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Original Research Article

Trend Changes of Studies on Temporomandibular Joint between 2013-2023: A Bibliometric Analysis

2013-2023 Yılları Arasında Temporomandibular Eklem Hakkında Yapılan Çalışmaların Trend Değişimleri: Bibliyometrik Analiz

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ABSTRACT

Aim: In this study, our aim was to provide a general perspective on this subject by making a bibliometric analysis of the trends and developments of the articles published on TMJ and indexed in Web of Science between 2013 and 2023.

Material and Method: An analysis was conducted on articles obtained from the Web of Science (WoSCC, Clarivate Analytics, Philadelphia, PA, USA) database on August 3, 2023. The search criteria included the time period '2013 to 2023' and the search term 'Temporomandibular junction'.

Results: The search found 8935 articles; after excluding those unrelated to TMJ, 8224 were analyzed. The top three topics were 'non-invasive interventions', 'inflammatory diseases in TMJ, and 'imaging methods'. Leading countries in publications were the USA, China, and Brazil. The most cited article was 'Diagnosis and Management of TMDs'.

Conclusion: Our analysis examined publications on TMJ from 2013 to 2023. There was a rise in the raw numbers of publications, with the highest number of publications in 2022. We expect a further increase in 2023. Developed countries contributed more to these publications, and our study identified key research trends, authors, journals, institutions, and countries involved.

Keywords: Bibliography; Bibliometrics; Temporomandibular joint; Temporomandibular joint disorders; Trends

ÖZET

Amaç: Bu çalışmada 2013-2023 yılları arasında TME konusunda yayınlanan ve Web of Science'da indekslenen makalelerin trendlerinin ve gelişimlerinin bibliyometrik analiz yapılarak bu konuya dair genel bir bakış açısı sunmak amaçlanmıştır.

Gereç ve Yöntem: 3 Ağustos 2023 tarihinde Web of Science (WoSCC, Clarivate Analytics, Philadelphia, PA, USA) veri tabanında yer alan makaleler üzerinden; zaman aralığı '2013-2023', arama terimi 'Temporomandibular junction' seçilerek arama yapıldı ve elde edilen makaleler üzerinden analiz gerçekleştirildi.

Bulgular: Yapılan arama sonucunda 8935 makaleye ulaşıldı ve TME ile ilgili olmayanlar elenerek 8224 makale ile çalışıldı. En çok çalışılan 3 konunun sırasıyla 'girişimsel olmayan müdahaleler', 'TME'nin inflamatuar hastalıkları' ve 'görüntüleme yöntemleri'ne ait olduğu, en çok yayın yapan ülkelerin sırasıyla Amerika Birleşik Devletleri, Çin ile Brezilya ve en çok atıf yapılan makalenin 'Diagnosis and Management of TMJ disorders' olduğu tespit edildi.

Sonuç: 2013-2023 arasındaki TME yayınlarını bibliyometrik olarak incelenmiş olup yıllar içinde TME'ye dair çalışmaların popülarite kazandığı ve 2022'de en yüksek yayın sayısının görüldüğü çalışmamızda, 2023 yılında artış olması öngörülmektedir. Çalışmamızda, araştırma eğilimleri, en üretken ve etkili yazarlar, dergiler, kurumlar, ülkeler tespit edilmiş olup gelişmiş ülkelerin yayınlara daha çok katkıda bulunduğu görüldü.

Anahtar Kelimeler: Bibliyografi; Bibliyometri; Temporomandibular eklem; Temporomandibuler eklem bozuklukları; Trendler

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INTRODUCTION

The stomatognathic system is a complex structure that includes the mandible, maxilla, the temporomandibular joint (TMJ), the muscles and ligaments of the maxillofacial region, teeth, salivary glands, and the hyoid bone. It enables functions such as opening and closing the mouth, swallowing, breathing, and various facial expressions. TMJ, a part of this system, belongs to the ginglymoarthroidal joint group and is located between the glenoid fossa of the temporal bone and the mandible. It includes an intra-articular disc, a fibrous capsule, synovial fluid, and various ligaments that provide support to these fundamental bony structures. Heterogeneous musculoskeletal system and neuromuscular disorders involving the TMJ complex and its components are referred to as 'Temporomandibular Joint Disorders (TMD)'.[1] Despite the high adaptability of the TMJ complex to changing conditions, it can exhibit symptoms such as pain, limited joint mobility, restricted mouth opening, and joint sounds due to factors such as overload, inflammation or macro or micro trauma.[2] It is more commonly seen in adults between the ages of 20 and 40, with an incidence of approximately 15%.[1] Various treatment options are defined for TMJ disorder, but the primary goal is to reduce or eliminate pain and joint sounds, while restoring normal jaw function.[3] Various non-invasive and non-surgical adjunctive treatments such as iontophoresis, phonophoresis, cognitive behavioral therapy (CBT), relaxation techniques, acupuncture, and hypnosis are used for the treatment of TMJ disorder. However, studies have not shown that any of these treatments are consistently superior or significantly more effective than others in managing pain or oral dysfunction associated with TMJ disorders.[4] TMJ disorders may require minimally invasive and open joint surgical procedures such as arthrocentesis, arthroscopy, and arthrotomy in 5% to 10% of all patients. After surgical procedures such as discectomy, disk plication, eminectomy, or eminoplasty, studies have shown that pain decreased in about 71% of patients and mouth opening improved in 61% of cases.[5]

