

Temporomandibular Joint Arthrocentesis: A Bibliometric Analysis From 1989 to 2024

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Abstract

BACKGROUND/AIMS: Arthrocentesis of the temporomandibular joint (TMJ), introduced in the early 1990s, has become a cornerstone of minimally invasive management for TMJ internal derangements; however, the scientific structure and evolution of research in this field have not been comprehensively evaluated. This study aimed to analyze the scientific development, research trends, and collaborative patterns in TMJ arthrocentesis using bibliometric methods.

MATERIALS AND METHODS: A total of 581 publications (1989-2024) were retrieved from the Web of Science Core Collection. Bibliometric analyses were performed using biblioshiny to evaluate publication trends, citation performance, leading authors, institutions, and journals. VOSviewer was employed to visualize author, institutional, and country collaboration networks, as well as article co-citation structures and keyword co-occurrence patterns, allowing the identification of influential research clusters and thematic evolution.

RESULTS: The United States and the Karolinska Institute demonstrated the highest contributions at the national and institutional levels, respectively. Manfredini D. and Guarda-Nardini L. were the most prolific authors, with the Journal of Oral and Maxillofacial Surgery as the primary publication venue. Common keywords included “arthrocentesis”, “temporomandibular joint”, and “temporomandibular joint disorders”. Bibliometric mapping revealed a temporal shift in thematic trends: whereas initial terms focused on mechanical concepts, regenerative agents such as “platelet-rich plasma” and “hyaluronic acid” showed increased co-occurrence density after 2020.

CONCLUSION: Current trends indicate that arthrocentesis is evolving from a traditional irrigation-based technique into a regenerative therapeutic modality. This bibliometric analysis provides a comprehensive overview of influential contributors, emerging topics, and evolving themes, offering guidance for clinicians and researchers seeking to advance the field.

Keywords: Arthrocentesis, bibliometrics, regenerative medicine, temporomandibular joint disorders

INTRODUCTION

Temporomandibular disorders (TMDs) are musculoskeletal conditions characterized by pain and dysfunction of the temporomandibular joint (TMJ). They represent the third most common oral and maxillofacial disorders after dental caries and periodontal disease. TMDs, which are more frequently observed in young adults and women, may present as acute or chronic conditions and are commonly associated with symptoms such as pain, limited mouth opening, and joint noises during

mandibular movement. These clinical manifestations can significantly impair patients' quality of life.^{1,2}

Management strategies for TMDs encompass a broad spectrum of treatment modalities, ranging from conservative, non-surgical approaches to minimally invasive interventions, and open joint surgery. Conservative therapies, such as patient education, physiotherapy, occlusal splint therapy, and pharmacological agents, including non-steroidal anti-inflammatory drugs and muscle relaxants, are generally

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recommended as first-line treatment options. When conservative management fails to achieve sufficient pain relief or functional improvement, minimally invasive procedures, particularly TMJ arthrocentesis and arthroscopy, are commonly considered.³⁻⁵

TMJ arthrocentesis was first described by Nitzan et al.⁶ in 1991 as a minimally invasive technique involving lavage of the upper joint compartment using solutions such as Ringer's lactate or sterile saline. The procedure is typically performed under local anesthesia but may also be carried out under intravenous sedation or general anesthesia.⁶ Since its original description, several technical modifications have been introduced, and arthrocentesis procedures are broadly classified by the number of puncture sites used: single- or double-puncture arthrocentesis.⁷ Arthrocentesis has been widely applied in the management of TMDs, particularly for internal derangements (including disc displacement with or without reduction) and for degenerative joint diseases such as osteoarthritis. These conditions are frequently associated with masticatory pain at rest or during function, limitation of maximum mouth opening, and subsequent deterioration in oral function and quality of life.⁸

Bibliometrics is a quantitative research method used to assess scientific productivity, research impact, and the intellectual structure of a specific field through the analysis of academic publications.⁹ Bibliometric analyses commonly examine publication output, citation performance, authorship patterns, and institutional or country-level contributions, as well as thematic structures that reflect the evolution of research topics over time. When appropriately applied, bibliometric approaches provide objective insights into research trends, influential contributors, and emerging areas of scientific interest.¹⁰

Although bibliometric studies have been conducted in oral and maxillofacial surgery focusing on TMJ disorders, TMJ osteoarthritis, and highly cited publications, no bibliometric analysis has specifically addressed TMJ arthrocentesis.¹¹⁻¹⁵ Consequently, the scientific development, structure, and evolution of research in this area remain underexplored. Therefore, this study aimed to provide a comprehensive bibliometric analysis of TMJ arthrocentesis publications from 1989 and 2024 by evaluating publication trends, collaborative networks, influential journals and authors, and temporal changes in research themes, to inform and guide future investigations in this field.

