

Therapies used for the management of myofascial temporomandibular disorders: bibliometric analysis

Terapias utilizadas para o manejo da disfunção temporomandibular de origem miofascial: análise bibliométrica

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ABSTRACT

BACKGROUND AND OBJECTIVES: Temporomandibular disorder (TMD) is the term used to describe a set of painful and functional conditions that can affect the temporomandibular joint (TMJ), the masticatory muscles and/or their associated structures. For myofascial TMD, conservative therapies, including drugs, physical therapy, occlusal splint and pain self-management show the best benefits to the patient. The objective of this study was to carry out, through a bibliometric analysis, a review of the existing knowledge regarding the treatments used in myofascial TMD.

CONTENTS: The search was conducted in the Web of Science (WOS) and SCOPUS databases in July and updated in December 2023, through the MeSh descriptors “Temporomandibular Joint Dysfunction Syndrome” and “Therapeutics”. Moreover,

bibliometric mapping was performed using the VOSviewer software. For the analysis, data on the terms of the title and abstract, type of document, number of citations, name of journals, most cited article and year of publication were included. Besides these, the country of the corresponding author, type of treatment, type of study and the results were included in the analysis. Of the 760 articles identified, 63 were selected to compose this review. Of these, most were original articles, clinical trials and were published in 2012. The most frequent treatments were: occlusal splint, laser, manual therapy, botulinum toxin and dry needling. Of the 15 countries analyzed, Brazil was the country with the highest number of publications.

CONCLUSION: There was an increase in articles published on the topic, with Brazil being the country with the highest number of publications. Finally, the most used treatments were occlusal splint and laser.

Keywords: Facial pain, Myofascial pain, Temporomandibular joint dysfunction syndrome, Therapeutics.

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HIGHLIGHTS

- Brazil is the country with the highest number of publications on temporomandibular dysfunction of myofascial origin in recent years.
- The most used treatments for temporomandibular dysfunction of myofascial origin were the occlusal splint and laser.
- In the articles included the words that appeared most often were myofascial pain, psychotherapy and temporomandibular disorders.

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RESUMO

JUSTIFICATIVA E OBJETIVOS: Disfunção temporomandibular (DTM) é um termo utilizado para descrever um conjunto de condições dolorosas e funcionais que podem afetar a articulação temporomandibular (ATM), os músculos mastigatórios e/ou suas estruturas associadas. Para DTM miofascial, terapias conservadoras, incluindo fármacos (analgésicos e/ou anti-inflamatórios), fisioterapia, placa oclusal e autogestão da dor apresentam os melhores benefícios para o paciente. O objetivo deste estudo foi abordar, através de uma análise bibliométrica, o conhecimento existente sobre os tratamentos utilizados na DTM de origem miofascial.

CONTEÚDO: A busca foi realizada na base de dados *Web of Science* (WOS) e SCOPUS, em Julho e atualização em Dezembro de 2023, por meio dos descritores do MeSh *Temporomandibular Joint Dysfunction Syndrome e Therapeutics*. Além disso, um mapeamento bibliométrico foi realizado no *software VOSviewer*. Para análise, foram incluídos dados sobre os termos do título e resumo, tipo de documento, número de citações, nome dos periódicos, artigo mais citado e ano de publicação e, além destes, o país do autor correspondente, tipo



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de tratamento, tipo de estudo e resultados. Dos 760 artigos identificados, 63 foram selecionados para compor esta revisão. Destes, a maioria era artigos originais, ensaios clínicos e foram publicados em 2012. Os tratamentos mais frequentes foram: placa oclusal, laser, terapia manual, toxina botulínica e agulhamento a seco. Dos 15 países analisados, o Brasil foi o país com maior número de publicações.

CONCLUSÃO: Houve um aumento de artigos sobre a temática publicados, sendo o Brasil o país com mais publicações e os tratamentos mais utilizados foram placa oclusal e laser.

Descritores: Dor facial, Síndrome da disfunção da articulação temporomandibular, Síndrome da dor miofascial.

INTRODUCTION

Temporomandibular disorder (TMD) is a term used to describe a set of painful and functional conditions that can affect the temporomandibular joint (TMJ), the masticatory muscles and/or their associated structures^{1,2}. The etiology of this dysfunction is multifactorial, involving genetic, individual, and environmental factors. It has been observed that increased stress has favored the appearance of muscle tension which, in turn, affects the functioning of the stomatognathic system and the TMJ^{3,4}.

According to the Diagnostic Criteria for TMDs, they can be categorized as myalgia, arthralgia, or headache attributed to TMD⁵. Myalgia can be divided into subgroups: local myalgia, myofascial pain with spreading, and referred myofascial pain^{5,6}. Myofascial pain affects 46% of the global population, and the morbidity rate among dental patients with TMDs ranges from 27% to 76%⁷. Besides the high prevalence, individuals who suffer from TMD are at a greater risk of experiencing depressive symptoms, difficulty in activities of daily living (ADL) and have a lower quality of life^{6,8,9}.