Bibliometric analysis is a quantitative method for evaluating the scientific recognition and performance of a research article in the literature by applying mathematical and statistical methods. Bibliometrics is of great importance in evaluating the research performance of individual authors, institutions, journals, or countries.[6] Descriptive statistical analysis of publications is increasingly used in the dental and medical literature to identify influential articles in the field. Clinically, it helps clinicians identify the most effective articles in their areas of practice, evaluate clinical problems that might attract research interest, and also helps researchers gain insight into the direction studies might take for further development.[7]

When examining bibliometric analyses in dentistry, it was noted that certain topics such as orthognathic surgery, implantology, oral lesions, extraction of impacted teeth, malignancies, maxillofacial trauma, and treatments receive relatively high levels of attention. In dental research, however, there are only a few bibliometric studies on TMJ.[8,9] The aim of our study was to provide a comprehensive overview of the trends in articles published in the literature on the TMJ by performing bibliometric analyses over the last 10 years.

MATERIAL AND METHOD

A literature search was conducted on August 3, 2023, using Web of Science (WoSCC, Clarivate Analytics, Philadelphia, PA, USA) to access studies on Temporomandibular Joint. The search criteria included the following:

Search term: 'Temporomandibular junction'

Language: 'English'

Time period: '2013 to 2023'

WoS Categories: 'Dentistry Oral Surgery Medicine, Surgery, Medicine General Internal, Medicine Research Experimental, Radiology Nuclear Medicine Medical Imaging'

WoS Index: 'SCI-expanded, ESCI, SSCI, CPCI-S, A&HCI, CPCI-SSH, BKCI-SSH'

The analysis was based on the articles available in this database that met the specified criteria.

The raw data was downloaded from WoS and processed with MS Excel® 2019 (Redmond, WA, USA) for analysis purposes. Articles were screened for relevance to the study topic by two researchers (S.V., K.A.D.). Any discrepancies or disagreements between the researchers in the analysis were

resolved by reviewing the full texts of the articles until a consensus was reached. The results of the analysis revealed articles on topics such as knee joint, hip joint, trapeziometacarpal joint, syndromic diseases, etc., which were not associated with the TMJ. Therefore, these articles were excluded from the study. The recorded subject headings included journal name, article title, study topic, names and number of authors, affiliation of the first author, country of the first author, publication year of the article, abstract, citation count, funding status, among others. The categorization of study topics of the articles was based on the classification modified by Okeson, in accordance with the classification of the American Academy of Orofacial Pain (AAOP) and the International Headache Society (IHS).

RESULTS

A total of 8935 articles were viewed in the Web of Science. Following evaluating the abstracts to exclude articles not related to TMJ, 8224 articles were included in the study. The analysis showed an increasing trend in the raw number of articles from 2013 to 2023. The highest number of studies was recorded in 2020, 2021, and 2022, the number of articles in 2022 being the highest (Figure 1).

The articles were categorized into thirty-seven main headings based on the classification modified by Okeson, which is derived from the classification by the American Academy of Orofacial Pain (AAOP) and the International Headache Society (IHS). It is noticeable that the most studies fall into the category of 'non-invasive interventions' such as injection therapies, laser therapy, manual therapy, and splint therapy. This is followed by the category 'Inflammatory disorders of TMJ,' which deals with osteoarthritis and juvenile idiopathic arthritis, with the second highest number of articles. Imaging procedures such as Cone Beam Computed Tomography (CBCT), Magnetic Resonance Imaging (MRI), and ultrasonography were third in frequency. In 'TMJ surgery' category, which is in fourth place, reconstructive treatment takes the top position with a percentage of 34%. The names of the topics and their respective numbers are listed in Table 1. The articles originated from ninety-two different countries and from 955 universities, and 247 non-university institutions such as private clinics and hospitals. The top twenty countries accounted for 84% of the articles, with the United States published most of the articles (14%), followed by China (13.9%) and Brazil (9%) (Figure 2). The five universities with the most publications on TMJ were: Shanghai Jiao Tong University, Sichuan University, University of Sao Paulo, Peking University, and University of California System (Figure 3).