MATERIALS AND METHODS

Data Source and Search Strategy

For our bibliometric analysis, we selected the Web of Science Core Collection (WoSCC), the globally recognized database platform provided by Clarivate Analytics, to obtain global academic data. The literature search was conducted on November 15, 2025, using the following strategy applied to the title, abstract, and author keywords fields: ("arthrocentesis" OR "lavage" OR "lysis" OR "irrigation" OR "joint washing" OR "lysis and lavage" OR "joint irrigation" OR "joint lavage therapy") AND ("TMJ" OR "temporomandibular" OR "TMJ" OR "craniomandibular joint") NOT (knee OR shoulder OR hip OR ankle OR elbow OR wrist). The retrieved records were refined according to predefined inclusion criteria. Publications indexed up to 2024 were included, while records from 2025 were excluded to avoid incomplete citation data. Publications from 2025 were excluded to ensure a complete citation window and to avoid bias related to incomplete indexing. Only documents classified as "article" or "review article" were considered. The analysis was restricted

to english-language publications indexed in the science citation index expanded and the emerging sources citation index and categorized under the Dentistry, Oral Surgery & Medicine category. Following the application of these criteria, a total of 581 publications were included in the final dataset (Figure 1). Bibliographic information, including publication year, title, authors, affiliations, countries, abstracts, keywords, and source journals, was exported in both TXT and BibTeX formats for subsequent bibliometric analysis. As no animals or humans were involved in the study, ethical approval was not required.

Eligibility Criteria and Language Selection

Only original research and review articles were included to ensure methodological consistency and reproducibility of bibliometric indicators. Document types with limited peer-review depth, including editorials, letters, conference proceedings, and case reports, were excluded from the analysis. The analysis was restricted to english-language publications. This language criterion was applied to maintain terminological consistency and enable reliable citation-based evaluation, as English is the predominant language of international scientific communication and indexing in bibliometric databases.

Bibliometric Analysis and Visualizations

Bibliometric analyses were performed using VOSviewer (version 1.6.20; Leiden University, Leiden, Netherlands) and the R package bibliometrix via its Biblioshiny interface (Vienna, Austria). VOSviewer was employed to construct and visualize collaboration networks among authors, institutions, and countries, as well as co-citation networks of references, authors, and journals. Keyword analysis was conducted using co-occurrence mapping to identify frequently associated terms and to reveal thematic structures and research hotspots within the field. Co-citation analysis was used to assess citation relationships: two publications were considered co-cited if they were both referenced by a third publication. In addition, bibliometrix was used to analyze publication output, citation performance, and the geographical distribution of research activity and to generate descriptive statistics and visual representations of bibliometric indicators across authors, institutions, and journals.

To evaluate author and journal productivity and citation impact, several complementary bibliometric indices were calculated. The h-index reflects the largest number h such that h publications have each received at least h citations, capturing both productivity and citation impact in a single measure.¹⁶ The g-index, proposed by Egghe¹⁷ as a citation-sensitive refinement of the h-index, is used less frequently in the literature than the h-index; it is defined as the largest number g such that the top g publications have collectively received at least g^2 citations. Because it incorporates the actual citation counts of the most-cited papers rather than simply counting papers above a fixed citation threshold, the g-index is always greater than or equal to the h-index and provides additional discriminatory power when comparing highly cited authors or journals.¹⁷ The m-index ($m = h/n$, where n is the number of years since the author's first publication) was also calculated to adjust productivity and impact for career duration, enabling more balanced comparisons among researchers at different career stages.¹⁶

Statistical Analysis

The bibliometric data were analyzed using descriptive statistical methods to summarize the literature's fundamental characteristics, including annual publication growth, document types, and

geographical distribution. Publication trends and citation performance were quantified using frequency and percentage distributions. Network visualizations, including co-authorship, co-citation, and keyword co-occurrence maps, were constructed using VOSviewer (version 1.6.20) and the Biblioshiny interface of the R-bibliometrix package to illustrate the field's collaborative and intellectual structure. Data cleaning and the generation of descriptive tables and charts were performed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Since this study relied on the automated extraction of bibliographic metadata and focused on relational network mapping, no manual content coding or inferential statistical testing was required.

RESULTS

Overview and Annual Publication

The WoSCC retrieved 581 documents related to arthrocentesis (1989-2024), published across 54 sources, including journals, books, and conference proceedings. Original research articles constituted the majority of the dataset (n=485; 83.4%), followed by review articles (n=88; 15.1%). The overall annual growth rate of publications was 10.21%, with an average of 22.56 citations per article and a cumulative total of 7,505 citations. The dataset comprised contributions from 1,919 authors, reflecting a highly collaborative research environment. In total, 809 keywords plus terms and 746 author keywords were identified, covering core topics such as arthrocentesis, TMJ disorders, and arthroscopy.

The annual distribution of publications and citations has shown a steady upward trend since 2005, with annual output exceeding 20 papers from 2017 onward and peaking in 2024 (n=60). The highest mean citation rate was observed in 1991 (229.5 citations per article). The highest average citation rate since the 2000s was observed in 2015, with 49.16 citations per article. Overall, the data indicate that interest in arthrocentesis has remained consistently strong over the years, with steady increases in publication activity and research interest.

Analysis of Authors

The 25 most influential authors in TMJ arthrocentesis research are summarized in Table 1. Manfredini D. was the most prominent contributor, with an h-index of 15, g-index of 19, and m-index of 0.789, accumulating 751 citations across 19 publications since 2007. Guarda-Nardini L. ranked second, with an h-index of 13, a g-index of 17, and 647 citations from 17 publications. Dolwick M. F. had with an h-index of 12 and a g-index of 13, with 1,054 citations from 13 publications published since 1990.