Among existing TMDs, myofascial TMD is the most common¹⁰. This pain is described as dull and persistent, being the most common symptom of this type of TMD^{10,11}. Besides the episodes of musculoskeletal pain, this type of dysfunction is represented by tenderness to palpation of the TMJ and masticatory muscles, as well as joint range of motion (ROM) restrictions^{3,12,13}. An essential aspect for the diagnosis and management of myofascial TMD is the consideration of morbidities often associated with it. In particular, psychosocial stressors associated with several comorbidities are critically related to this manifestation of pain^{6,10,11}.

In the 1990s, dental factors were typically associated with TMDs, with the treatment of these problems often leading to such dysfunction⁷. However, according to more recent evidence, conservative therapies, including pharmaceutical (analgesics and/or anti-inflammatory drugs), physical therapy, occlusal splint and pain self-management show the best benefits for the patient^{6,14-19}.

In this sense, the objective of the present study was to describe, through a bibliometric analysis, which treatments are most commonly used for the management of TMD of myofascial origin in order to guide any professional interested in this topic by mapping current treatment trends..

CONTENTS

The search was conducted in the Web of Science (WOS) and SCOPUS database in July and update in December 2023. The following MeSH descriptors and their synonyms were used: Temporomandibular Joint Dysfunction Syndrome, Therapeutics.

Thus, the following search key was formed: in WOS ((*ALL= (Temporomandibular Joint Dysfunction Syndrome OR TMJ Syndrome OR Temporomandibular Joint Syndrome)*) AND *ALL= (Therapeutics OR Therapeutic OR Therapy OR Therapies OR Treatment OR Treatments)*) AND *ALL= (Facial Pain OR Face Pain OR Orofacial Pain OR Craniofacial Pain OR Myofascial Pain)*; and in SCOPUS: (*TITLE-ABS-KEY (temporomandibular AND joint AND dysfunction AND syndrome OR TMJ AND syndrome OR temporomandibular AND joint AND syndrome) AND TITLE-ABS-KEY (therapeutics OR therapeutic OR therapy OR therapies OR treatment OR treatments) AND TITLE-ABS-KEY (facial AND pain OR face AND pain OR orofacial AND pain OR craniofacial AND pain OR myofascial AND pain)*).

An initial scan was carried out to select the articles that met the inclusion criteria: articles that address therapies that are or were used in the treatment of temporomandibular myofascial dysfunction and articles which studied dysfunction was not associated with another disease or that had a joint origin. Thus, articles that were not available in full, or that did not have an abstract, on patients that had TMD because of another disease or that were qualitative studies were excluded. There were no restrictions on the language and period of publication.

The search results were exported in Excel and RIS format and were analyzed in terms of the type of document, number of citations, name of journals, most cited article and year of publication. In addition to these, the country of the corresponding author, type of treatment, type of study and the results were also analyzed.

For the bibliometric analysis, the VOSviewer software was used. This software performs an analysis through data exported from the database and displays them in a cluster format. In the network map produced by VOSviewer, the results are displayed in nodes and links of different colors. Nodes represent an element type (countries, co-authors), the larger the node the higher the frequency of occurrence of the element. The links, which interconnect the nodes, represent the collaborative relationships between the elements. The more frequent these collaborations are, the denser and closer the links will be. In addition, the colors of the nodes and links identify which clusters the element belongs to^{14,20}. In this study, a bibliometric mapping was performed for an in-depth analysis based on the title and abstract terms, as well as on the co-authors.

A total of 760 articles were identified, from which 63 articles were selected to compose the sample for meeting the inclusion criteria of this study. The period of publication was from 1993 to 2023, with 2012 being the year with the highest number of records (6) and the years 1993, 1994, 1996, 2000, 2004, 2007 and 2014 with only 1 record each. The years 1999, 2002, 2009, 2010, 2011 and 2013 with 2 articles, while 2006, 2008, 2018, 2021 and 2023 with 3 articles, and 2017 and 2019 with 4 articles, 2015, 2020 and 2022 with 5 articles.

According to the type of document, original articles and reviews were found, with original articles being the most frequently

found, totaling 22 articles (57.89%) and 16 reviews (42.11%). Regarding the type of study, most were clinical trials (50%), followed by systematic reviews (31.58%) and literature reviews (15.79%), as well as case reports (2.63%) (Table 1).

According to the type of treatment, there was a wide variety of techniques used for the management of TMD, with the most common being: Occlusal splint (19), Laser (16), Manual Therapy (9), Botulinum Toxin (9) and Counseling (9). The number of treatments listed exceeds the number of articles included, as some articles cite or use more than one type of treatment in their intervention or narration (Table 2).