Table 1. Titles and numbers of study topics

Topics	Numbers
Non-invasive intervention	949
Inflammatory diseases of TMJ	790
Imaging	787
TMJ surgery	694
Anatomy of TMJ	560
TMJ and systemic diseases	413
Irregularity of the condyle-disc complex	337
Effect of orthognathic surgery on TMJ	331
TMJ cysts and tumors	314
Clinical examination of the TMJ	250
Structural incompatibility of joint surfaces	249
Ankylosis	217
Disorders of the masticatory muscles	201
Fractures	198
The effect of psychological factors on TMJ	196
Arthrocentesis	187
The effect of occlusion on TMJ	165
TMJ prostheses	159
Dysfunction	148
The effect of hormones on TMJ	130
Classification of TMJ diseases	108
Tissue engineering	106
Arthroscopy	98
Trauma to TMJ and its effects	93
Effect of masticatory force on TMJ	79
Orofacial pain	77
Awareness of TMJ diseases	73
The effect of parafunctional habits on TMJ	66
TMJ and its adjacent structures	52
Congenital and developmental bone disorders	43
Loss of functions	40
The effect of occupational fatigue on TMJ	38
Trismus	23
Effect of body posture on TMJ	20
Conditions causing bone necrosis and its effect on TMJ	17
Pain	14
Coronoid impedans	2

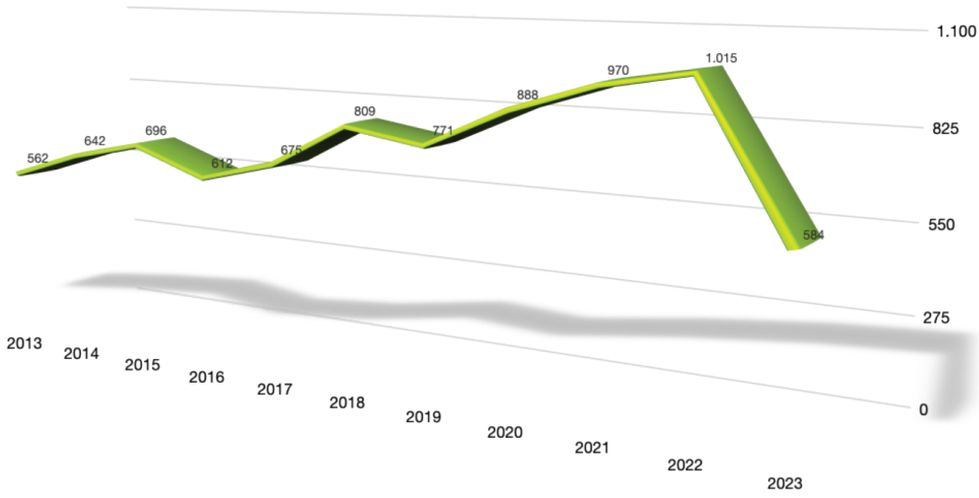

Figure 1. Distribution of articles about TMJ by years

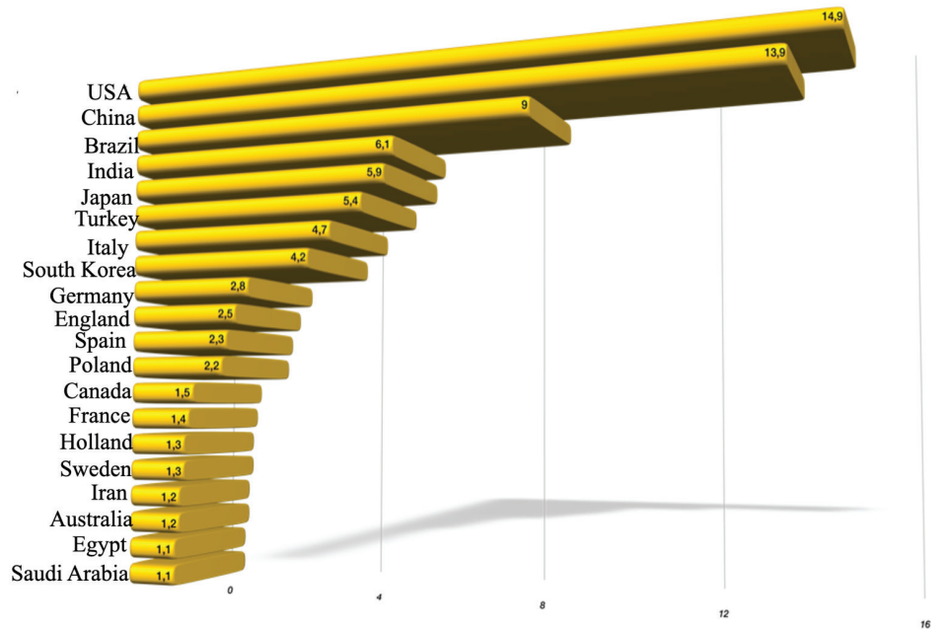

Figure 2. Countries with the most publications about TMJ and their proportions

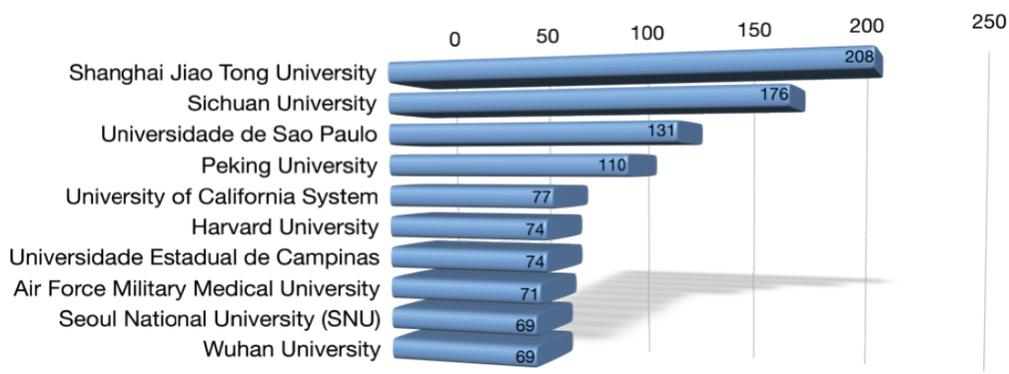

Figure 3. Top 10 universities with the most publications on TMJ and the number of published articles