The co-authorship network of authors with at least three publications is shown in Figure 2A. A total of 143 authors were distributed across 47 clusters, indicating a highly fragmented but centralized collaboration structure. The cluster led by Hamada exhibited the highest collaboration density (ten authors), followed by the Guarda-Nardini cluster (six authors). Co-citation analysis (Figure 2B), including authors with at least 25 citations, identified five clusters comprising 143 authors. Manfredini emerged as the most central and influential author, characterized by both high citation counts and high total link strength, while Guarda-Nardini showed similar co-citation prominence. Foundational authors, such as Nitzan, occupied intermediary positions, connecting multiple research themes within the arthrocentesis literature. Institutional

Table 1. Top twenty-five authors by productivity and impact in temporomandibular joint arthrocentesis research

Author	h-index	g-index	m-index	TC	NP	PY_start
Manfredini D	15	19	0.789	751	19	2007
Guarda-Nardini L	13	17	0.684	647	17	2007
Dolwick Mf	12	13	0.333	1054	13	1990
Hamada Y	11	15	0.478	240	15	2003
Kondoh T	10	11	0.385	221	11	2000
Seto K	10	11	0.385	227	11	2000
Emshoff R	9	10	0.346	263	10	2000
Ferronato G	9	9	0.5	418	9	2008
Holmlund Ab	9	12	0.321	256	12	1998
Segami N	8	10	0.258	413	10	1995
Dimitroulis G	7	9	0.226	413	9	1995
Grossmann E	7	12	0.538	145	12	2013
Kaneyama K	7	8	0.28	239	8	2001
Kurita K	7	7	0.241	182	7	1997
Nitzan Dw	7	7	0.194	904	7	1990
Gonzalez-Garcia R	6	8	0.3	237	8	2006
Nagori Sa	6	7	0.667	95	7	2017
Rudisch A	6	6	0.231	162	6	2000
Sato J	6	7	0.25	185	7	2002
Sembronio S	6	6	0.3	152	6	2006
Senturk Mf	6	8	0.6	109	8	2016
Iizuka T	5	5	0.161	293	5	1995
Jose A	5	5	0.625	90	5	2018
Kutuk N	5	5	0.625	42	5	2018
Machon V	5	5	0.333	134	5	2011

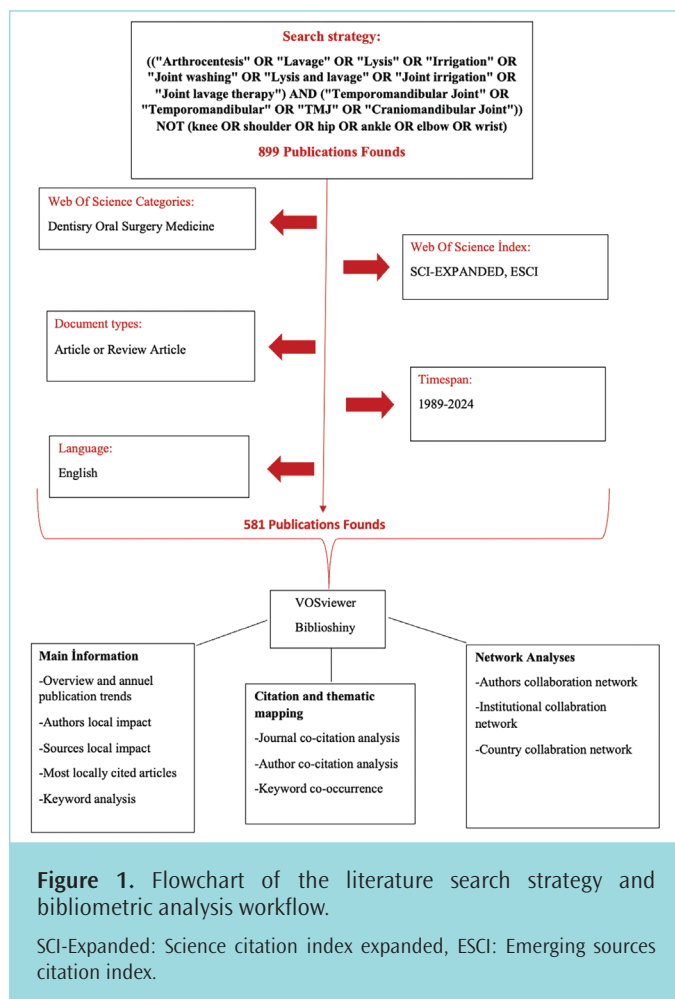
NP: Number of publications, TC: Total citations, PY_start: Publication year starting.

collaboration analysis (Figure 2C) identified Tsurumi University as the most productive institution with 18 publications, followed by Karolinska Institutet and the University of Padua with 16 and 14 publications, respectively. Network analysis revealed Karolinska Institutet as the most central collaborative institution, whereas the University of Padua, despite its high publication output, demonstrated relatively limited inter-institutional collaboration.

At the country level (Figure 2D), 30 countries were grouped into seven collaborative clusters. The United States exhibited the strongest international collaboration, particularly with Sweden, Japan, and Brazil, underscoring its central role in global TMJ arthrocentesis research. In contrast, Türkiye, despite its high publication output, showed lower total link strength, suggesting predominantly domestic collaboration patterns.

