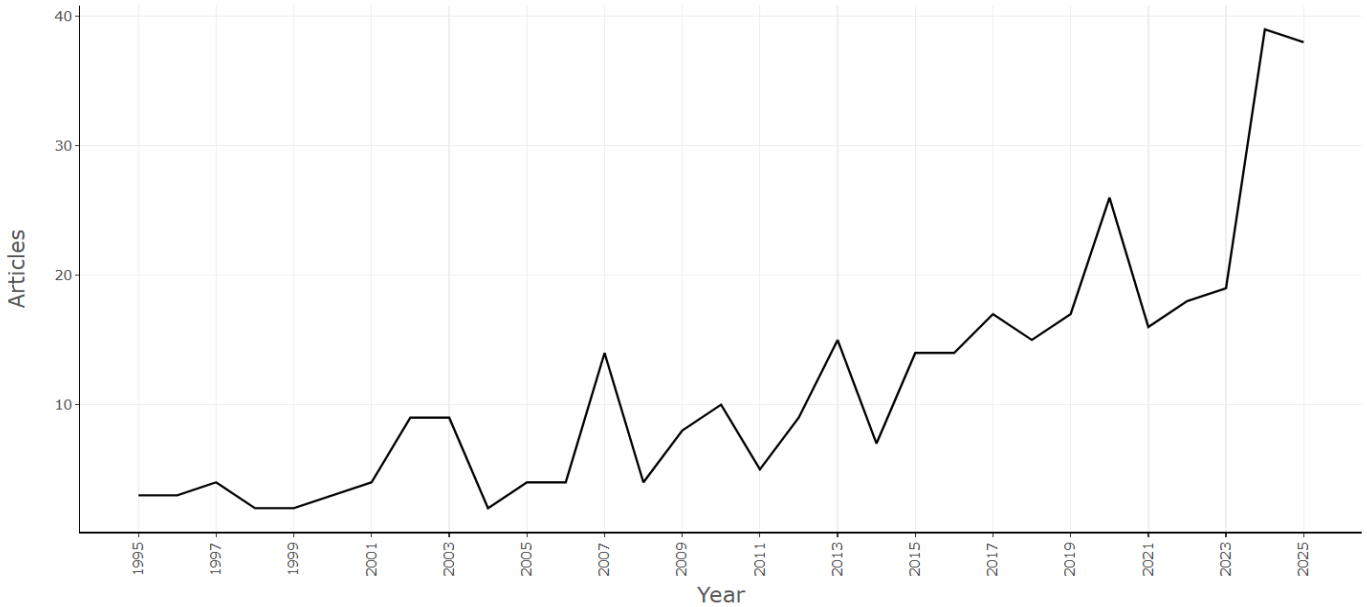

Figure 1. Annual Scientific Production Related to Ultrasonographic Imaging of the Temporomandibular Joint Between 1995 and 2025.

Keywords Co-occurrence Network Analysis revealed that the terms "ultrasonography" and "temporomandibular joint" were located at the center of the network structure with high connection density. In addition, the terms "magnetic resonance imaging," "osteoarthritis," "diagnostic imaging," "juvenile idiopathic arthritis," "arthrocentesis," "bruxism," "electromyography," "muscle," "myofascial pain," "masseter muscle," "children," and "temporomandibular disorders" emerged as prominent nodes within the network structure (Figure 2).