The subheadings of the four most frequently analyzed topics as well as the number of articles published and their percentage over the last ten years are listed in Table 2. Of the 8224 articles, 2120 articles were funded or supported in some way. Table 3 lists the ten most frequently cited articles up to the time of analysis, together with the names of the authors, their countries, affiliated institutions, and the number of citations. A total of 8224 articles were published in 1377 different journals and books. The top five journals with the highest number of publications were: Journal of Oral and Maxillofacial Surgery (376), Cranio-The Journal of Craniomandibular & Sleep Practice (299), International Journal of Oral and Maxillofacial Surgery (291), Journal of Craniofacial Surgery (273), and Journal of Cranio-Maxillofacial Surgery (269).

DISCUSSION

TMJ is one of the most important and complex joints in the human body. Not only does it have an anatomy that functions within physiological limits, but it also interacts with surrounding structures such as muscles and ligaments. These relationships have a direct influence on the dynamics and function of the mandible.[10]

Recently there has been an increase in complaints in connection with TMJ disorders. Complaints such as pain in the TMJ region and masticatory muscles, restricted jaw movements, clicking or cracking sounds in the joint, which can restrict daily activities such as chewing or speaking, have the potential to significantly affect quality of life. The National Institute of Dental and Craniofacial Research (NIDCR)

Table 2. The four most studied topics and their subheadings

Topic	Subheading	Year											Total n(%)
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Non-invasive intervention	Injection therapy	16	16	17	17	24	21	25	39	35	38	24	272, %28.7
	Splint therapy	9	8	12	7	10	11	8	16	13	24	12	130, %13.7
	Laser therapy	10	10	12	5	7	14	11	15	18	18	6	126, %13.3
	Manuel therapy	11	5	4	10	8	5	10	12	9	24	11	109, %11.5
	Orthodontic treatment	6	9	9	6	9	10	8	14	9	19	6	105, %11.1
Inflammatory diseases of TMJ	Osteoarthritis	15	18	30	25	30	31	40	35	43	57	38	362, %45.9
	Juvenil idiopathic arthritis	14	14	20	13	15	25	17	22	20	23	16	199, %25.2
	Arthritis	20	21	25	17	21	32	19	25	6	6	4	62, %7.9
	Septic arthritis	22	21	28	20	27	33	22	14	5	3	1	30, %3.8
Imaging	MRI	18	17	21	14	17	20	14	25	28	30	18	222, %28.3
	CBCT	17	14	9	14	16	18	19	22	26	24	9	188, %23.9
	CT	3	6	4	7	4	5	4	9	9	7	2	60, %7.7
	Ultrasonography	4	2	4	4	3	5	3	4	5	6	1	48, %6.1
TMJ surgery	Reconstruction	8	24	25	19	23	24	25	14	31	25	20	238, %34.3
	Disc reposition surgery	12	19	8	12	7	13	14	22	25	18	12	162, %23.4
	Arthroplasty	3	6	8	8	1	3	9	8	11	6	3	66, %9.9
	Distraction osteogenesis	6	4	5	2	8	7	5	5	7	5	6	60, %8.7

has reported that TMJ and muscle disorders are among the most common causes of facial pain. Furthermore, TMJ disorders are the second most common chronic disease of musculoskeletal system after chronic back pain. Considering that pain associated with TMJ disorders can interfere with a person's daily activities, psychosocial functionality, and quality of life, accurate diagnosis of these complex musculoskeletal disorders and appropriate clinical care is important.[11]

TMJ disorders, their diagnoses, treatment approaches, and the various defined techniques used in therapy make up a significant part of the literature. Analyzing the trends and developments of these topics over the years and periods within the literature can be done effectively through a bibliometric analysis. Bibliometrics is a functional technique that examines a wide range of literature and associated metadata to reveal historical development processes. It serves as a reliable method to explore future trends in specific academic fields. By examining data such as authors, keywords, and citations, this method helps to analyze progress in scientific fields.[12] The literature analysis shows that a total of 8224 articles related to TMJ were published in the Web of Science (WoS) within the ten-year period between 2013 and 2023. Looking at the number of articles per year, there is a general trend of an increase each year compared to the previous year (Figure 1). A bibliometric analysis conducted by Balel *et al*.[13] on TMJ reconstruction covering the years from 1986 to 2020, also shows an increase in the number of articles over the years. The increasing prevalence of TMJ problems and their significant impact on patients' quality of life

