Observational Study

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Bibliometric analysis of research developments in oral and maxillofacial neuralgia from 2004 to 2023

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Abstract

This study employs bibliometric techniques to dynamically represent the research landscape of oral and maxillofacial neuralgia. Its goal is to pinpoint research hotspots and delineate forthcoming trends. A systematic search of the Web of Science Core Collection was performed using targeted keywords to retrieve literature from January 2004 to December 2023. Citespace version 6.2.6 was utilized to analyze countries, institutions, authors, co-cited journals, and keywords. The analysis indicates an annual increase in research literature on oral and maxillofacial neuralgia, albeit with a decline observed in the past 2 years. In the last 5 years, a total of 279 publications have been produced, predominantly by developed countries. The average betweenness centrality exceeds 0.1. Analysis of co-cited literature revealed 100 nodes, with research frontiers closely associated with trigeminal neuralgia, gamma knife radiosurgery, percutaneous balloon compression, among others. Keyword clustering analysis generated 61 nodes, primarily concentrated on 3 research areas: gamma knife, microvascular decompression, and hemifacial spasm. The emergence of keywords closely correlates with trigeminal neuralgia. Research frontiers in the field of oral and maxillofacial neuralgia are primarily focused on trigeminal neuralgia, with major therapeutic approaches including gamma knife radiosurgery and percutaneous balloon compression. These areas, along with botulinum toxin, represent current hotpots and are likely to drive the future direction of research in treating oral and maxillofacial neuralgia.

Abbreviations: BTX-A = botulinum toxin type A, GKS = gamma knife surgery, PBC = percutaneous balloon compression, SRS = stereotactic radiosurgery, WOS = Web of Science.

Keywords: CiteSpace, frontiers, hotpots and tendency, Web of Science

1. Introduction

Neuropathic pain arises from lesions or diseases affecting the somatosensory nervous system. This condition spans a broad spectrum of pain syndromes, encompassing peripheral and central disorders.[1] Epidemiological studies indicate that neuralgia's prevalence in the general population may reach 7% to 8%.[2] Neuralgia manifests with diverse symptoms, including burning, tingling, and electric shock-like sensations, significantly affecting quality of life.[3] The oral and maxillofacial region is primarily affected by conditions such as trigeminal neuralgia, glossopharyngeal neuralgia, interneural neuralgia, and occipital neuralgia.[4] By synthesizing research findings on oral and maxillofacial neuralgia, scrutinizing its theoretical underpinnings, analyzing contemporary research frontiers, and probing into focal areas of interest, this study seeks to inform future research directions in this domain.

Bibliometric analysis has become increasingly prevalent in the field of medicine. For instance, it has been utilized to analyze conditions such as heart failure,[5] nonalcoholic fatty liver disease,[6,7] Parkinson disease,[8] and Alzheimer disease.[9] However, bibliometric analyses focusing on oral and maxillofacial neuralgia have been limited, therefore, utilizing the literature sources available in the Web of Science (WOS) database (http://www.webofknowledge.com/), a comprehensive collection and analysis of literature on oral and maxillofacial neuralgia from 2004 to 2023 was conducted using the bibliometric visualization software CiteSpace. The objective was to discern research trends, consolidate the knowledge base and research hotspots, and shed light on prospective research trajectories in this field.

Despite several reports having conducted bibliometric analyses on studies related to neuralgia,[10–12] most have been limited

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Bibliometrics is a cross-cutting science that uses mathematical and statistical methods to quantitatively analyze all knowledge carriers and therefore does not involve ethical approval.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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to isolated associated neuropathies. There is a lack of comprehensive bibliometric analysis specifically for neuralgia in the orofacial region, thus this study fills that gap.

2. Methods

2.1. Search strategies

Electronic searches were performed on January 1, 2024, and literature data were retrieved from all databases within the WOS Core Collection, which is the most renowned and influential scientific literature database and includes the Science Citation Index Expanded (SCI-E). The search terms used were ("oral maxillofacial" or "facial") AND "neuralgia." The literature time span was from January 2004 to December 2023. Journal categories were limited to "Neuroscience," "Clinical Neurology," and "Dental Oral Surgery." After the initial search, articles related to oral and maxillofacial neuralgia were manually reviewed for relevance. A total of 950 eligible articles were downloaded in plain text format and imported into CiteSpace 6.2.6 for further analysis.

2.2. Data inclusion and exclusion

Inclusion criteria: articles, reviews, and proceeding papers published in the WOS Core Collection database.

Exclusion criteria: non-article types such as letters and news items. Duplicate publications. Other types of documents like book chapters and meeting abstracts. Documents with incomplete data information. Documents that could not be recognized by software.

2.3. Data cleaning

The principle of standardizing author names is an established practice. For countries with different writing styles, select a standardized nomenclature, such as "England," "the United States," and "The People's Republic of China," which should be rendered as "ENGLAND," "USA," and "PEOPLES R CHINA" respectively. Harmonization of author names across different formats is also necessary, such as changing "Zakrzewska, Joanna M" to "Zakrzewska JM". Additionally, it is important to standardize the formatting of institutional affiliations with different formats, for example, rendering "MAYO CLINIC" as "Mayo Clinic."

Journal and Keyword Standardization Principles: Journal titles should be capitalized; for instance, "Neurosurgery" should be rendered as "NEUROSURGERY." Keywords, including "trigeminal neuropathy" and "botulinum toxin", should be standardized.

2.4. Measurement and analysis methods

Publication volume analysis was performed using WPS Office (China Kingsoft Co., Ltd.) to generate line graphs. De-duplicated data files were imported into CiteSpace 6.2.6 for econometric analysis. The time slicing was configured from January 2004 to December 2023, with each slice encompassing a 5-year period. Generated network diagrams were segmented into 4 periods based on the time slicing: 2004 to 2008, 2009 to 2013, 2014 to 2018, and 2019 to 2023. The analysis centered on collaborative networks among authors, institutions, and countries, as well as co-occurrence networks of keywords, and co-citation analysis of cited literature, journals, and authors. For the analysis of countries, institutions, and authors, the filtering strategy employed was "Top N% = 100%" under "Selection Criteria". In the keyword analysis, the filtering strategy was adjusted to "Top N = 35", and the relationship strength algorithm was standardized to the Cosine method.[13] During the analysis of co-cited literature, the filtering strategy was modified to "Top N = 25", with a g-index of 10. The 15 countries and organizations with the highest number of published articles were identified.