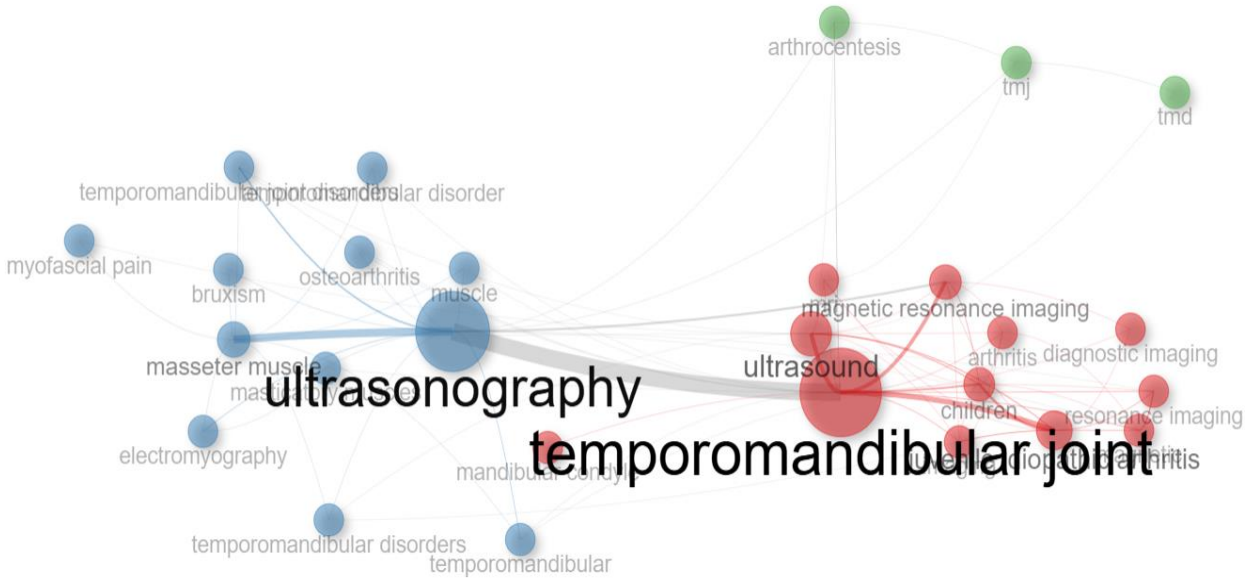

Figure 2. Author Keywords Co-occurrence Network Analysis Related to Ultrasonographic Imaging of the Temporomandibular Joint.

Thematic Map Analysis revealed that the terms "ultrasonography," "masseter muscle," and "temporomandibular disorders" were located within the basic themes cluster, whereas the terms "temporomandibular joint," "ultrasound," and "MRI" were observed within the motor themes cluster. The terms "juvenile idiopathic arthritis," "magnetic resonance imaging," and "children" were identified within the niche themes cluster, while the terms "temporomandibular disorders" and "joint" were located within the emerging/declining themes cluster (Figure 3).