Table 3. The ten most cited articles about TMJ

Name of the article	Year	Author	Institution	Citation	Country
Diagnosis and Management of TMDs	2013	de Leeuw et al.	University of Kentucky	582	USA
Differential Diagnosis and Management of TMDs	2018	de Leeuw et al.	University of Kentucky	554	USA
General Considerations in Managing Oral and Facial Pain	2014	Okeson et al.	University of Kentucky	499	USA
Pain and Dysfunction of the Temporomandibular Joint	2015	Nitzan et al.	Hebrew University of Jerusalem	435	Israel
Synthetic materials in craniofacial regenerative medicine: A comprehensive overview	2022	Yazdanian et al.	Baqiyatallah University of Medical Sciences (BMSU)	423	Iran
Preclinical orofacial pain assays and measures and chronic primary orofacial pain research: where we are and where we need to go	2023	Sadighparvar et al.	McGill University	319	Canada
A current overview of materials and strategies for potential use in maxillofacial tissue regeneration	2017	Jazayeri et al.	Marquette University	282	USA
Temporomandibular Joint Surgery	2017	Bouloux et al.		278	England
Tissue Engineering for the Temporomandibular Joint	2019	Acri et al.	University of Iowa	260	USA
Timing interventions in relation to temporomandibular joint closed lock duration: a systematic review of 'locking duration'	2014	Al-Baghdadi et al.	N8 Research Partnership	253	England

have led to the development of various treatment options and the sharing of results in the literature. As a results, the number of academic studies focusing on the TMJ has increased significantly. Although it occupies a relatively small area in relation to body volume, TMJ is remarkably complex in structure. Its intricate nature, combined with the variety of clinical symptoms and functional impairments resulting from internal changes or pathologies, has led to research into the TMJ spreading across different areas. This is due to the development of both invasive and non-invasive treatment protocols aimed at treating address these conditions.[14]

In our study, the articles were categorized under thirty-seven main headings. When reviewing the topic headings, the heading 'Non-invasive interventions' was in first place. The subcategories within this heading showed that injection therapy accounts for the highest percentage, and the number of articles published in this area increased each year (Table 2). Injection therapy refers to the concept of injecting various substances such as growth factors, hyaluronic acid, corticosteroids, platelet-rich plasma, and stem cells into the joint space to mitigate or halt the progression of the current condition of the joint and relieve pain. This therapy is used for conditions that cause internal irregularities such as osteoarthritis and herniated discs.[14-16]

Patients with TMJ disorders often experience pain, dysfunction and are reluctant to undergo invasive procedures. For this reason, both patients and doctors tend to focus on non-invasive treatments such as injection therapy, splint therapy, laser therapy and orthodontic treatment before incorporating advanced surgical procedures into their treatment protocol. Also noteworthy is the presence of psychological factors that exacerbate pain in individuals with TMJ disorder. Approximately 75% of these patients exhibit varying degrees of emotional disturbance, ranging from mild to severe anxiety, stress, and similar psychological disorders. These psychological changes are associated with the tendency of patients to avoid invasive procedures such as surgery and opt for less complex treatments, a trend supported by the results of various studies.[17]

Inflammatory diseases, autoimmune diseases, and various types of connective tissue diseases form a group of diseases that contribute to long-term damage in several joints, with TMJ is frequently affected among these joints.[18] Pain is the most common symptom of degenerative changes in the TMJ, and osteoarthritis is considered the most widespread joint disease.[19] Osteoarthritis is a debilitating degenerative disease involving inflammation and the bones of the joints. Osteoarthritis of the TMJ, considered one of the most severe types of TMJ disorder, has a prevalence of 18.0% to 84.5% and affects 8% to 16% of the world's population.[20] The second most important topic in the subject heading of the article was 'Inflammatory diseases of the TMJ'. When evaluating the subcategories within this heading, the subheading 'Osteoarthritis' showed a steady increase in the number of publications (Table 2). The higher number of publications can be correlated with the prevalence of the condition, which can lead to complications such as reduced posterior facial height due to condylar osteolysis, joint instability, ankylosis and facial deformities. The increase in publications may be consistent with the search for solutions to these complications.[19]

Imaging the TMJ plays a crucial role in diagnosis, treatment planning, evaluation of treatment outcomes and understanding the anatomy of soft and hard tissues. It also has significant educational value. MRI has become a fundamental tool in the evaluation of TMJ disorders because it can noninvasively image the major regional anatomic structures, detect the presence of effusions within the joint, and reveal abnormalities in bone marrow signal intensity.[21] MRI is considered the gold standard for disk displacement disorders. High-quality MRI images consistently show a normal position of the disk, even in open-mouth views. Dental cone beam CT scan (CBCT) is gaining popularity among imaging techniques due to its low radiation emission and fast image acquisition, making it ideal for the examination of bone and dental structures, while MRI and CBCT are gaining importance within imaging techniques.[12] In addition to these benefits, the third most investigated topic category concerns 'Imaging techniques', which mainly focuses on studies conducted using 'MRI' and 'CBCT' (Table 2). Imaging techniques are important tools for understanding the anatomical structure and function of the TMJ, aid in the diagnosis and treatment of TMJ disorders, and contribute significantly to the development of treatment plans to improve patients' quality of life.