Analysis of Sources

Table 2 presents the ten most productive and influential journals in TMJ arthrocentesis research. The Journal of Oral and Maxillofacial Surgery ranked first with 118 publications and 4,061 citations (h-index =37), followed by the International Journal of Oral and Maxillofacial Surgery and the Journal of Cranio-Maxillofacial Surgery, with 66 and 54 publications, respectively.



Journal co-citation analysis (Figure 3A) identified 21 journals connected through 174 citation links, forming six distinct clusters. Node size corresponded to publication volume. The Journal of Oral and Maxillofacial Surgery occupied a central position within the network, reflecting both high publication output and strong citation connectivity. Notably, strong interconnections among the Journal of Oral and Maxillofacial Surgery, the International Journal of Oral and Maxillofacial Surgery, and the Journal of Cranio-Maxillofacial Surgery suggest that these journals function as key interdisciplinary bridges within the field.

Analysis of Most Local Cited Articles

Table 3 presents the local citation (LC) analysis of TMJ arthrocentesis-related publications and lists the ten articles with the highest LC counts. The top-ranked article by Manfredini D (2012, Journal of Oral Rehabilitation) received 48 LCs and 84 global citations, yielding an LC/GC ratio of 57.14%. This was followed by studies by Schiffman E (2017, Journal of Dental Research) and Guarda-Nardini L (2015, Journal of Oral Rehabilitation). Additional highly cited contributions included studies by Nagori SA (2018) and Kropmans TJB (1999). LC/GC ratios ranged from 1.69% to 71.43%, indicating substantial variation in the relative local influence of seminal publications within the arthrocentesis literature.

Keyword Analysis

Keyword co-occurrence analysis (Figure 3B) identified the most frequent terms: "arthrocentesis", "temporomandibular joint",

"temporomandibular joint disorders", "arthroscopy", "hyaluronic acid", "temporomandibular disorders", and "osteoarthritis". Larger nodes reflect higher frequency of occurrence, while shorter distances and thicker links indicate stronger associations between keywords.

Temporal keyword analysis (Figure 3C) revealed a clear shift in research focus. Earlier studies primarily emphasized mechanical and procedural concepts, whereas publications after 2020 increasingly focused on biological and regenerative approaches, particularly platelet-rich plasma (PRP) and hyaluronic acid. This trend indicates a transition from symptom-oriented management toward biologically driven strategies aimed at joint and disc repair. In contrast, the relatively stable or declining prominence of terms such as "occlusal splints" suggests their continued clinical relevance but reduced novelty in recent research.

Collaboration Network Analysis

Collaboration networks among authors, institutions, and countries are presented in Figure 4. Author-level analysis revealed a centralized collaboration structure dominated by several core clusters. The red cluster, led by Manfredini, Guarda-Nardini, and Ferronato, formed the most densely interconnected group, indicating sustained scholarly collaboration. The blue cluster was characterized by Hamada's central bridging role, linking multiple clusters through collaborations with authors such as Holmlund, Gynther, and Takahashi. The orange cluster, including Sato, Segami, and Kaneyama, also demonstrated strong internal collaboration among its members.

Analysis of institutional collaboration showed that the most intensive network consisted primarily of Japanese institutions (Tsurumi University, Nihon University, and Tohoku University) together with the Karolinska Institute. A secondary cluster included Atatürk University and Akdeniz University, reflecting regionally concentrated yet productive institutional partnerships.

At the country level, the United States occupied the most central position within the global collaboration network, maintaining strong collaborative ties with Türkiye, Japan, and China. European countries demonstrated moderate connectivity, whereas many Asian and Latin American countries exhibited more regionally confined patterns of collaboration. Overall, these findings illustrate a globally distributed yet regionally stratified structure of scientific collaboration in TMJ arthrocentesis research.

DISCUSSION

To the best of our knowledge, this study is the first comprehensive bibliometric analysis to focus exclusively on TMJ arthrocentesis, covering publications from 1989 to 2024. The primary aim was to quantitatively map the scientific development, thematic evolution, and intellectual structure of research in this field. Analysis of 581 publications revealed several key findings: a sustained increase in research output since 2005; a concentration of publications within a limited number of core journals, most notably the Journal of Oral and Maxillofacial Surgery; a dominance of influential authors such as Manfredini and Guarda-Nardini; and a clear thematic shift toward regenerative and biologically oriented treatment strategies.

The purpose of this bibliometric analysis is to highlight the fragmented structure of the existing literature, identify knowledge gaps, and clarify how the arthrocentesis technique has evolved over time.