In total, 13 countries were analyzed, with the number of studies published highlighted by color intensity, according to the map produced in Microsoft Excel (Figure 1). The country with the highest number of published articles is Brazil (15), followed by the United States (11), Turkey (6), Spain, Iran and Finland (4), Canada and Italy (3), China (2), as well as South Korea, Austria, Switzerland, India, Poland, Japan, the United Kingdom, Egypt, Israel, Sweden and Australia (1). Based on the analysis of citations by country, Figure 2 shows the correlation of authors from different countries that contribute to each other. For instance, Brazil collaborates with many countries, such as Spain, USA, Canada and Turkey. The minimum number of documents for a country was defined as 2. Thus, 10 countries met the established criteria, forming 5 clusters.

In the top 3 journals, Journal Oral Rehabilitation had the greatest number of articles (4), followed by the Journal of Oral & Facial Pain and Headache (4) and the Journal of Orofacial Pain with 3 articles.

The network view shows the correlation between co-authors and keywords. With regard to co-authors, the minimum number of occurrences was of 1 document per author. Of the 270 authors, 12 authors met the established criteria. The co-authorship network map provides the visualization of relevant connections between authors, which can subsidize possible collaboration oppor-

Table 1. Characteristics of the studies included

Documents type	n	%
Articles	43	68.25
Reviews	20	31.74
Types of study		
Clinical trials	40	79.36
Systematic reviews	14	22.22
Literature reviews	8	12.69
Case report	1	1.58

Table 2. Types of treatments used in the studies

Types of treatment	
Occlusal splint	19
Laser	15
Manual therapy	9
Botulinum Toxin	8
Dry needling	8
Counseling	6
Drugs	6
Transcutaneous Electrical Nerve Stimulation (TENS)	5
Exercises	5
Physiotherapy	5
Cognitive behavioral therapy	2
Acupuncture	2
Kinesiotaping	2
Biofeedback	2
Relaxation training	2
Hypnosis	2
Other therapies (Ozone therapy, photobiomodulation, neuroreflex therapy, Pain education)	1

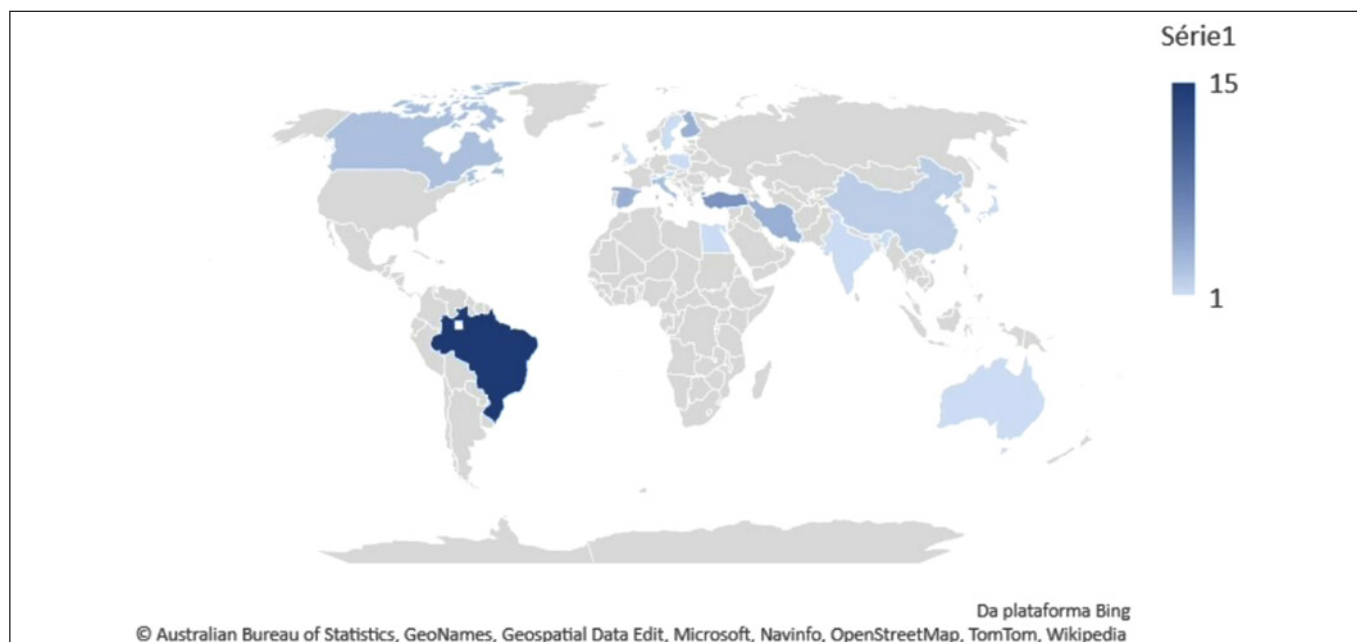


Figure 1. Frequency of published articles distributed by countries or regions.