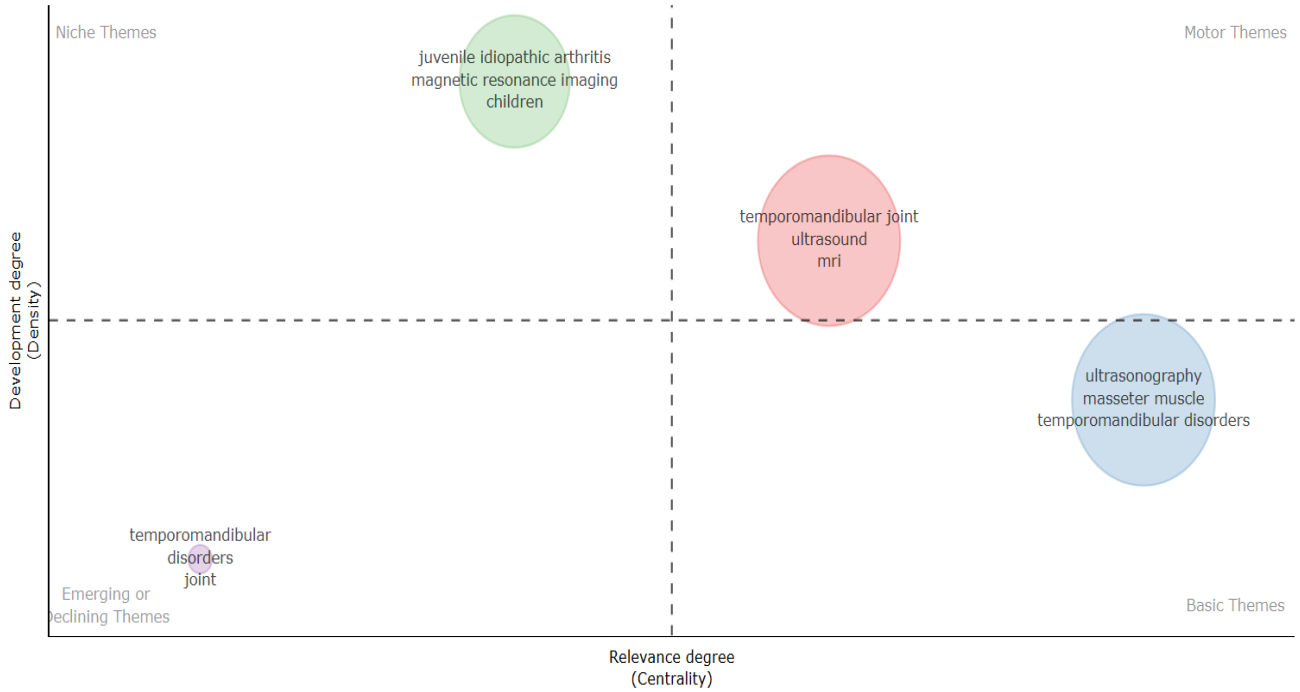

Figure 3. Thematic Map Analysis Related to Ultrasonographic Imaging of the Temporomandibular Joint.

Thematic Evolution Analysis revealed that the themes "arthritis," "face," "TMJ," "MRI," and "physical therapy" were prominent during and before 2010, whereas the themes "arthrocentesis," "rheumatoid arthritis," "ultrasound," and "temporomandibular" became more prominent in the subsequent period. In contrast, the themes "temporomandibular joint" and "ultrasonography" remained prominent throughout both periods (Figure 4).

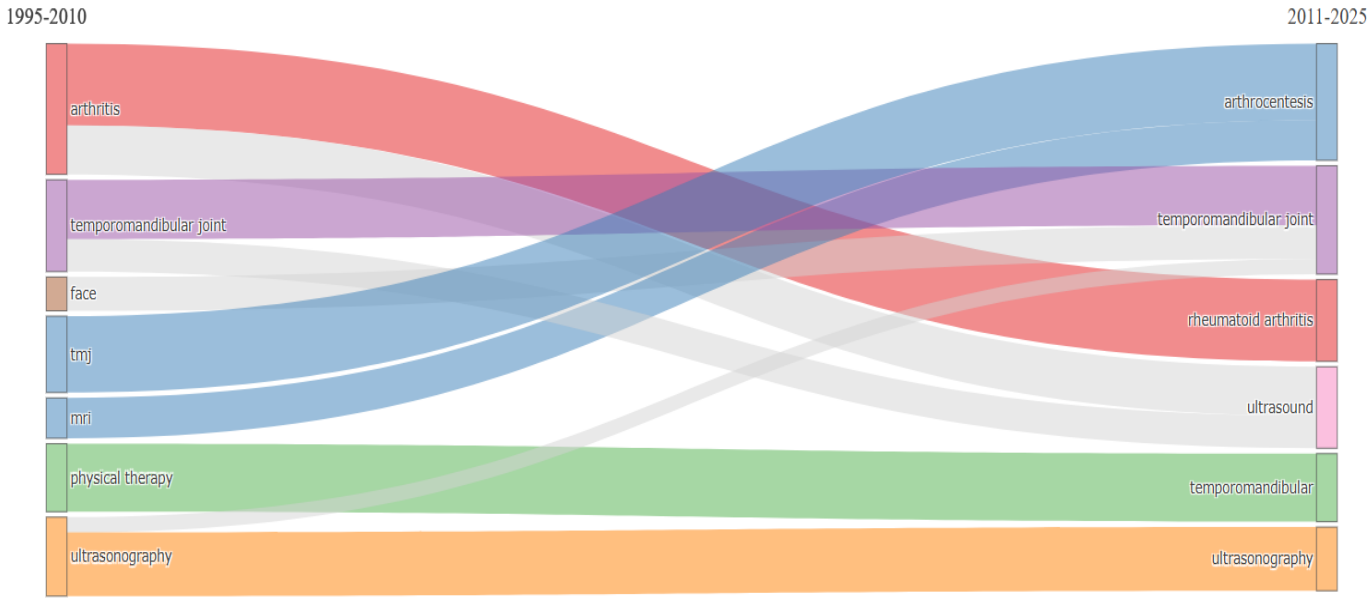

Figure 4. Thematic Evolution Analysis Related to Ultrasonographic Imaging of the Temporomandibular Joint Between 1995–2010 and 2011–2025.