A complete reconstruction of the joint structure may be necessary if there is a significant loss in the TMJ. Such losses may result from pathologies, condylectomy, traumatic joint damage or severe degeneration of the articular surfaces leading to skeletal changes and malocclusion. Irreparable damage due to trauma, ankylosis, degenerative, rheumatic and iatrogenic diseases are considered the gold standard in the reconstruction of severely damaged TMJs.[22] TMJ surgery is an effective treatment method for certain joint disorders. However, it is recommended when non-surgical treatments prove insufficient due to the complexity of available techniques and potential complications such as infection, facial nerve damage, loss of stability of TMJ prostheses over time or foreign body reactions. Surgical treatment options such as meniscectomy, meniscoplasty, eminectomy, condylectomy and condylotomy are preferred in such cases. Compared to open joint procedures, arthrocentesis and arthroscopy are less invasive, simple and less costly procedures.[23] The fourth most studied topic was 'TMJ surgery' with 'Reconstruction' and 'Disc repositioning surgery' accounting for the highest percentages in their respective subcategories (Table 2). The concept of reconstructive treatment includes the use of biocompatible, corrosion-resistant and mastication-resistant TMJ prostheses for conditions such as ankylosis, congenital diseases or syndromes, neoplastic diseases and trauma-related fractures.[24] For this purpose, autogenous grafts such as metatarsal, fibula, tibia, iliac, costochondral and sternoclavicular bones as well as customized TMJ implants can be used as alloplastic grafts.[18] Disc reduction surgery is preferred as a treatment option in cases where the disk is severely deformed in advanced stages due to loss of structural integrity of the posterior, medial and lateral supporting ligaments.[18,25] In clinical studies on disk reduction surgery, patients who underwent this surgical procedure showed a decrease in pain intensity of 80% to 94% and an improvement in mandibular function.[26] In our study, a total of 238 articles on TMJ reconstruction were published, 23 in 2017, 25 in 2019 and 31 in 2021, indicating an increasing trend in this field. Consequently, bibliometric analysis studies conducted by Balel *et al*. on TMJ reconstruction from 1986 to 2020 have also shown the growing popularity of this topic at different time intervals.[13]

In the bibliometric analysis of publications on medical topics found in the literature, the evaluation of the institutions in which studies were conducted found that universities produce more scientific publications than hospitals or private clinics. This is attributed to the physical resources, financial support, and variety of cases available at universities compared to hospitals and private clinics.[27] In line with this information, 78.6% of the articles included in our study were from 955 different universities. Among them, Shanghai Jiao Tong University has the most publications with 208 articles, followed by Sichuan University in second place with 176 articles and University de Sao Paulo in third place with 131 articles (Figure 3). This result is consistent with a bibliometric analysis by Wang *et al*. on TMJ disc shifts between 1992 and 2022, in which two of the most productive universities were Shanghai Jiao Tong University and University of Sao Paulo.[27] The differences in the number of studies between universities are due to various factors, such as research areas, countries in which the universities are located, financial resources, university project support, international collaborations and the number of academic staff. If we look at the number of items produced by each country, we see that the highest numbers come from the United States and China. These countries stand out as major centers of scientific research and academic study. Collaborations between universities and joint efforts by researchers from different countries can influence the distribution of these article numbers. The countries with the highest number of studies are the United States (113), China (82), Turkey (71), Japan (68) and Brazil (67). Looking at the total number of universities in these developed countries, the United States has 4140 universities, China has 2138 universities and Turkey has 208 universities. The reason Turkey produces a higher number of publications on TMJ despite having fewer universities compared to other countries could be due to cultural factors, living conditions and higher stress levels in the country. This situation could lead to an increased need for scientific research and, consequently, to an increase in the number of studies carried out in this area. Therefore, the growing number of publications on TMJ in Turkey appears to be related to the complex socio-cultural structure of the country and the dynamics of its academic environment. An

academic bibliometric analysis on myofascial pain conducted by Tang *et al*. found that Turkey ranked second in the number of published articles on bruxism-related topics between 1956 and 2022.[28] The number of science and technology articles and papers published worldwide in 2018 amounted to 2.556.000, with China leading the way (528.263), followed by the United States (422.808) and India (135.788). The total number of articles published by each country correlates with the number of articles published on TMJ disorder. In a bibliometric analysis on the reconstruction of TMJ disorder conducted by Balel and colleagues, it was found that the countries with the most contributions were the USA, China and the United Kingdom.[13] Highly developed countries, especially those with strong economies such as the USA and China, significantly influence academic research and the production of articles through the financial support they provide to universities and through their extensive university networks. These contributions play a crucial role in the conduct of scientific research and the publication of articles. These advantages enable advanced countries to maintain their leading position in the production and dissemination of scientific knowledge.