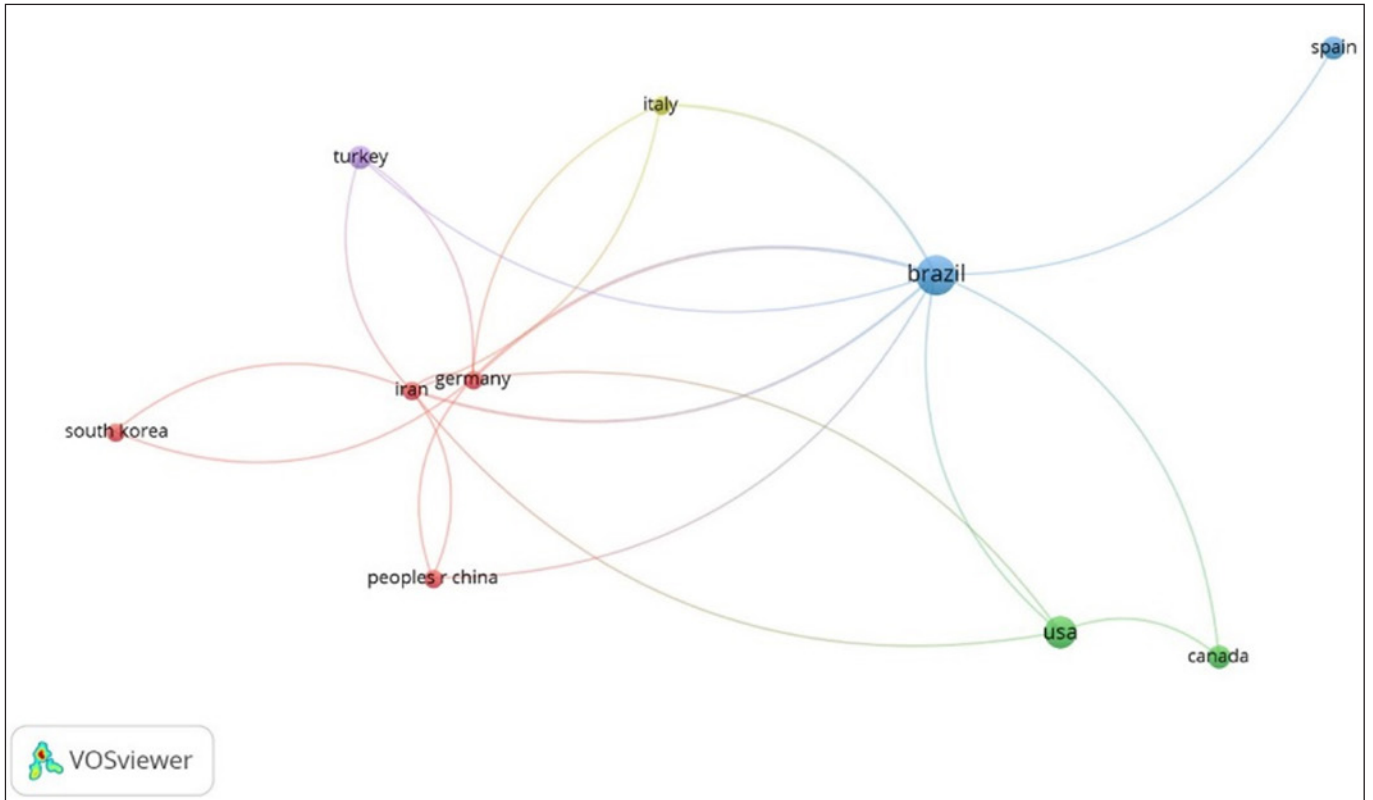


Figure 2. Distribution of the main research countries in the study of myofascial temporomandibular disorder.