The authors' collaboration network was constructed by setting the node type to "Author" within CiteSpace. Similarly, the authors' co-citation network was constructed by setting the node type to "Cited author", with co-citation counts being determined and ranked. To construct a journal co-citation network, the node type was set to "Cited Journal", and the top 3 journals were identified based on co-citation frequency. The influence of these journals was assessed via the WOS database to ascertain their impact factors. The co-citation network was constructed by setting the node type to "Reference". Subsequently, the "Cluster Explorer" results, following cluster analysis, were used to identify the research frontiers of the first 3 clusters. Upon setting the node type to "Keyword", the co-occurrence graph was constructed. The "All in One" function key, located in the network visualization interface's shortcut keys, was used to perform cluster analysis. Cluster naming was set to "K", and the LLR log-likelihood ratio algorithm was selected for analysis.

Keyword clustering effectiveness was evaluated based on the modularity of the graph (Q-value > 0.3) and the silhouette coefficient (S-value > 0.5). The top terms were then output, with duplicates removed. Based on keyword clustering, "Time Line View" was selected from the shortcut function keys to analyze the timeline graph. The "Burstness" function from the control panel was then utilized to obtain keyword emergence results.

In the present study, we utilized CiteSpace version 6.2.6 to conduct the bibliometric analysis. To ensure the accuracy and scientific validity of our analysis, we strictly adhered to the official guidelines and best practices of CiteSpace, available at https://leanpub.com/howtousecitespace. This included aspects such as data preparation, parameter settings, and result interpretation. First, we exported relevant literature data from the Web of Science database, ensuring completeness and accuracy of the data; second, we set appropriate time slices and thresholds in CiteSpace to ensure clarity of the network maps and richness of information; finally, using the analytical tools provided by CiteSpace, we conducted a detailed interpretation of key nodes and emerging trends. Through these rigorous procedures, we ensured the reliability and validity of our research findings.[14]

3. Results

3.1. General information and volume of publications

A total of 1627 articles were retrieved from the WOS Core Collection database. After applying the inclusion criteria and removing duplicates and irrelevant articles, 950 articles were ultimately selected. The detailed process for article selection is shown in Figure 1 and Table 1.

In the past 20 years, the WOS database has documented a total of 950 publications pertaining to oral and maxillofacial neuralgia. The data shows an overall upward trend in publication numbers from 2004 to 2018, punctuated by a brief dip between 2005 and 2007. However, the annual publication counts consistently exceeded 30, with a significant rise in 2007 to 2008 and a stable range of 40 to 51 publications annually from 2008 to 2012. Between 2012 and 2014, there was a decrease in publication numbers, yet they remained higher than the 2004 to 2008 average (34 publications). From 2014 to 2018, there was a steady annual increase in the number of publications. Although the number of publications slightly decreased between 2018 and 2020, the count remained above 60 each year. The number of publications increased from 2021 to 2022. However, there was a subsequent drop after 2022, yet the count still remained above 30. By 2023, the number again rose to 50, surpassing the 20-year average of 48 (Fig. 2).

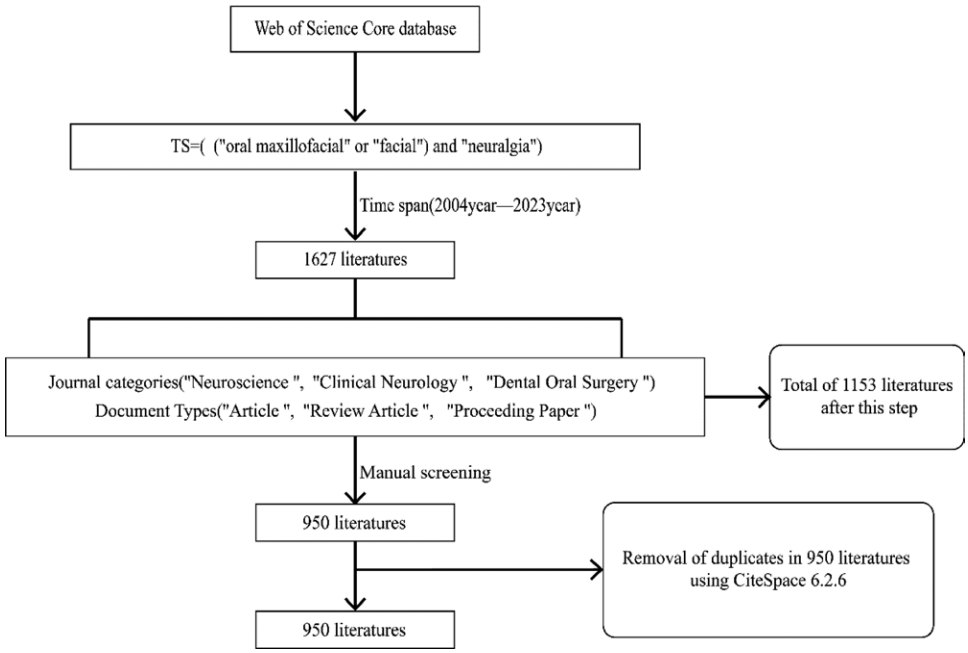

Figure 1. Diagram of paper search and screening process.

Table 1

Search strategy overview.

Search strategy	Details
Database	Web of Science Core Collection (WOS)
Search date	January 1, 2024
Subject terms	"Oral maxillofacial" or "facial" and "neuralgia"
Inclusion criteria	Article types: articles, reviews, and proceeding papers
Exclusion criteria	Non-article types (letters, news Item)
	Duplicate publications
	Other types of documents (book chapters, meeting abstract)
	Incomplete data information
	Unrecognizable by software
Time span	January 2004 to December 2023 (cutoff date: December 31, 2023)
Journal categories	Neuroscience, Clinical Neurology, Dental Oral Surgery
Total articles retrieved	950 eligible articles
Software used	CiteSpace 6.2.6 for data import/export and analysis

3.2. Country and institutional visualization analysis

Figure 3 presents the state's visual analysis, indicating that the network consists of 41 nodes and 37 links, with a density of 0.0451 (namely, the D-value automatically computed by the interface following the visual analysis). The network is centered on USA, JAPAN, and ENGLAND, which demonstrate close cooperation with other countries and regions. USA leads with the highest number of publications (331), comprising 34.8% of the total, followed by PEOPLES R CHINA with 142 publications, and JAPAN with 65. The principal contributors were developed countries, with an average betweenness centrality of 0.135, exceeding 0.1. Figure 3 illustrates 12 nodes with a betweenness centrality >0.1, denoted by purple outer boxes. The size of the dots in the network represents the number of citations of each country's publications, and the thickness of the connecting lines indicates the strength of the partnerships. The colors of the inner circles and connecting lines are differentiated by publication periods: purple for 2004 to 2008, blue for 2009 to 2013, yellow-green for 2014 to 2018, and red for 2019 to 2023. USA, with the most publications, also exhibits broader and more robust connectivity with other nodes, reflected in a node centrality of 0.53, which exceeds 0.1. Although PEOPLES R CHINA ranks second in the number of publications, its node centrality is merely 0.08, indicating it is not a pivotal node; the node with the highest centrality is RUSSIA, with a score of 0.78, surpassing 0.1. Although it is a key node with the densest connections to other nodes, it has a mere 3 publications, the second-lowest count.