Citation analysis refers to the systematic examination and evaluation of research conducted on a particular topic or text using bibliometric methods. It includes the assessment of the impact of researchers, individual studies, institutions, and entire fields of study.[29] Table 3 shows the top ten most cited articles among the 8224 publications on TMJ. This table shows that three of the most cited articles come from the USA. This shows that research from the USA occupies a significant place in the literature and is frequently cited by other countries. The influence of the USA in the scientific literature is reflected in the fact that the most frequently cited articles and publications are predominantly from the USA, making it the country with the highest publication rate and the greatest citation impact. In line with the results of our study, Balel's bibliometric analysis of embedded third molars between 2000 and 2020 also showed that the most significant contribution came from the USA.[8] "Al-Sharaee *et al*." found that among the 100 most cited articles in the field of TMJ disorders, 46 of these articles were from the USA. Similarly, in the bibliometric analysis of "Wang *et al*." on TMJ disc displacement, covering a 30-year period from 1992 to 2022, the USA was found to be the largest contributor, which is consistent with the results of our study.[13,27] These results indicate that the USA is a leader in the academic world and one of the countries that contribute the most to scientific research worldwide.

The first two most cited studies in the literature on TMJ disorder are attributed to the book "Orofacial Pain: Guidelines for Assessment, Diagnosis, and Management" by de Leeuw *et al*. It is clear that this book serves as an important reference source in TMJ disorder research.

The impact factor is a tool used to measure the importance of journals within a certain category by calculating how often selected articles have been cited in recent years. Journals with a higher number of publications of review articles tend to have higher impact factors, and those with higher impact factors are considered more important than those with lower impact factors.[30] The Journal Citation Reports (JCR) is a database that provides unbiased and objective tools for evaluating important journals worldwide and offers comprehensive statistical information based on critical citation data. When examining journals that publish on TMJ, the 'Journal of Oral and Maxillofacial Surgery' is at the top of the list with a total of 376 published articles, indicating that research in this field is highly valued in this journal. According to the JCR publication of 2023, the impact factor for the Journal of Oral and Maxillofacial Surgery is 2.1, which illustrates its significant position among journals dealing with topics in oral and maxillofacial surgery. In the bibliometric analysis of TMJ reconstruction conducted by Balel *et al*., the 'Journal of Oral and Maxillofacial Surgery' also appears to have made the greatest contribution.[13] In second place is the journal 'Cranio-The Journal of Craniomandibular & Sleep Practise' with an impact factor of 1.6 and 299 articles, while the 'International Journal of Oral and Maxillofacial Surgery' is in third place with an impact factor of 2.4 and 291 articles. In the bibliometric analysis by Wang *et al*. on TMJ disc displacements between 1992 and 2022, it was found that two of the three journals with the most published articles were the 'Journal of Oral and Maxillofacial Surgery' and 'Cranio-The Journal of Craniomandibular & Sleep Practice'.[27] The observation that three of the five

journals with the most publications are from the USA suggests that research in the field of TMJ covers a wide range of aspects in terms of diagnosis and treatment. The large number of articles published in these journals indicates a comprehensive examination of the various facets of TMJ.

CONCLUSION

Our study, conducted using bibliometric analysis, aims to identify the publications, journals, countries, most cited articles, and authors related to TMJ disorders between the years 2013 and 2023. It was found that the number of articles on TMJ disorder has increased rapidly over the years, with the highest number of publications in 2022. As our study was conducted in August, the first seven months of 2023 were considered, and it is possible that the total number of articles in 2023 may exceed those of previous years. The research shows that non-invasive approaches in the treatment of TMJ disorders, which have an increasing impact on patients' quality of life, have gained popularity, with non-interventional interventions being the most intensively studied topic. The categorization of articles by topic is intended to help identify areas in need of further research. The three most productive institutions are universities, in particular Shanghai Jiao Tong University, Sichuan University, and University of Sao Paulo, in parallel with the USA, China, and Brazil, respectively. This bibliometric analysis provides a comprehensive examination of publications on TMJ, identifies areas of research, recognizes potential trends, and should serve as a valuable reference guide for future studies.

REFERENCES

1. Gauer RL, Semidey MJ. Diagnosis and treatment of temporomandibular disorders. Am Fam Physician 2015;91:378-86.

2. Wieckiewicz M, Boening K, Wiland P, Shiau YY, Paradowska-Stolarz A. Reported concepts for the treatment modalities and pain management of temporomandibular disorders. J Headache Pain 2015;16:106.

3. Dimitroulis G. Management of temporomandibular joint disorders: A surgeon's perspective. Aust Dent J 2018;63:79-90.

4. Buescher JJ. Temporomandibular joint disorders. Am Fam Physician 2015;76:1477-82

5. Tzanidakis K, Sidebottom AJ. Outcomes of open temporomandibular joint surgery following failure to improve after arthroscopy: is there an algorithm for success? Br J Oral Maxillofac Surg 2013;51:818-21.

6. Gogos C, Kodonas K, Fardi A, Economides N. Top 100 cited systematic reviews and meta-analyses in dentistry. Acta Odontol Scand 2020;78:87-97.