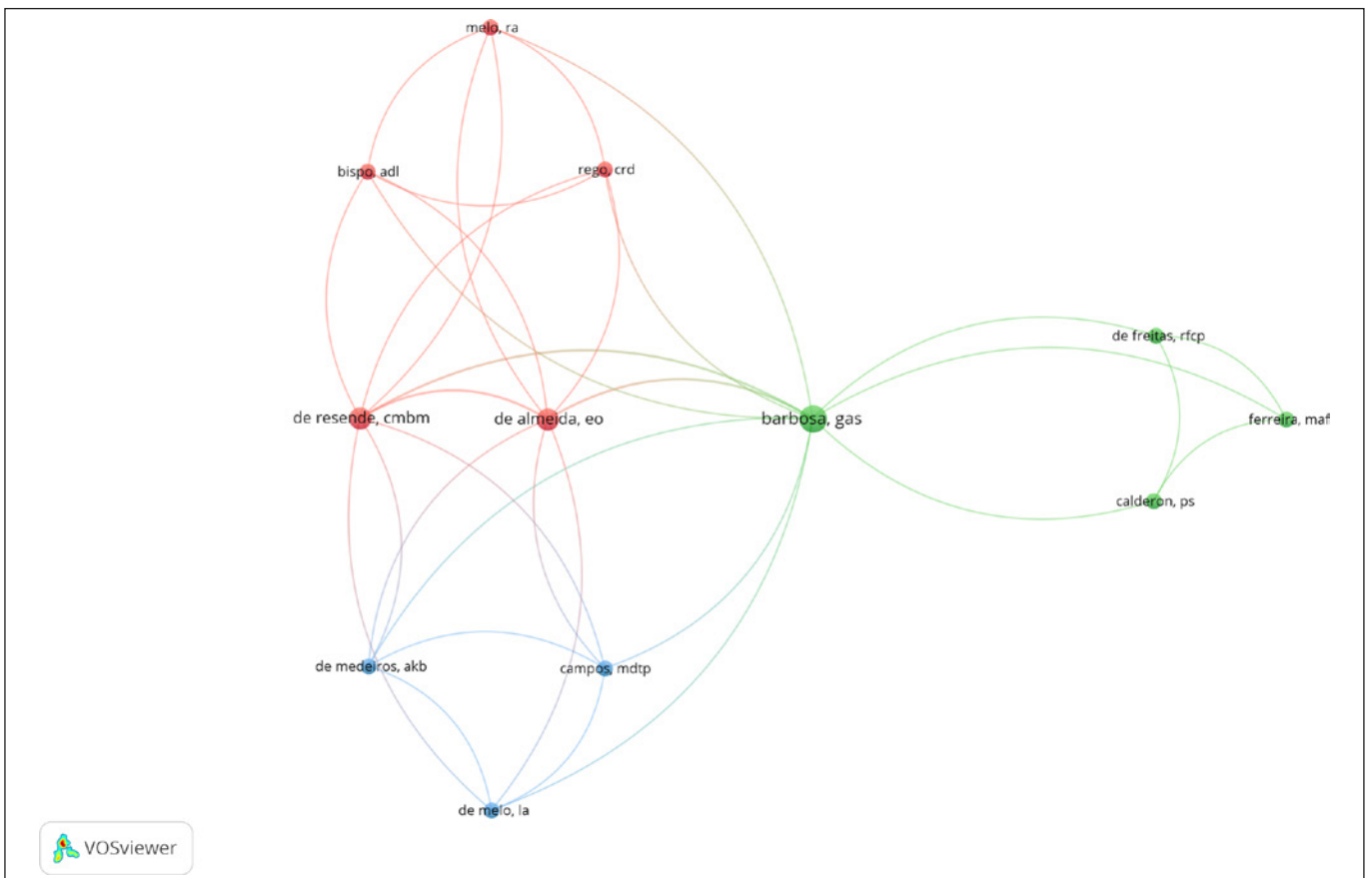


Figure 3. Correlation between authors in the studies included.