Figure 4 depicts the collaborative network of institutions, comprising 246 nodes, 370 links, and a density of 0.0123. The University of London led with the highest number of publications, totaling 37, followed by the Mayo Clinic with 33, and Shanghai Jiao Tong University with 31. While the aforementioned institutions have numerous publications, they exhibit low betweenness centrality (below 0.1), with the exception of the Mayo Clinic. For the Mayo Clinic, unlike the first 2 institutions, it is centrally positioned in the network graph and maintains close relationships with other nodes. Shanghai Jiao Tong University also maintains close ties with Chinese institutions such as Tianjin Medical University, Soochow University, and Zunyi Medical University, yet it is not central within the network. Table 2 shows that universities and colleges dominate the Web of Science institutions in terms of the number of publications, accounting for 28.4% of the total number of publications. These institutions are mainly concentrated in developed countries such as the USA and ENGLAND. The size of the dots in the diagram represents the number of citations of the country's issuance, while the thickness of the connecting lines between the dots indicates the strength of the partnership. The diagram displays node betweenness centrality >0.1 and is color-coded to represent 4 different time periods: purple for 2004 to 2008, blue for 2009 to 2013, yellow-green for 2014 to 2018, and red for 2019 to 2023, with the inner circle and connecting lines colored accordingly.

3.3. Analysis of principal investigators and co-cited journals

Based on the analysis of both the author collaboration and co-citation networks (Appendix Figures S1 and S2, Supplemental

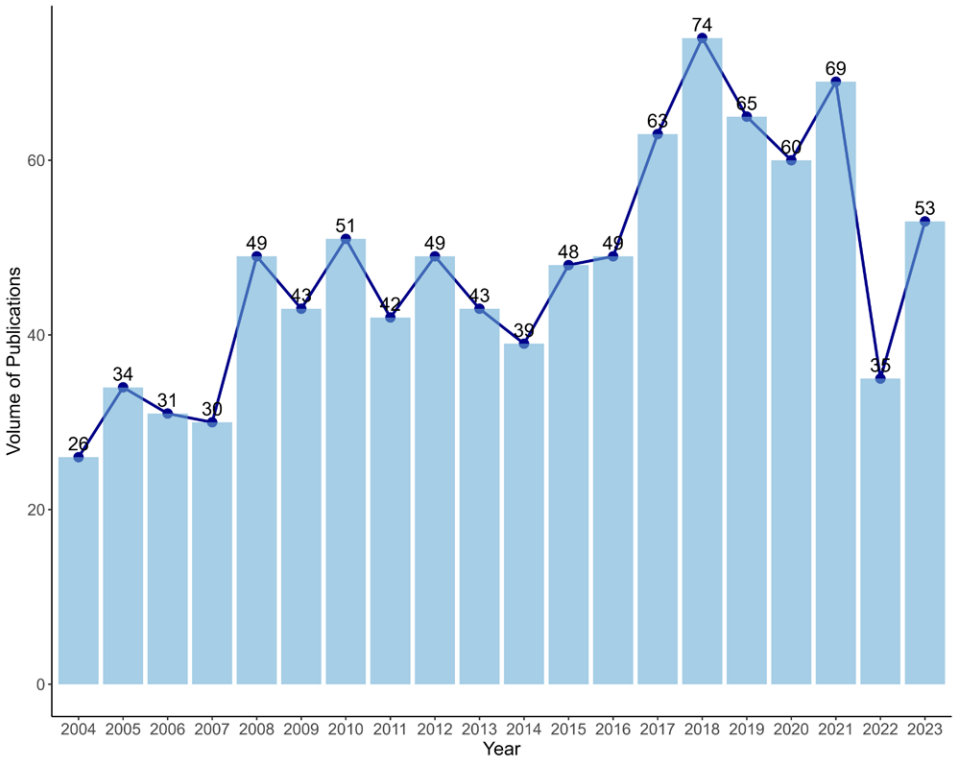

Figure 2. Oral and maxillofacial neuralgia trend in number of posts, 2004 to 2023.

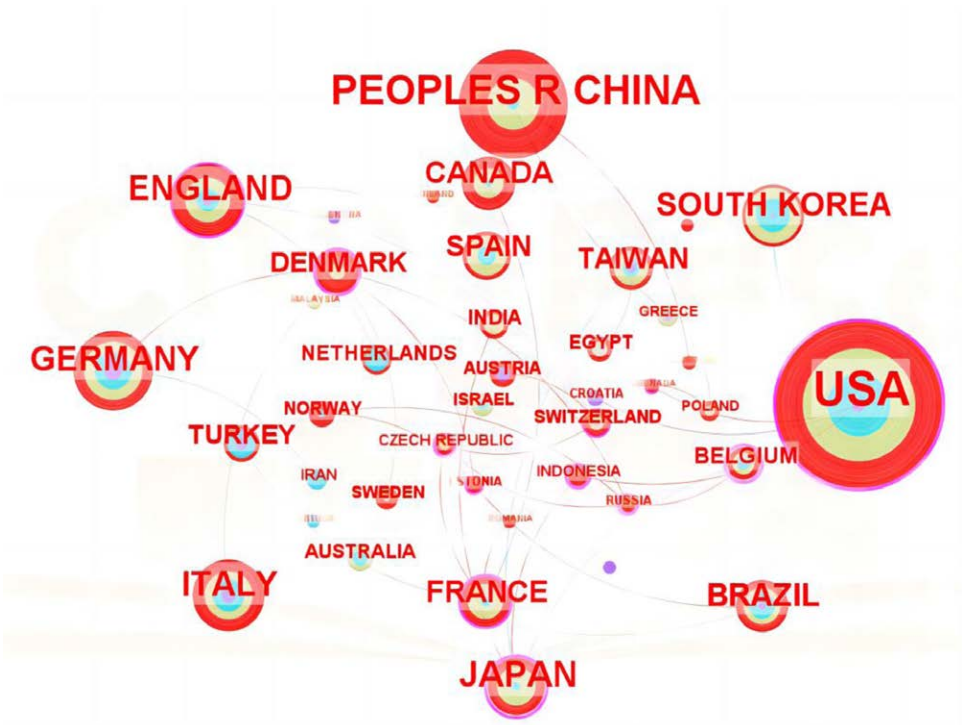

Figure 3. Top 15 countries and territories by number of articles.