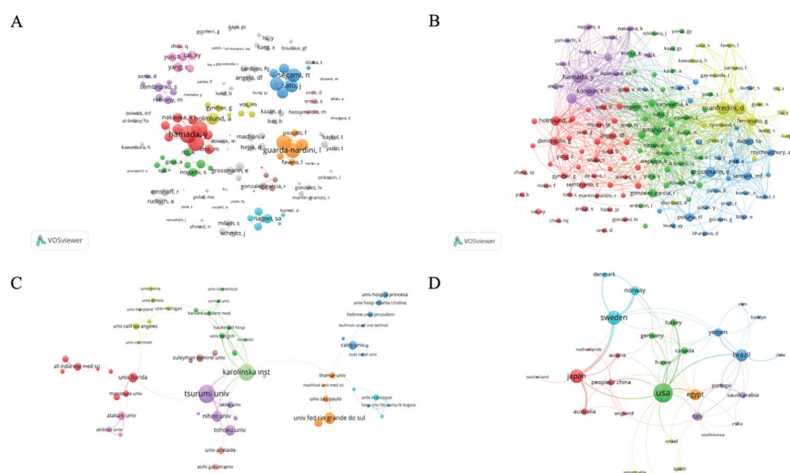


Figure 2. Collaboration and co-citation networks in TMJ arthrocentesis research visualized using VOSviewer. (A) Author co-authorship network showing collaborative relationships among authors with at least three publications. Node size represents publication output, while link thickness indicates collaboration strength. (B) Author co-citation network illustrating the intellectual structure of the field based on co-citation relationships. Larger nodes reflect higher citation impact, and clusters represent closely related research communities. (C) Institutional collaboration network depicting inter-institutional research partnerships. Node size corresponds to publication volume, and links indicate collaborative connections between institutions. (D) Country collaboration network demonstrating international research cooperation patterns in TMJ arthrocentesis. Node size reflects publication output, and link strength represents the intensity of collaboration between countries. Colors indicate distinct collaboration clusters.

TMJ: Temporomandibular joint.

Table 2. The ten most productive and influential journals in temporomandibular joint arthrocentesis research

Source	h-index	g-index	m-index	TC	NP	PY_start
Journal of Oral and Maxillofacial Surgery	37	52	0.86	4061	118	1990
International Journal of Oral and Maxillofacial Surgery	29	36	0.78	1990	66	1997
Journal of Cranio-Maxillofacial Surgery	23	34	0.83	1286	54	2000
Oral Surgery Oral Medicine Oral Pathology Oral Radiology	23	32	0.61	1580	34	1998
British Journal of Oral and Maxillofacial Surgery	13	29	0.54	984	34	1998
Journal of Oral Rehabilitation	14	22	0.58	888	26	1985
Cranio: The Journal of Craniomandibular & Sleep Practice	14	18	0.48	487	24	1994
Journal of Maxillofacial and Oral Surgery	10	18	0.83	574	21	2004
Journal of Oral & Facial Pain and Headache	8	10	0.4	272	17	2010
Oral and Maxillofacial Surgery Heidelberg	8	10	0.3	220	16	2010

NP: Number of publications, TC: Total citations, PY_start: Publication year starting.

Table 3. The ten most locally cited articles in temporomandibular joint arthrocentesis research

Document	DOI	Year	LC	GC	LC/GC ratio(%)	NLC	NGC
Manfredini D, 2012, J Oral Rehabil	10.1111/j.1365-2842.2011.02265.x	2012	48	84	57.14	21.00	3.21
Schiffman El, 2007, J Dent Res	10.1177/154405910708600109	2007	23	85	27.06	10.00	2.32
Guarda-Nardini L, 2015, J Oral Rehabil	10.1111/joor.12282	2015	21	42	50.00	9.73	0.85
Nagori Sa, 2018, J Oral Rehabil	10.1111/joor.12665	2018	17	29	58.62	17.41	1.52
Kropmans Tjb, 1999, J Oral Rehabil	10.1046/j.1365-2842.1999.00417.x	1999	16	37	43.24	9.00	1.30
Ozdamar Sm, 2017, J Oral Rehabil	10.1111/joor.12467	2017	15	23	65.22	21.18	0.97
Al-Baghdadi M, 2014, J Dent Res	10.1177/0022034514528333	2014	14	76	18.42	6.50	2.87
Haigler Mc, 2018, J Am Dent Assoc	10.1016/j.adaj.2018.07.025	2018	14	47	29.79	14.34	2.46
Toameh Mh, 2019, Dent Med Probl	10.17219/dmp/109329	2019	14	25	56.00	16.10	2.63
Guarda-Nardini L, 2011, J Oral Rehabil	10.1111/j.1365-2842.2010.02164.x	2011	12	23	52.17	13.50	1.08

LC: Local citations, GC: Global citations, LC/GC ratio: Percentage of local to global citations, NLC: Normalized local citations, NGC: Normalized global citations.