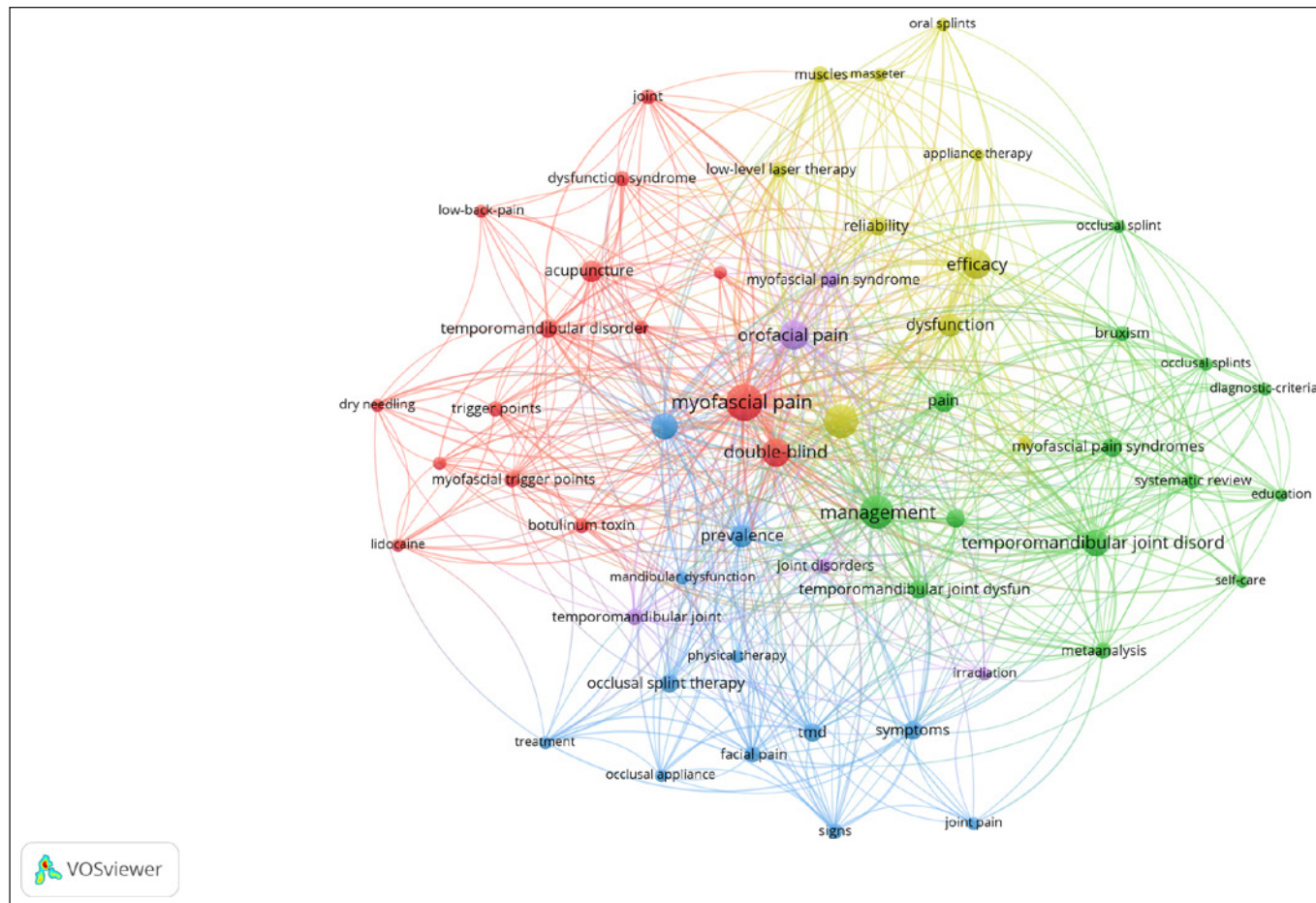


Figure 4. Correlation between keywords in the studies included.

tunities. A cluster is formed by each different color, for which each cluster indicates that the author is working collaboratively and in the same area, involving the same research topic. Different colors with links indicate that they collaborate with people with different themes (Figure 3).

The same analysis was carried out for the keywords. The minimum occurrence was 3 for a term, with 353 terms being found, of which 56 met the established criteria. This type of analysis is important to verify the most important topics used by researchers and scientific areas internationally (Figure 4).

DISCUSSION

During the last decade, scholars from all over the world have published studies about TMD¹⁴. Although 2012 had the highest number of publications on the treatment of TMD, from 2015 onward an increase in the number of studies was observed, with 3-5 publications per year on this topic. Brazil leads in terms of the number of publications, ahead of the USA. According to the study¹⁴ the USA had the highest number of citations, with a broad international scientific center for research related to TMD. This may have occurred due to the objective of the present research being only on treatments for myofascial TMD, different from the objective of authors¹⁴, who searched for the general literature

on TMDs. In addition, they report that despite the USA being the most productive country, that is, the country with the most published articles, it is in Europe that the institutions collaborate the most on research on TMD.

The oldest publication was by the authors²¹, who evaluated the effects of intraoral appliance and biofeedback in the treatment of pain and sensitivity in the muscles of mastication and in the TMJ region, in depression and in the management of stress in patients with TMD. However, the study on TMDs began in 1920, when an author²² stated that the loss of molar teeth would be responsible for deafness and that TMJ was related to ear and face symptoms. Thereafter, those studies began their research into the symptomatology, diagnosis, etiology, and treatment of TMDs.

It is important to mention that, in 1992, a study²³ developed the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). With a multiaxial approach, the RDC/TMD is indicated a physical diagnosis for the most common forms of TMD and assessment of the psychosocial status of patients with this disorder²⁴. After many years of being used in scientific research, the RDC/TMD was updated. In 2014, the Diagnostic Criteria for Research in Temporomandibular Disorders (DC/TMD) was launched, which can be used in research, with a high rate of reliability and also in clinical practices for TMD assessment²⁵.