Digital Content, http://links.lww.com/MD/O60 and http://links.lww.com/MD/O60), ZAKRZEWSKA, JM (Eastman Dental Hospital, ENGLAND, 16 articles), MAARBJERG, S (University of Copenhagen, DENMARK, 15 articles), and BENDTSEN, L (Danish Headache Center, DENMARK, 12 articles) have made significant contributions to the field of oral and maxillofacial neuralgia, with ZAKRZEWSKA, JM, and BENDTSEN, L being key nodes demonstrating strong connections with others (Appendix Figure S1, http://links.lww.com/MD/O60). The diagram also displays node betweenness centrality >0.1 and represents 4

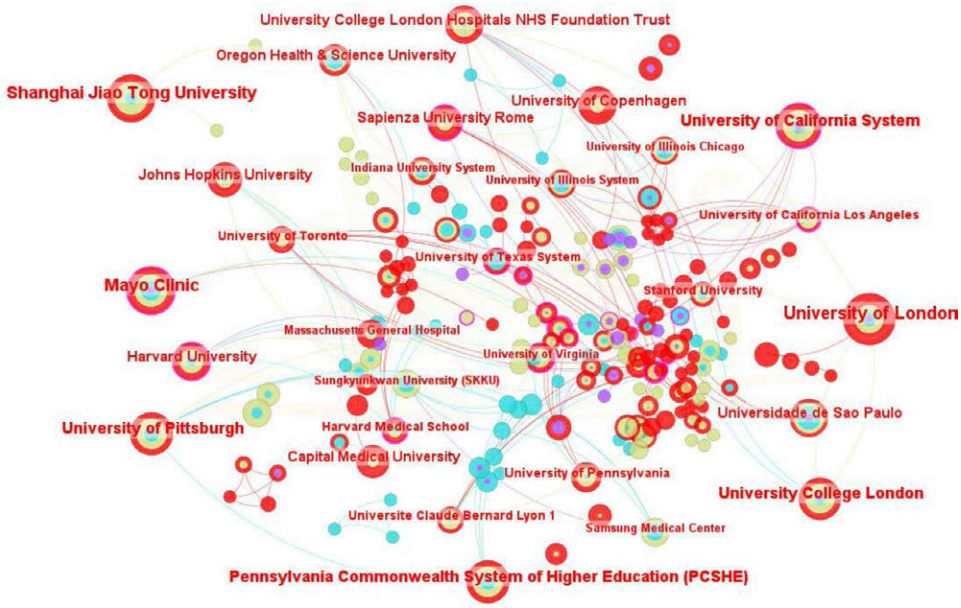

Figure 4. Collaborative network of institutions in the research direction of oral and maxillofacial neuralgia.

Table 2

Top 10 institutions with maximum publications.

Rank	Institutions	Country	Publications
1	University of London	ENGLAND	37
2	Mayo Clinic	USA	33
3	Shanghai Jiao Tong University	PEOPLES R CHINA	31
4	University of California System	USA	27
5	University College London	ENGLAND	25
6	Pennsylvania Commonwealth System of Higher Education (PCSHE)	USA	25
7	University of Pittsburgh	USA	25
8	Universidade de Sao Paulo	BRAZIL	23
9	University College London Hospitals NHS Foundation Trust	ENGLAND	22
10	Harvard University	USA	22

different time periods, each denoted by a different color: blue for 2004 to 2008, green for 2009 to 2013, yellow for 2014 to 2018, and red for 2019 to 2023, indicating the temporal evolution of research collaborations and citations. Table 3 lists the top 10 authors by number of co-citations, with BARKER, FG, JANNETTA, PJ, and ZAKRZEWSKA, JM as the top 3, who have amassed 265, 218, and 210 co-citations respectively, indicating their prominent academic stature and influence in the field of oral and maxillofacial neuralgia. The 3 leading journals by co-citation count are "JOURNAL OF NEUROSURGEY" (J NEUROSURG), "NEUROSURGEY" and "ACTA NEUROCHIRURGICA" (ACTA NEUROCHIR), boasting impact factors of 4.1, 4.8, and 2.4, respectively. Consequently, the journal "J NEUROSURG" exerts the greatest scientific impact within the domain of oral and maxillofacial neuralgia (Fig. 5).

3.4. Research frontiers in oral and maxillofacial neuralgia

The co-citation clustering analysis yielded 100 nodes and 92 paths, with a Q-value of 0.8145, which signifies a well-defined cluster structure. An S-value of 0.9179 confirms the robustness of the clustering. Appendix Figure S3, Supplemental Digital Content, http://links.lww.com/MD/O60 provides a visual representation of the clustering. A negative correlation exists between the size of the literature clusters and their numerical order. Subsequent to the cluster analysis, the leading research topics of the first 3 clusters were discerned using the "cluster explorer "tool. The 3 primary clusters were designated as: #0 tic douloureux, #1 radiosurgery, and #2 trigeminal neuropathy. Derived from subject terms produced by the LLR and MI algorithms, the predominant research themes in cluster 0 include tic douloureux, gamma knife, trigeminal issues, and numbness, among others; Cluster 1 is chiefly characterized by topics like radiosurgery, percutaneous balloon compression (PBC), gamma knife surgery (GKS), and the suboccipito-retrosigmoid approach. Additionally, the trigeminovascular system emerges as a significant focus; Cluster 2's primary research themes encompass trigeminal neuropathy, hemifacial spasm, radiosurgery, and temporomandibular disorders. Within these, the co-cited literature in cluster 1 ranges from 2016 to 2020, with a median citation year of 2018, marking it as the most contemporary cluster. This indicates that recent research has predominantly concentrated on radiosurgery and PBC in the context of neuralgia. Analysis of these clusters shows that the study of trigeminal nerve-related anatomy, trigeminal neuralgia, and GKS are at the forefront of oral and maxillofacial neuralgia research.

3.5. Research hotpots in oral and maxillofacial neuralgia

Keyword cluster analysis produced 61 nodes and 62 links, with a modularity (D) value of 0.0339. The modularity (Q) value was determined to be 0.7728, signifying a well-defined cluster structure, while the silhouette (s) value was 0.9593, deemed robust.[13,15] Figure 6 illustrates the keyword clustering, revealing a negative correlation between the size of the clusters and their numerical order.