IV. DISCUSSION

An increasing prevalence of temporomandibular joint disorders has been observed in recent years (14). Although these disorders may have different etiologies, the similarity of certain symptoms can create difficulties in differential diagnosis in clinical practice. Magnetic resonance imaging is considered the gold standard for the evaluation of the soft tissue components of the temporomandibular joint (15, 16). However, due to its high cost and limitations in use among certain patient groups, ultrasonography has emerged as an alternative imaging modality for the evaluation of the temporomandibular joint (8, 9). Although ultrasonography is an operator-dependent imaging modality, its use has demonstrated relatively satisfactory results in the detection of pathologies related to the articular disc (8, 9, 17). Numerous studies regarding ultrasonographic imaging of the temporomandibular joint have been reported in the literature (8, 10, 18, 19). However, there is limited information in the literature regarding the evaluation of scientific production, conceptual structure, and thematic evolution on this topic. Therefore, the scientific production, conceptual structure, and thematic evolution of this research area should be examined using bibliometric analysis methods (12).

Evaluation of the Annual Scientific Production related to the present study revealed an increasing trend in annual scientific output despite certain fluctuations over time. The fact that the highest level of scientific production was reached in recent years suggests that the importance of this topic in the literature has been progressively increasing. In particular, the increase observed after 2018 may be associated with the growing clinical use of ultrasonography in dentistry. Furthermore, advances in artificial intelligence technologies and the increasing prevalence of temporomandibular joint disorders may also have contributed to this increase (14, 20, 21).

Author Keywords Co-occurrence Network Analysis revealed that the terms “temporomandibular joint” and “ultrasonography” were located at the center of the network structure with high connection density, which may indicate that ultrasonography has become one of the major imaging modalities in temporomandibular joint research (9). The presence of the terms “arthritis” and “osteoarthritis” within the network structure indicates that degenerative joint diseases represent one of the research areas associated with this topic (22). The presence of the terms “bruxism,” “myofascial pain,” “electromyography,” and “masseter muscle” within the network structure may indicate that surrounding muscular structures are also evaluated during ultrasonographic imaging of the temporomandibular joint (23, 24). The presence of the term “arthrocentesis” within the network structure suggests that ultrasonography is used for guidance during interventional procedures involving the temporomandibular joint by taking advantage of its real-time imaging capability (25).

Thematic Map Analysis revealed that the themes “masseter muscle” and “temporomandibular disorders” were located within the basic themes cluster, indicating that the use of ultrasonography in the evaluation of temporomandibular joint disorders and masticatory muscles occupies an important place in the literature and represents one of the major research topics in this field (8, 17, 26). The presence of the themes “temporomandibular joint,” “ultrasound,” and “MRI” within the motor themes cluster indicates that the combined use of ultrasonography and magnetic resonance imaging represents one of the major research topics

guiding the literature in this field (27, 28). The presence of the themes "juvenile idiopathic arthritis" and "children" within the niche themes cluster indicates that these topics represent limited but well-developed research areas focusing on specific patient groups and particular clinical conditions (29, 30).

Thematic Evolution Analysis of the present topic revealed that the themes "arthritis" and "temporomandibular joint" were prominent during the early period. This finding indicates that earlier studies mainly focused on inflammatory diseases affecting the temporomandibular joint. In the subsequent period, the association of the theme "arthritis" with "rheumatoid arthritis" suggests that, after 2010, the research field became more focused on specific disease groups (31, 32). The persistence of the themes "temporomandibular joint" and "ultrasonography" throughout both periods indicates that these topics have maintained their academic popularity for many years (8, 10). The recent emergence of the theme "arthrocentesis" suggests that studies in this field have gradually evolved toward interventional clinical applications (33).

V. CONCLUSIONS

The results of the present study demonstrated that scientific production related to ultrasonographic imaging of the temporomandibular joint has shown an increasing trend over the years. It was also observed that research topics in this field have evolved over time toward more specific areas of interest. Future studies are recommended to be designed using different databases and search terms in multiple languages.

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