CO-OCCURRENCE OF AUTHORS AND KEYWORDS

The correlation between the authors of the studies was demonstrated in figure 2, in which 12 authors met the established criteria. This means that these authors collaborate with each other in research on TMD. Divided into 3 clusters, they are analyzed as follows:

In Cluster 1, colored red, the authors verified the effect of treatments on pain and anxiety in patients with TMD. Through a randomized clinical trial (RCT) published in 2020, in which participants were divided into 4 groups: 1-occlusal splint (OS), 2- manual therapy (MT), 3- counseling (C) and 4- combination of an occlusal splint and counseling (OSC), the authors concluded that the therapies used decreased pain and the level of anxiety, though no therapy proved to be superior to another.²⁶

In Cluster 2, the blue group, the systematic review¹⁰ investigated the effectiveness of manual therapy in the treatment of TMD-related myofascial pain. Five articles were included, of which one compared it with botulinum toxin²⁷, the other with manual therapy and previously instructed manual therapy performed at home²⁸. The others compared manual therapy with counseling²⁹⁻³¹. The authors found that manual therapy was effective for the outcome analyzed, though not superior to botulinum toxin or counseling¹⁰. More studies are needed on the subject, since there are few studies that have evaluated the effectiveness of manual therapy for myofascial TMD pain. In addition, the studies have presented inconclusive data and little homogeneity.

Cluster 3, the green group, also a systematic review, carried out in 2013, analyzed the effectiveness of counseling or self-management therapies and other therapies (occlusal splints, physiotherapy, postural training, muscle relaxation exercises, cognitive behavioral therapy, prescription of drugs) in pain relief and functional abilities of patients with TMD. Despite the large number of records found (581 articles), only 7 met the inclusion criteria for analysis. The study concluded that counseling was effective in improving muscle sensitivity to palpation and mouth opening in patients with and without TMD-related pain. This data indicates that therapies with counseling and self-management can be used and are an alternative form of conservative and low-cost treatment³².

The co-occurrence of keywords was also analyzed by the VOSviewer software. The most frequent keywords were: myofascial pain (23) and double blind (14) in cluster 1, management (19) and temporomandibular joint disorders (12) in cluster 2, therapy (12) in cluster 3 and temporomandibular disorders (19) and efficacy (15) in cluster 4, as well as orofacial pain (15) in cluster 5. All these words demonstrate links to each other. Of the terms related to TMD, the most frequent is myofascial pain, which can be explained by the fact that pain in this region is a common symptom for this specific type of TMD.

TYPE OF TREATMENT

The most reported treatment in this bibliometric review was occlusal splint (OS). This treatment is widely used in clinical practice and consists of an intraoral device, removable, made

of acrylic and can be used during the day or night^{6,26}. The research compared the mandibular splint and the upper Michigan splint, which are two of the most common approaches to occlusal splints and found that there was no significant difference between the two types of splints. Occlusal splints were compared to manual therapy and counseling²⁶, demonstrating the effectiveness in reducing pain as much as other therapies. The same was observed when compared to laser³³, both of which are effective in reducing pain and improving mandibular movements.

On the other hand, in a recent systematic review³⁴, the analyzed studies showed no difference in the improvement of pain, quality of life and mandibular movements between the groups that performed only exercises or exercises associated with the use of the occlusal splint, corroborating the results of the study³⁵ in their randomized clinical trial. When compared with TENS³⁶, the occlusal splint showed better results in reducing pain, muscle sensitivity and mouth opening.

The oldest studies in this review already used occlusal splints as a treatment for myogenic TMD^{21,37}. The authors²¹ performed two clinical trials. In the first trial, participants were divided into 3 groups: splint group (GPO), biofeedback associated to stress management group (GBF/GE) and control group (patients on the waiting list). The authors found that the GPO was more effective than the GBF/GE in pain and depression. However, with 6 months of follow-up, these results declined in the GP, while in the GBF/GE the improvements remained. In the second trial, the authors treated a group of 30 participants using an oral splint, biofeedback, and stress management. They observed that the participants showed improvements in pain and depression, before and after treatment (6 months).

When compared to the groups in the first clinical trial, the combination of therapies was superior. However, the data must be analyzed with caution, since, in the second clinical trial, besides not having a control group, the authors did not evaluate the therapies in isolation, instead only evaluating them before and after the combination therapies. The author³⁷, in his narrative review, on the other hand, suggests that occlusal splint is effective when used alone or in combination with other treatments, though the author does not report whether one is better than the other.

Regarding studies that compare different types of splints, authors⁶ report that there was no statistically significant difference between the use of splints in the upper or lower arch to reduce pain over a period of 6 months, unlike the study³⁸, who, using 3 different types of splints, found that they all offered pain reduction at different times (7 days, 60 days and 90 days).

The authors^{38,39} recommended the use of an occlusal splint for patients with myofascial TMD, as their research found that participants who used the splint achieved improvement in symptoms, persisting for 6 and 12 months. The divergences found in the studies are due to the fact that the splints do not have the same manufacturing standard besides, the different follow-up time and the association or not of counseling in the groups that were treated with splints.

According to the systematic review³², intraoral appliances were effective in improving the sensitivity to palpation of the masticatory muscles and maximal mouth opening. Nonetheless, the other approaches studied (counseling, pain education, physical

therapy) also obtained similar results, indicating the likely joint action on psychosocial factors.