The size of the dots represents the number of citations of the country's issuance, while the thickness of the connecting lines between the dots represents the strength of the partnership. Clustering labels for keywords predominantly reflect the focus on clinical surgical procedures like gamma knife and microvascular decompression, alongside research domains such as hemifacial spasm and occipital neuralgia. Within each cluster, key terms such as cluster headache, neuralgia, and diagnosis

are grouped under the category of microvascular decompression; associated with the gamma knife category, terms like surgery and quality of life are identified. Within the foramen ovale cluster, key terms include safety, efficacy, botulinum toxin, and radiofrequency thermocoagulation. The diagram displays node betweeness centrality >0.1. The outer box is colored purple, while the inner circle and connecting lines are colored purple for the years 2004 to 2008, blue for 2009 to 2013, yellow-green for 2014 to 2018, and red for 2019 to 2023. The LLR algorithm clusters keywords. Figure 7 presents the most prominent keywords from 2004 to 2008, such as tic douloureux, postherpetic neuralgia, and cluster headache, with the research concentrating on the category of oral and maxillofacial neuralgia. During 2009 to 2013, the most prominent keywords included "consecutive patients", "dysfunction", "gamma knife surgery", and "trigeminal neuropathic pain", with the primary research focus being on the treatment of neurologic dysfunction. For the 2014 to 2018 period, the most significant keywords and research hotpots encompass botulinum toxin, functional neurosurgery, and related terms, with a central focus on the treatment of functional neurological disorders. For 2019 to 2023, the research hotpots have mainly centered on the study of PBC for trigeminal neuralgia, with key terms including neuralgia, safety, Gasserian ganglion, and PBC featuring prominently.

Figure 8 presents a timeline graph that shows the 2004 research hotpots focused on stereotactic radiosurgery (SRS), facial pain, hemifacial spasm, and trigeminal neuralgia. Between 2004 and 2009, keywords like "posterior ganglionic root glycerol block", "cerebellopontine angle", "glossopharyngeal neuralgia", "trigeminal neuralgia", and "efficacy" indicate the use of glycerol block in clinical neuralgia treatment and highlight the focus on surgical treatment and its effectiveness. In the 2010 to 2014 timeframe, emerging

Table 3

Top 10 co-cited authors.

Rank	Institution	Cited authors	Country	Publications
1	Massachusetts General Hospital	BARKER FG	USA	265
2	University of Pittsburgh	JANNETTA PJ	USA	218
3	Eastman Dental Hospital	ZAKRZEWSKA JM	ENGLAND	210
4	University of Washington	BURCHIEL KJ	USA	163
5	Mayo Clinic College of Medicine	POLLOCK BE	USA	160
6	University of Pittsburgh	KONDZIOLKA D	USA	153
7	University of Rome	CRUCCU G	ITALY	166
8	University of Lyon	SINDOU M	FRANCE	150
9	St. Joseph Hospital and Barrow Neurological Institute	ROGERS CL	USA	143
10	Timone University Hospital	REGIS J	FRANCE	112

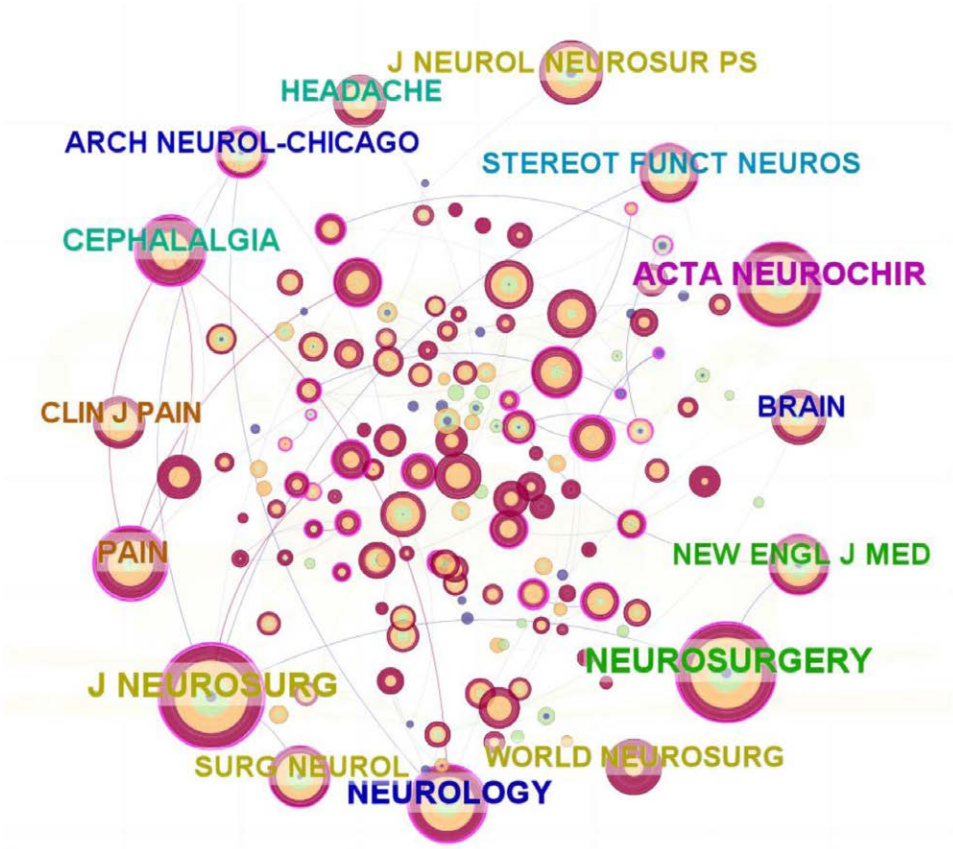

Figure 5. Network of top 15 cited journals.