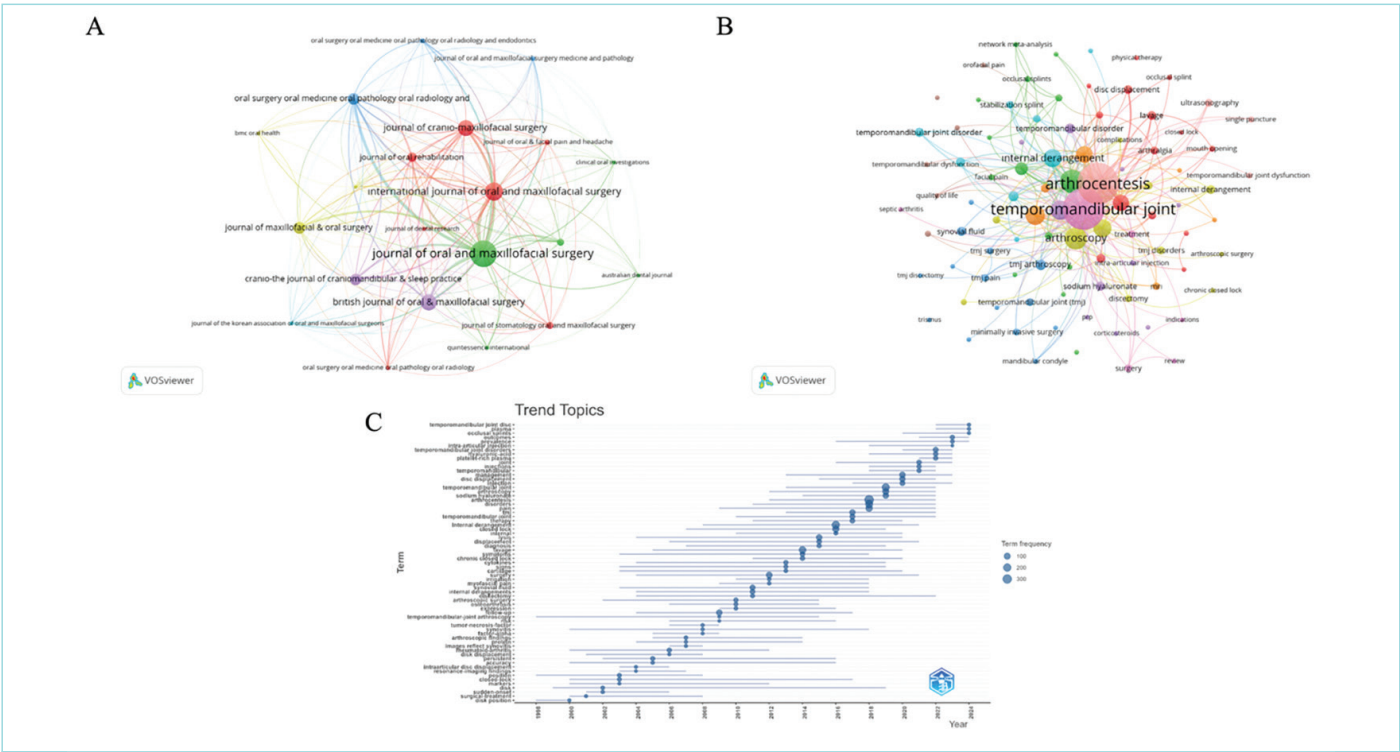


Figure 3. Journal, keyword, and thematic trend analyses in TMJ arthrocentesis research. (A) Journal co-citation network showing relationships among the most influential journals. (B) Keyword co-occurrence network illustrating the main research topics and their interrelationships. (C) Trend topics analysis demonstrating the temporal evolution of frequently used keywords over time.

TMJ: Temporomandibular joint.