The second most common treatment was low-frequency laser (LBF), with 15 studies, of which 1 was a case report, 7 clinical trials, 1 literature review and 6 systematic reviews. Regarding the case report⁴⁰, there was a decrease in painful sites, though LBF was associated with other therapies. Thus, it cannot be inferred that it alone caused this improvement. Clinical trials that have found laser efficacy in decreasing pain^{33,41-44} and increased ability to open the mouth^{33,41,42-44} were compared with occlusal splints³³ or laser placebos⁴¹⁻⁴⁴.

Of the articles that used laser, only one⁴⁵ differed from the results above. The authors did not find significant statistical differences between the groups that used active laser and placebo in the temporal and masseter muscles after treatment. The divergence may have occurred due to the small study sample, 9 adolescents, 5 from the plaque group and 4 from the placebo group. In addition, the age range of adolescents between 14-23 years old differs from the other studies⁴⁵. The studies found that LBF therapy can be considered an alternative or complementary approach for the management of myofascial TMDs, due to its analgesic and myorelaxant effects. Besides, it is a non-invasive, non-pharmacological therapy that has no side effects⁴⁶.

It is worth mentioning that systematic reviews⁴⁷⁻⁵¹ found that LBF therapy reduced pain related to myofascial TMD. However, the heterogeneity of laser parameters (characteristics of the light beam, frequency and output; number and duration of laser application) requires caution in interpreting the results⁴⁹. In a recent systematic review⁵¹ with meta-analysis, carried out in 2022, the authors studied the ideal wavelength ranges for laser application. The authors stated that laser therapy with a wavelength of 910-1100nm was the most effective in the treatment TMD of muscular origin³⁷.

Manual therapy, when combined or not with other therapies (exercise, relaxation, biofeedback) can be effective in reducing pain and increasing mouth opening^{26,52}. However, the authors⁵³, in their literature review, emphasize that patients with myofascial TMD need a multimodal approach and not isolated interventions, given that the etiology of the disease is multifactorial. A current systematic review¹⁰ analyzed the effectiveness of manual therapy in treating pain in myofascial TMD and found that although manual therapy was effective in reducing pain, it is not more effective than counseling or botulinum toxin.

Other treatments were described in the studies included in this review. Authors¹⁷ found that botulinum toxin (TXB) was more effective than placebo (only within 1 month) and conventional treatment (up to 12 months). The study⁵⁴ found that most patients experienced pain improvement when opening their mouth and pain when chewing after 6 months of application. For the authors^{17,10,55} there is no statistically significant difference between TXB and manual therapy (MT), although MT presents greater pain reduction in patients with myofascial TMD.

Regarding TXB and low-frequency laser (LBF), the study⁴⁸ corroborated the findings by authors¹⁷, as both stated that, although LBF is faster in improving pain, it is not more effective than TXB. Thus, it is clear that the evidence on botulinum toxin is

insufficient to support the use of TXB as an exclusive treatment to reduce myofascial TMD pain^{10,17,56,57}.

A drug study, where morphine and lidocaine were used, found no difference between the two drugs, although it was better than placebo, producing analgesic effects for up to 48 hours⁵⁸. A meta-analysis has already pointed out that muscle relaxation produced by cyclobenzaprine has a positive effect in the treatment of myofascial TMD. Nevertheless, this effect was only studied for 3 weeks, requiring evidence with long-term effects and also analyzing the side effects of this drug⁵⁹.

Dry needling may be better than other interventions. However, the evidence is of low quality and has a small effect size⁶⁰. Moreover, the number and frequency of sessions, which muscles should be needled, remains unstandardized^{40,52,53,61}. Counseling and pain education are also used as an alternative to low-cost conservative treatment, being beneficial for the treatment of myofascial TMD to improve the psychological domains of the dysfunction and remove harmful behavior for the control of signs and symptoms. However, alone, they are no longer effective, having similar results to other therapies^{10,26,33,53,62}.

Other therapies were found in this analysis, such as exercises, physiotherapy, biofeedback, acupuncture, Kinesiotaping, ozone therapy, relaxation, photobiomodulation, cognitive behavioral therapy, hypnosis and neuroreflexotherapy. Some are effective in reducing pain and other symptoms of myofascial TMD.

LIMITATIONS

This bibliometric analysis was not able to evaluate all works published on therapies in the treatment of myofascial TMD, as only articles from the Web of Science (WOS) and SCOPUS database were included. The lack of similar methodologies made it difficult to compare and analyze the treatments used in the articles.

CONCLUSION

Based on this bibliometric review, the authors reached the conclusion that there has been an increase in published articles on therapies for the treatment of TMDs of myofascial origin, although the number of publications is still low. Brazil was the country with the highest number of published articles related to the topic and the authors' correlation revolved around Brazilian authors and splint and laser were the most used treatments, followed by manual therapy and botulinum toxin.

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ERRATUM

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