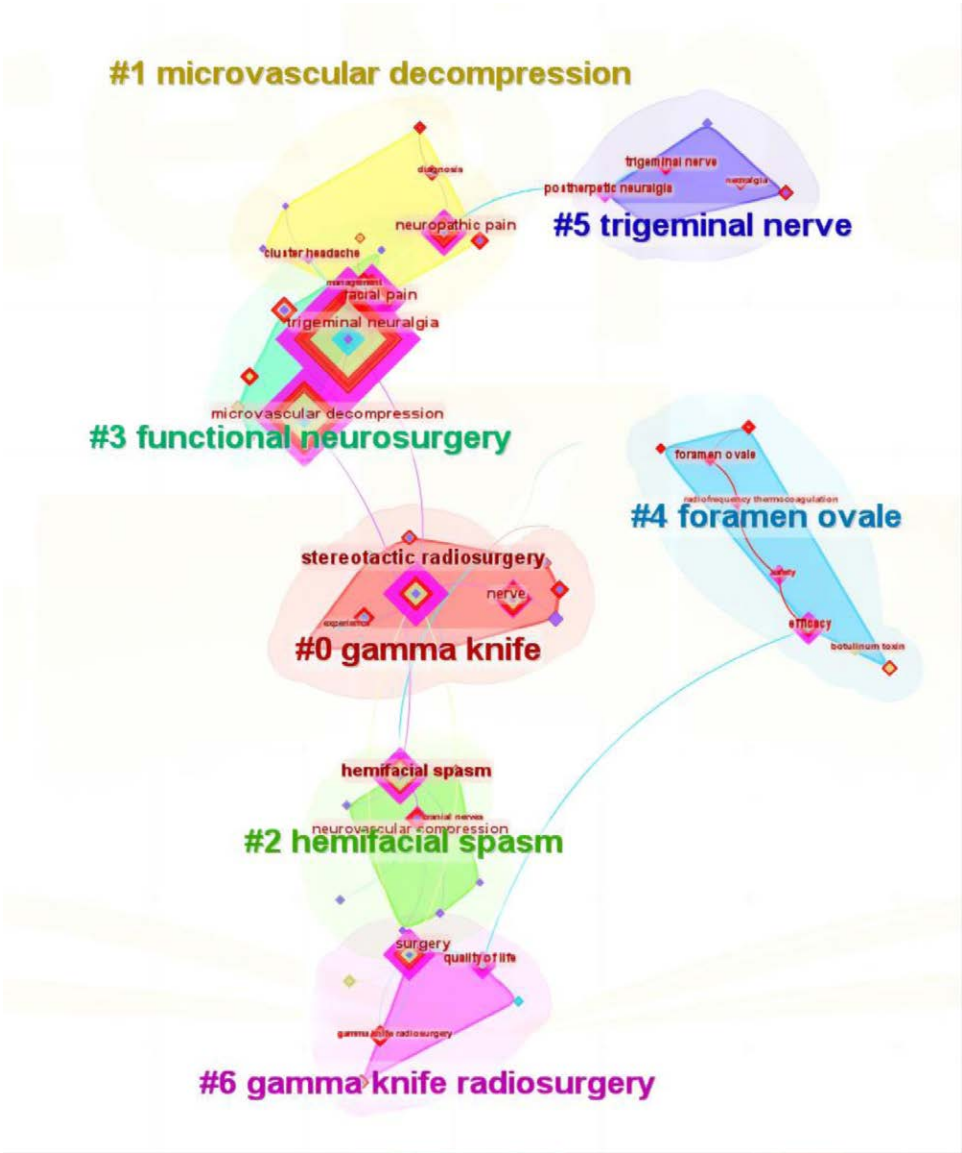

Figure 6. Keyword cluster analysis.

research hotpots included chronic pain, functional neurosurgery, and botulinum toxin application. From 2015 to 2023, keywords like "consecutive series", "pathophysiology", "Gasserian ganglion", and "percutaneous balloon compression" have become prominent research hotpots. Research on trigeminal neuralgia has consistently been a focus from 2004 to 2023.

4. Discussion

The primary findings of this study reveal a consistent growth in publications on orofacial neuropathic pain research over the past 20 years, with a slight decline in the last 3 years followed by a rapid resurgence, indicating that research in this area remains a persistently hot topic. Network analysis of national and institutional collaborations reveals that the USA, JAPAN, and ENGLAND serve as central nodes in the research network, not only leading in the number of publications but also contributing significantly to international cooperation. Particularly, the USA, with its extensive collaborative network and high node centrality, stands out as a significant force in driving the scientific advancement of the field. Notably, while CHINA ranks second in the number of publications, its centrality within the network is relatively low, suggesting that its connectivity and influence in global collaborations could be enhanced. Concurrently, RUSSIA, despite having a lower publication volume, exhibits higher centrality due to its close connections with multiple nodes, potentially reflecting its important role in specific collaborations. At the institutional level, leading bodies such as University College London, Mayo Clinic, and Shanghai Jiao Tong University demonstrate high publication outputs; yet apart from the Mayo Clinic, the other institutions exhibit lower betweenness centrality, implying that their networking and bridging roles in the network are less pronounced. The central position of the Mayo Clinic and its strong connectivity with multiple institutions highlight its unique contribution to promoting academic exchange and collaboration. Moreover, the significant presence of universities and colleges among top institutions underscores the core role of educational and research institutions in orofacial neuropathic pain studies and emphasizes the critical function of academic entities in knowledge generation and dissemination. At the individual researcher level, scholars such as ZAKRZEWSKA, JM, MAARBJERG, S, and BENDTSEN, L are not only prolific but have also established strong connections with other