7. Hassona Y, Qutachi T. A bibliometric analysis of the most cited articles about squamous cell carcinoma of the mouth, lips, and oropharynx. Oral Surg Oral Med Oral Pathol Oral Radiol 2019;128:25-32.e6.

8. Balel Y. Bibliometric analysis of international publication trends in impacted third molar surgery research '2000-2020'. Br J Oral Maxillofac Surg 2021;59:1220-6.

9. Ahmad P, Vincent Abbott P, Khursheed Alam M, Ahmed Asif J. A bibliometric analysis of the top 50 most cited articles published in the Dental Traumatology. Dent Traumatol 2020;36:89-99.

10. Iturriaga V, Bornhardt T, Velasquez N. Temporomandibular Joint: Review of Anatomy and Clinical Implications. Dent Clin North Am 2023;67:199-209.

11. Ahmad M, Schiffman EL. Temporomandibular Joint Disorders and Orofacial Pain. Dent Clin North Am 2016;60:105–24.

12. Xiong X, Gao X, Zhong J, Hu S, Li Y, Zheng Y, *et al*. Bibliometric Analysis of Research on Temporomandibular Joint and Occlusion from 2000 to 2022. J Pain Res 2023; 16: 2847–60

13. Balel Y, Tümer MK. A Bibliometric Analysis of International Publication Trends in Total Temporomandibular Joint Replacement Research '1986–2020'. Journal of Oral and Maxillofacial Surgery 2021;79:1458.e1-1458.e12.

14. Derwich M, Mitus-kenig M, Pawlowska E. Mechanisms of Action and Efficacy of Hyaluronic Acid, Corticosteroids and Platelet-Rich Plasma in the Treatment of Temporomandibular Joint Osteoarthritis—A Systematic Review. Int J Mol Sci 2021;22:7405.

15. Gupta S, Sharma AK, Purohit J, Goyal R, Malviya Y, Jain S. Comparison between intra-articular platelet-rich plasma injection versus hydrocortisone with local anesthetic injections in temporomandibular disorders: A double-blind study. Natl J Maxillofac 2018;9:205-8.

16. Long X. Intra-articular injections of hyaluronic acid for anterior disc displacement of temporomandibular joint. Zhonghua Kou Qiang Yi Xue Za Zhi 2017;52:161–5.

17. Buescher JJ. Temporomandibular Joint Disorders. Am Fam Physician 2007;76:1477–82

18. Henry A, Mehra P. Reconstruction of the TMJ and condyle in inflammatory arthritis. J Oral Biol Craniofac Res 2022;12:623–32.

19. Derwich M, Mitus-Kenig M, Pawlowska E. Interdisciplinary Approach to the Temporomandibular Joint Osteoarthritis—Review of the Literature. Medicina 2020;56:225 .

20. Liu X, Li H, Feng Y, Guo H, Li Y, Ke J, *et al*. Resatorvid alleviates experimental inflammatory TMJOA by restraining chondrocyte pyroptosis and synovial inflammation. Arthritis Res 2023;25:230.

21. Tasali N, Cubuk R, Aricak M, Ozarar M, Saydam B, Nur H, vd. Temporomandibular joint (TMJ) pain revisited with dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI). Eur J Radiol 2012;81:603–8.

22. Sidebottom AJ. Alloplastic or autogenous reconstruction of the TMJ. J Oral Biol Craniofac Res 2013;3:135–9.

23. Sheikh O, Logan G, Komath D, Grossman P, Ayliffe P. Splint-assisted disc plication surgery. Ann Stomatol (Roma) 2017;7:73–8.

24. Mehrotra D, Kumar S, Mehrotra P, Khanna R, Khanna V, Eggbeer D, vd. Patient specific total temporomandibular joint reconstruction: A review of biomaterial, designs, fabrication and outcomes. J Oral Biol Craniofac Res 2021;11:334–43.

25. Göçmen G, Varol A, Karatas B, Basa S. Evaluation of temporomandibular joint disc-repositioning surgery with Mitek mini anchors. Natl J Maxillofac Surg 2013;4:188.

26. Rajkumar K, Roy Chowdhury SK, Sinha R. Clinical and MRI Evaluation of Orthodontic Mini-Screws for Disc Repositioning in Internal Derangement of TMJ: A Prospective Study. J Maxillofac Oral Surg 2018;17:52–8.

27. Wang Q, Jia J, Zhou C, Ye W, Bi R. A Bibliometric Analysis of Research on Temporomandibular Joint Disc Displacement from 1992 to 2022. Healthcare 2023;11:2108.

28. Tang F, Jiang C, Chen J, Wang L, Zhao F. Global hotspots and trends in Myofascial Pain Syndrome research from 1956 to 2022: A bibliometric analysis. Medicine 2023;102:e33347.

29. Frachtenberg E. Citation analysis of computer systems papers. PeerJ Comput Sci 2023;9:e1389.

30. Sharma M, Sarin A, Gupta P, Sachdeva S, Desai A. Journal Impact Factor: Its Use, Significance and Limitations. World J Nucl Med 2014;13:146.