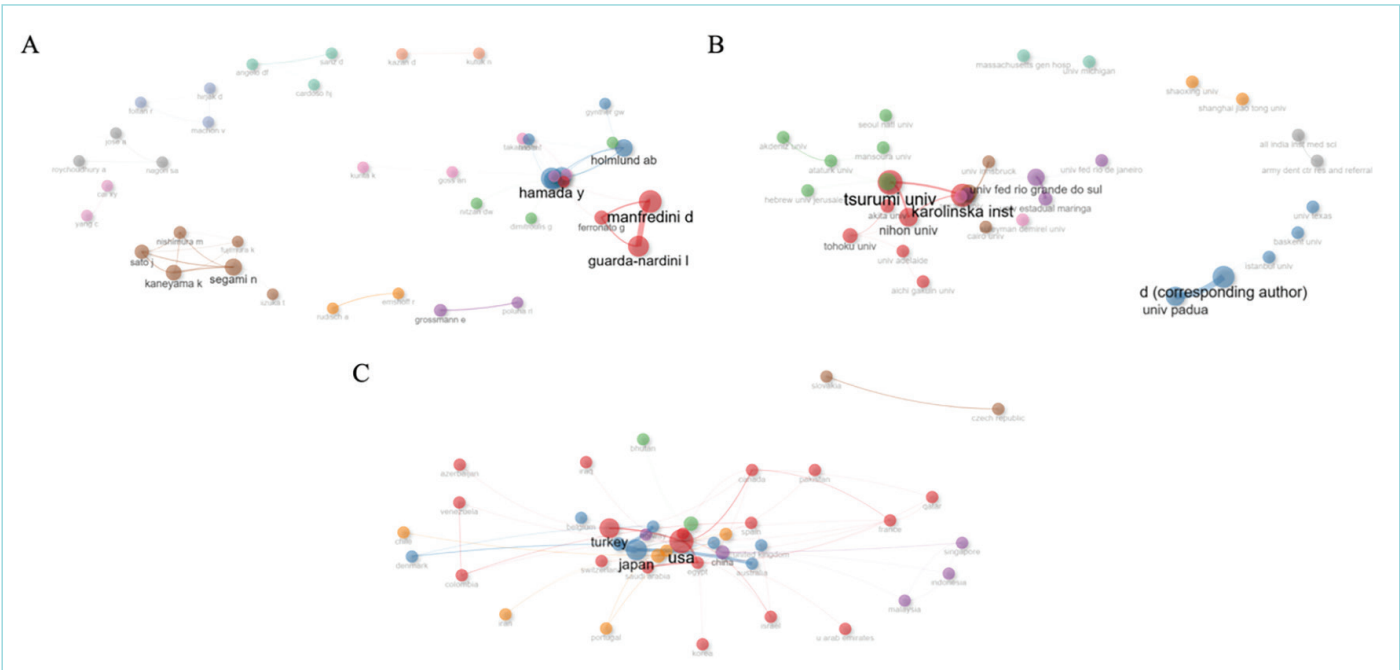


Figure 4. Global collaboration networks in TMJ arthrocentesis research (1989-2024). (A) Author Network: Visualizes co-authorship clusters, highlighting the central roles of Manfredini, Guarda-Nardini, and Hamada. (B) Institutional Network: Illustrates research partnerships among leading academic centers, with Tsurumi University and Karolinska Institutet appearing as major hubs. (C) Country Network: Displays international cooperation patterns, showing the United States, Türkiye, and Japan as the primary contributors to global scientific exchange.

TMJ: Temporomandibular joint.

The annual publication trends show increases and decreases that correspond to major developments in the field. After Nitzan first described arthrocentesis in 1991, studies of hyaluronic acid and steroid injections appeared in the early 2000s. Ultrasound-guided techniques emerged around 2010, and in 2012, arthrocentesis was defined as a minimally invasive, effective, and low-risk treatment for TMJ disorders. In the same year, Şentürk and Cambazoglu⁷ proposed a classification of arthrocentesis techniques based on the number of puncture sites, distinguishing single-puncture from double-puncture arthrocentesis and providing a standardized framework that has since been widely used to compare procedural variants. From 2015 onward, regenerative approaches such as PRP and stem-cell-based products gained attention; after 2020, efforts shifted toward standardization and improving levels of evidence. These milestones explain the overall publication pattern.¹⁸⁻²⁴

The development of research on TMJ arthrocentesis appears to mirror the scientific trends observed in studies of other joints. In the context of TMJ arthrocentesis, this procedure offers direct, albeit rare, access to synovial fluid, and its biochemical profiling has the potential to substantially advance personalized joint-specific treatment strategies. A comprehensive 2024 bibliometric analysis of synovial fluid research in osteoarthritis found a marked increase over the past decade in studies focusing on the diagnostic and biological significance of synovial fluid. This global trend aligns with the rise in TMJ arthrocentesis publications after 2018, highlighting growing interest in minimally invasive treatment approaches. While large joints such as the knee and hip have been extensively investigated—particularly regarding synovial fluid biomarkers, inflammatory pathways, and intra-articular therapies—research on the TMJ remains relatively limited. This indicates that further clinical and scientific work is needed and that the present study not only represents the first bibliometric analysis in this field but also addresses a meaningful gap in the current literature.²⁵⁻²⁷

The most clinically relevant finding of this study is the thematic evolution revealed by keyword co-occurrence and trend analyses. Over the past three decades, TMJ arthrocentesis research has shifted from symptom-oriented pain relief toward biologically driven strategies aimed at repairing TMJ disc pathology. The increasing volume of publications on regenerative approaches, together with a growing emphasis on treatment outcomes, reflects a broader transition toward evidence-based comparisons of different techniques. Recent high-level evidence supports this trend. Turosz et al.²⁸ compared arthrocentesis techniques and intra-articular biological agents exclusively through randomized controlled trial-based systematic reviews, identifying approaches supported by stronger evidence. In parallel, Zhang et al.²⁹ systematically compared regenerative agents such as PRP, i-PRF, and bone marrow aspirate concentrate (BMAC) across different follow-up periods, providing robust comparative data on their clinical effectiveness. Collectively, these studies reinforce the growing focus on regenerative treatments and align closely with the patterns identified in our bibliometric analysis. However, the absence of standardized application protocols, including preparation methods, injection volume, treatment frequency, and follow-up duration, continues to generate substantial heterogeneity in reported outcomes, highlighting a critical gap in the current literature.

Analysis of the literature's intellectual structure shows that research on TMJ arthrocentesis is primarily shaped by studies focused on oral and maxillofacial surgery published in high-impact journals, such

as the *Journal of Oral and Maxillofacial Surgery*. Core publications by Manfredini, Guarda-Nardini, and Nagori form the main scientific foundation of the field, as reflected by their high LC rates. In contrast, the work of Schiffman et al.³⁰ demonstrates broader influence beyond arthrocentesis-specific research, with high global citation counts driven by its relevance to orofacial pain and multidisciplinary TMD research. This pattern indicates that while arthrocentesis research is anchored in surgical literature, its conceptual development benefits from interdisciplinary contributions, particularly from pain-related disciplines.

The distinct separation of clusters observed in the visualizations indicates strong regional research hubs in the TMJ arthrocentesis literature; however, international collaboration among these hubs appears limited. Notably, Italian and Japanese clusters form the core of the network, whereas smaller clusters from other countries remain relatively isolated. This pattern suggests that the field continues to evolve around country-based research foci, and that strengthening multicenter and international collaborations may enhance the coherence, methodological diversity, and overall evidence base of the literature.