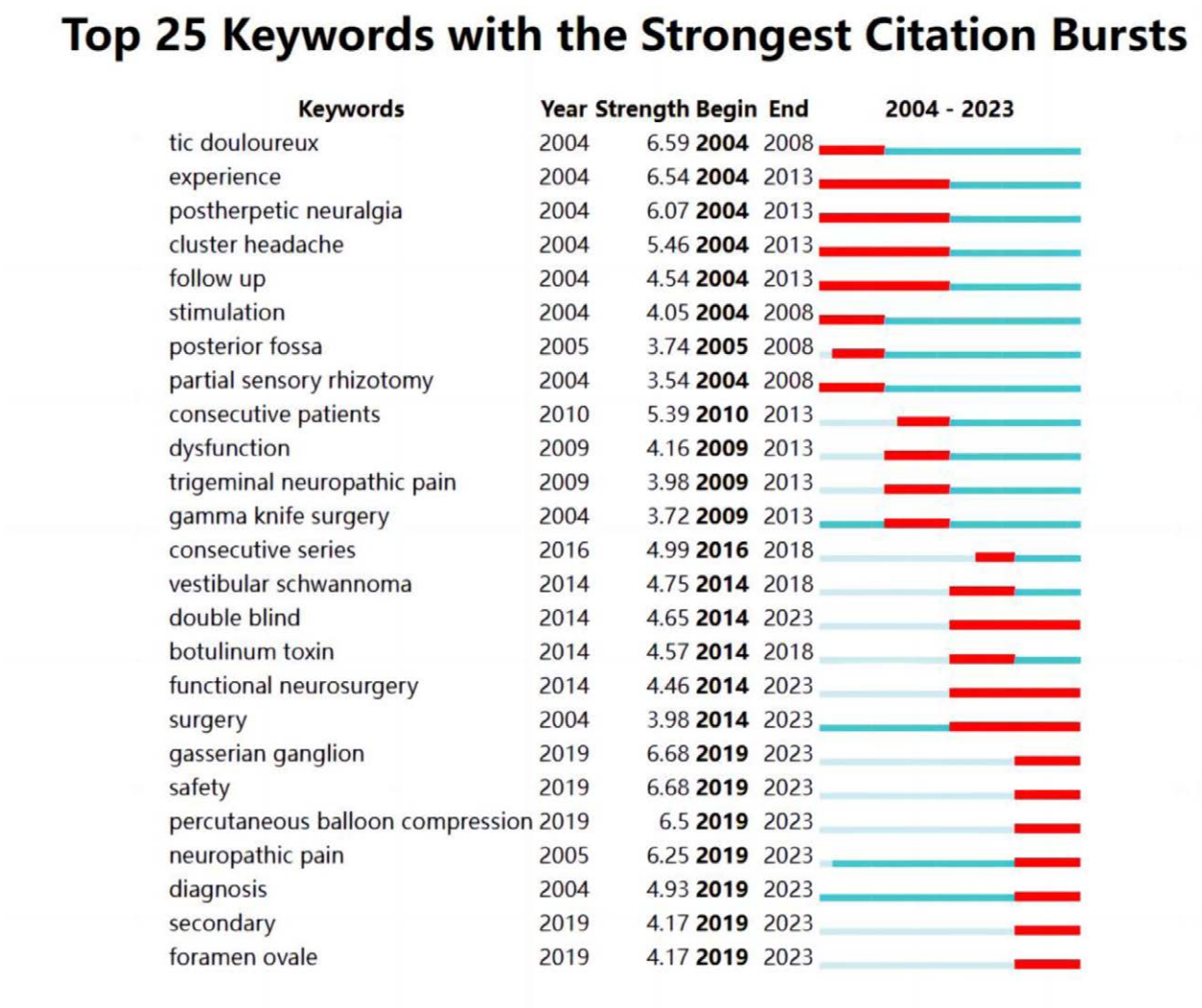

Figure 7. Keywords with bursts from 2004 to 2023.

studies, indicating their significant contributions to the field of orofacial neuropathic pain. Their research findings contribute to the understanding of disease mechanisms, improvements in treatment methods, and provide guidance for future research directions. In terms of journal impact, "JOURNAL OF NEUROSURGERY" (J NEUROSURG), "NEUROSURGERY," and "ACTA NEUROCHIRURGICA" (ACTA NEUROCHIR) stand out as the most influential journals in the domain of orofacial neuropathic pain, due to their high impact factors. Particularly, the "JOURNAL OF NEUROSURGERY" (J NEUROSURG) holds a leading position in scientific influence, reflecting not only its capability to publish high-quality research but also demonstrating that its content is widely recognized and cited within the academic community.

In summary, the progress in research and treatment of orofacial neuropathic pain is dependent on a robust global collaborative network. To further advance scientific innovation and clinical treatment developments in this field, it is essential to strengthen international cooperation, especially by enhancing the participation of countries and regions that have potential centrality but currently lack sufficient influence. By conducting an in-depth analysis of author collaboration networks and journal co-citation networks, we can derive a more comprehensive understanding of the structure of orofacial neuropathic pain research, identify key contributors, and influential journals, a critical step for advancing the future development of this domain.

4.1. Hotpots and tendency

Keyword cluster analysis can reveal research hotpots and trends within specific fields.[16] The frequency of keyword citations, the temporal trends of these keywords, and their emergence were utilized to conduct a comprehensive analysis of research hotpots and trends in oral and maxillofacial neuralgia. We have found that the current research hotpots and trends in oral and maxillofacial neuralgia primarily focus on trigeminal neuralgia, with main treatment approaches including pharmacotherapy with botulinum toxin and surgical interventions such as balloon compression. This signifies a shift towards more innovative, safer, and minimally invasive methods in the management and treatment of oral and maxillofacial neuralgia. The detailed analysis is as follows:

4.2. Trigeminal neuralgia

Trigeminal neuralgia is identified as a hotpots in the field of oral and maxillofacial neuralgia research through keyword clustering analysis. Trigeminal neuralgia, also referred to as tic douloureux, is a chronic neuropathic pain disorder. It is characterized by sudden, intense, and transient paroxysmal electric shock-like pain that is limited to 1 or more branches of the trigeminal nerve.[17,18] Worldwide prevalence of trigeminal neuralgia ranges from 76.8/100,000 (0.0768%) to 29.5/100,000 (0.0295%).[19] The pathophysiology of trigeminal neuralgia is