Analysis of the geographical distribution of publications demonstrates a pronounced global interest in TMJ arthrocentesis, with the United States, Türkiye, and Japan as the leading contributors. Türkiye's substantial research output reflects a sustained clinical commitment to minimally invasive TMJ interventions, facilitated by the procedural simplicity of arthrocentesis and by its low morbidity profile, rapid postoperative recovery, and limited equipment requirements. This productivity is further reinforced by the country's large young demographic, the rising prevalence of stress-related bruxism, and the longstanding integration of regenerative therapies into routine clinical practice.²² Although Türkiye is among the most productive countries in the TMJ arthrocentesis literature, its low total link strength may stem from research being conducted largely within the same institutions or domestic networks. This limited integration into international research structures likely weakens the country's overall capacity for collaboration. Japan's prominent position is consistent with its historical scientific leadership in the field, grounded in foundational contributions such as Murakami's double-needle arthrocentesis technique, Honda and Kurita's systematization of operative arthroscopy, and Yasunori Yamamoto's endoscopic characterization of intra-articular anatomy.³¹ The high burden of age-related degenerative joint conditions in Japan—driven by the world's oldest population—also likely stimulates greater demand for minimally invasive TMJ treatments.³² In the United States, the strong scientific engagement with arthrocentesis is attributable not only to the epidemiological prevalence of TMJ disorders but also to robust institutional research infrastructures and funding ecosystems. Notably, the National Institutes of Health routinely supports investigations into TMJ pathophysiology, minimally invasive surgical strategies, and regenerative modalities under thematic programs such as “pain disorders”, “musculoskeletal degeneration”, and “oral and maxillofacial health”, thereby sustaining a high level of scholarly activity in arthrocentesis and arthroscopy.³³

The primary strength of this study lies in its novelty as the first comprehensive bibliometric analysis dedicated to TMJ arthrocentesis research. By integrating performance analysis with Biblioshiny and scientific mapping with VOSviewer, the study provides a multi-level evaluation of research productivity, collaborative networks, and the

intellectual structure of the field, thereby extending beyond purely descriptive bibliometric metrics.

Study Limitations

This study has several limitations. First, data retrieval was restricted to the WoSCC. Although WoSCC is widely recognized as a high-quality citation database, the exclusion of other major sources, such as Scopus and Embase, may have led to the omission of relevant publications. Second, the time-dependent nature of citation accumulation inherently disadvantages recently published studies, because they have had limited opportunity to accrue citations, potentially underestimating their scientific impact. Third, the methodological framework relied exclusively on VOSviewer and Biblioshiny. Although both tools are effective for performance analysis and network visualization, an alternative tool, CiteSpace-particularly useful for identifying research-front “burst” topics- was not employed and might have provided additional insights. This study shares the inherent limitations of bibliometric analyses. Quantitative indicators, such as publication counts or total citations, do not necessarily reflect methodological quality or clinical relevance, and highly cited studies are not always synonymous with high scientific merit, as citation frequency may also be influenced by controversy or negative attention. Author-level productivity figures in Table 1 reflect the broad, multi-term search strategy adopted in this study (arthrocentesis, lavage, lysis, irrigation, and related terms). Consequently, author-specific publication counts may differ from those obtained using a narrower, single-term search in other databases such as PubMed.

CONCLUSION

This study provides the first comprehensive bibliometric overview of TMJ arthrocentesis research published between 1989 and 2024. Analysis of 581 publications reveals a clear thematic shift from symptom-oriented pain management toward biologically driven and regenerative treatment strategies, particularly involving PRP, BMAC, and hyaluronic acid. Research output is concentrated in a limited number of specialized maxillofacial surgery journals and reflects broader regenerative trends observed in other joints, with increasing emphasis on methodological rigor and evidence-based comparisons. The growing adoption of regenerative agents underscores the need for standardized application protocols and high-quality comparative studies to enhance clinical translation. Overall, this bibliometric analysis offers a concise reference for clinicians and researchers to understand the evolving research landscape of TMJ arthrocentesis and guide future investigations in this field.

MAIN POINTS

- This study is the first comprehensive bibliometric analysis of temporomandibular joint (TMJ) arthrocentesis from 1989 to 2024.
- Research activity in the field has shown a steady upward trend since 2005, culminating in a significant peak in publication output in 2024.
- A major thematic shift has been identified: a movement from traditional mechanical irrigation concepts toward regenerative therapeutic modalities, such as platelet-rich plasma and hyaluronic acid.

- The United States, Türkiye, and Japan are the leading contributors to the global scientific output on TMJ arthrocentesis.
- As the field grows, standardized application protocols are critically needed to reduce heterogeneity in clinical outcomes.

ETHICS

Ethics Committee Approval: This study was based exclusively on data retrieved from the Web of Science Core Collection database and did not involve human participants, animals, or patient records. Therefore, ethical approval and informed consent were not required.

Informed Consent: Not applicable, as this study is a bibliometric analysis of previously published literature.

Footnotes

Authorship Contributions

Concept: M.I., A.A., Design: M.I., A.A., Data Collection and/or Processing: A.A., Analysis and/or Interpretation: M.I., A.A., Literature Search: M.I., A.A., Writing: M.I., A.A.

DISCLOSURES

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