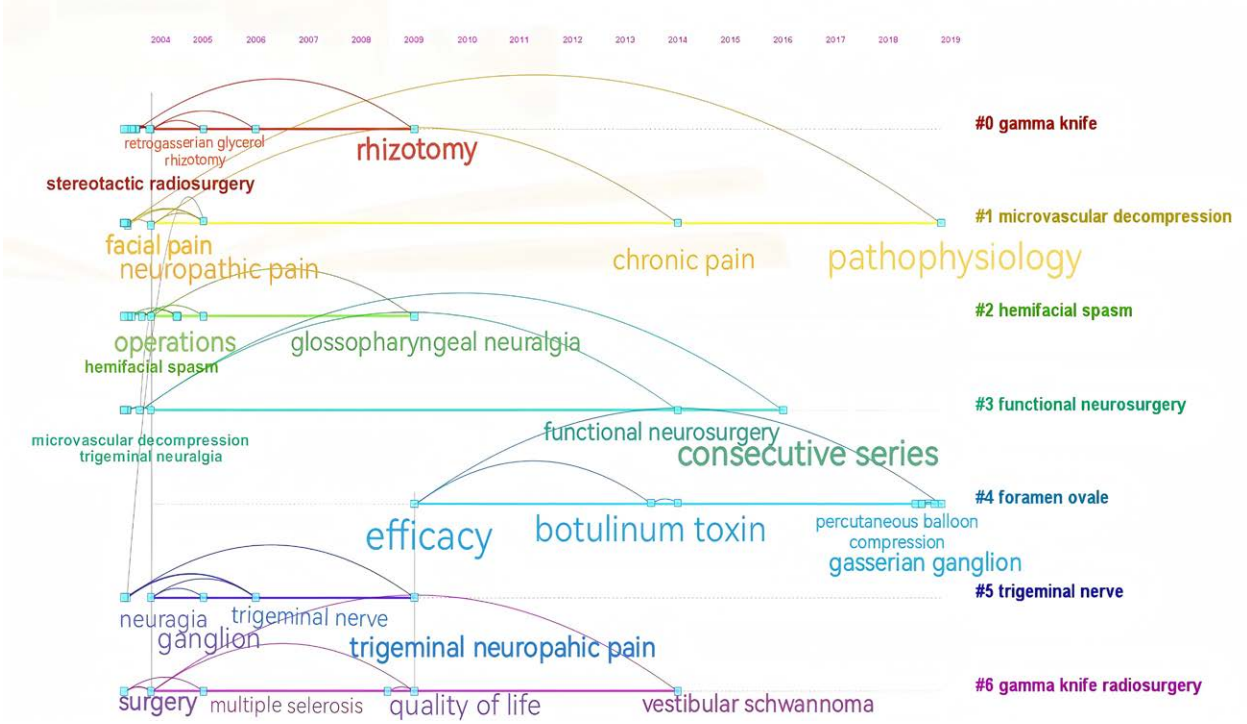

Figure 8. The timeline view of keywords.

primarily associated with compression of the nerve roots in the anterior pool. Neurovascular compression can be either primary, with no secondary cause, or secondary, as in the case of meningiomas, arteriovenous malformations, or cysts.[20]

4.3. Botulinum toxin

Botulinum toxin is a neurotoxin that is commonly used to treat muscle hyperactivity disorders, such as dystonia and spasticity.[21–24] Botulinum toxin type A (BTX-A) is considered the most effective. It works by inhibiting the release of acetylcholine at the neuromuscular junction. This inhibition is achieved by cleaving proteins involved in the release process.[25] BTX-A is utilized in the treatment of various forms of neuralgia and neuropathic pain. It has demonstrated promising outcomes in pain relief and enhancing patient prognosis. Although additional research is warranted, BTX-A holds considerable potential as a therapeutic option for diverse neuralgias. This treatment's capacity to alleviate pain and ameliorate these conditions offers hope to those affected by neuropathic pain.[26] In dentistry, employing botulinum toxin in the trigeminal region represents a major research focus for the treatment of trigeminal neuralgia. Anticonvulsant drugs, such as carbamazepine and oxcarbazepine, are the first-line medications for this condition. Between 25% and 50% of patients on medication become refractory, necessitating surgical interventions. However, severe neurological dysfunction can occur postoperatively.[27] Consequently, botulinum toxin therapy constitutes a significant element of trigeminal neuralgia's pharmacological management.

4.4. PBC

PBC was first proposed by Mullan and Lichtor.[28] The patient is subjected to a specific procedure under general anesthesia. Guided by X-ray fluoroscopy, the puncture needle is inserted into the foramen ovale's lateral opening while the patient is in an orthostatic and lateral position. Subsequently, a balloon is positioned within Meckel cave via the Fogarty guidewire, and contrast medium is injected to facilitate balloon inflation. Generally, the balloon is inflated with 0.5 to 1 mL of anesthetic, compressing the trigeminal ganglion for 3 to 4 minutes. This procedure offers immediate postoperative relief of facial pain with a success rate of 80% to 90%. The advantages of this procedure include high efficacy, a brief hospital stay, and low rates of complications and mortality.[29,30]

4.5. Research frontiers

Through the co-citation analysis of literature, we can identify the cutting-edge areas of research in oral and maxillofacial neuralgia, which include trigeminal neuralgia, gamma knife radiosurgery, and PBC. This analytical method not only provides insights into the current hotspots in research but also indicates potential directions for future studies. Specifically, the comprehensive overview of gamma knife radiosurgery demonstrates its effectiveness and precision in treating trigeminal neuralgia in the oral and maxillofacial region.

Dr Lars Leksell proposed the concept and pioneered the development of SRS, creating the Leksell stereotactic frame to accurately target specific brain areas with radiation. In 1968, the Karolinska Institute in Stockholm, Sweden, developed a prototype Gamma Knife device utilizing gamma radiation.[31] Currently, most SRS systems employ a cobalt-60 source (Gamma Knife) or a single-source linear accelerator. GKS delivers radiation to the brain using multiple isocentres, enhancing the precision in targeting irregularly shaped tumors while sparing the surrounding tissue. The primary indications for SRS include brain and spinal metastases, trigeminal neuralgia, meningiomas, nerve sheath tumors, and arteriovenous malformations.[32] Consequently, gamma knife radiosurgery's versatility extends to the oral and maxillofacial regions, proving effective in the treatment of trigeminal neuralgia.[33–36]

4.6. Limitations

The aim of this paper is to explore emerging research trends in oral and maxillofacial neuralgia and to delineate future

research trajectories through bibliometric analyses of Web of Science databases spanning the years 2004 to 2023. This study has its limitations, primarily because it relies solely on the Web of Science core database. Importantly, this study did not specifically distinguish or confine its analysis to "registered studies." Our data sources comprised "articles," "reviews," and 'proceeding papers' from the Web of Science Core Collections database, recognized for their high quality and representation of academic research. We selected these types because they can effectively support in-depth analyses of knowledge structures, research trends, and scholarly impacts within subject areas. In this way, researchers are enabled to more accurately map knowledge in their disciplines, identify research hotpots, track cutting-edge advances, and assess the research performance of individuals, organizations, or countries. In addition, the literature screening for this study was conducted manually and was primarily limited to the fields of "Neuroscience," "Clinical Neurology," and "Oral Dentistry," potentially introducing some limitations.

5. Conclusion

This study utilized CiteSpace 6.2.6 software to perform a bibliometric analysis on 950 articles related to oral and maxillofacial neuralgia from the Web of Science Core Collection database, covering the period from 2004 to 2023. The analysis aimed to pinpoint research hotpots and predict future trends in the field.

Key findings indicate a rising trend in publications over the past twenty years, although there was a slight decline in the last 3. The majority of contributions come from developed countries, particularly the USA, JAPAN, and ENGLAND, highlighting the need for increased participation from developing countries. Author analysis shows that ZAKRZEWSKA, JM of England has made significant contributions to the field, evidenced by her high publication count and co-citation intensity.

Journal co-citation analysis identified J NEUROSURG as the most cited journal, indicating its pivotal role in the field, while NEUROSURGERY, with the highest impact factor of 4.8, emerges as the most academically prestigious.

Research frontiers in the field are primarily focused on trigeminal neuralgia, with major therapeutic approaches including gamma knife radiosurgery and PBC. These areas, along with botulinum toxin, represent the current hotpots and are likely to drive future research directions in treating oral and maxillofacial neuralgia.

Author contributions

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Visualization: Yuhang Cai.
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