

Systematic Review

Evaluation of the effectiveness of occlusal splint therapy and exercise therapy on temporomandibular disorders: a systematic review

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ABSTRACT

Introduction: Temporomandibular disorders (TMD) involve the temporomandibular joint, masticatory muscles, and associated structures, presenting with various symptoms such as difficulty in chewing, speaking, and other orofacial functions. Common treatment options for TMD include occlusal splint therapy and exercise therapy. This study aims to evaluate the effectiveness of occlusal splint therapy and exercise therapy in managing TMD through a systematic review. **Methods:** Literature searches were conducted in PubMed, ProQuest, and Google Scholar, covering publications from 2012 to 2022. The keywords used included ("temporomandibular disorders") AND (exercise OR physiotherapy OR "exercise therapy") AND ("splints" OR "occlusal splints" OR "occlusal appliance" OR "occlusal splint therapy"). Data synthesis was performed using qualitative data analysis techniques. **Results:** Based on the search results, 1,707 articles were identified. After checking for duplicates and filtering according to PICOS and inclusion criteria, 7 articles were found to be eligible. From the results that had already been obtained and analyzed, occlusal splint therapy and physical exercise therapy had the same effectiveness but had their own advantages and disadvantages. Both therapies demonstrated a reduction in pain and improvement in limited mouth opening. **Conclusion:** There is no difference in the effectiveness of occlusal splint therapy and exercise therapy for managing TMD. Considering their respective benefits and limitations, exercise therapy may be recommended as an initial treatment for TMD, while occlusal splint therapy can be employed for specific pathological conditions or as a complementary treatment in advanced cases.

KEY WORDS: temporomandibular disorders, occlusal splint therapy, exercise therapy

Evaluasi efektivitas terapi splin oklusal dan terapi fisik latihan terhadap gangguan temporomandibular: *systematic review*

ABSTRAK

Pendahuluan: Gangguan Temporomandibular (TMD) melibatkan sendi temporomandibular, otot pengunyahan, dan struktur terkait, dengan gejala seperti kesulitan mengunyah, berbicara, dan fungsi orofasial lainnya. Pilihan perawatan yang umum untuk TMD adalah terapi splin oklusal dan terapi latihan. Penelitian ini bertujuan untuk mengevaluasi efektivitas terapi splin oklusal dan terapi latihan dalam menangani TMD melalui tinjauan sistematis. **Metode:** Pencarian literatur dilakukan melalui PubMed, ProQuest, dan Google Scholar dengan cakupan publikasi dari tahun 2012 hingga 2022. Kata kunci yang digunakan meliputi: ("temporomandibular disorders") AND (exercise OR physiotherapy OR "exercise therapy") AND ("splints" OR "occlusal splints" OR "occlusal appliance" OR "occlusal splint therapy"). Sintesis data dilakukan menggunakan teknik analisis kualitatif. **Hasil:** Berdasarkan hasil pencarian, ditemukan 1.707 artikel. Setelah dilakukan pengecekan duplikasi dan penyaringan berdasarkan PICOS serta kriteria inklusi, diperoleh 7 artikel yang sesuai. Berdasarkan hasil yang sudah didapatkan dan dianalisis, terapi splin oklusal dan terapi fisik latihan memiliki efektivitas yang sama namun memiliki kelebihan dan kekurangannya masing-masing. Kedua terapi tersebut dapat memberikan hasil mengurangi rasa nyeri dan perbaikan keterbatasan pembukaan mulut. **Simpulan:** Tidak ditemukan perbedaan dalam efektivitas terapi splin oklusal dan terapi latihan untuk menangani TMD. Berdasarkan kelebihan dan keterbatasannya, terapi latihan dapat direkomendasikan sebagai perawatan awal untuk TMD, sementara terapi splin oklusal dapat digunakan untuk kondisi patologis tertentu atau sebagai perawatan tambahan pada kasus lanjut.

KATA KUNCI: gangguan temporomandibular, terapi splin oklusal, terapi latihan

INTRODUCTION

The masticatory system is a functional unit comprising several components, including teeth, temporomandibular joints, masticatory muscles, and the nervous system. The temporomandibular joint (TMJ) is located in front of the ear, connecting the lower jaw to the temporal bone. It works synergistically with the facial bones and associated muscles to facilitate various movements, such as opening and closing the mouth, forward and backward motion, rotation, and lateral movement.¹ Temporomandibular joint dysfunction refers to conditions affecting the TMJ, masticatory muscles, and associated structures.^{2,3} These disorders are multifactorial and are often associated with various factors, including occlusal conditions, trauma, parafunctional habits, emotional stress, disc anatomy, muscle pathophysiology, age, and hormonal influences related to gender differences. The complex interplay of these factors highlights the need for a comprehensive approach to understanding and managing TMJ disorders.^{4,5}

Temporomandibular disorders have a high prevalence. An epidemiological study in Brazil found that 39.2% of participants had at least one symptom, with joint sounds being the most common, followed by joint pain, which is significantly more prevalent in women than men. This higher prevalence in women is attributed to their greater biological sensitivity, influenced by estrogen, making them more sensitive to pain in the temporomandibular joint. A study in Japan found a prevalence of 74% among students, while in Indonesia, approximately 79.3% of adults experience these disorders, similar to rates in other countries.^{3,6}

Treatment of temporomandibular disorders must consider the complexity and variability of these conditions. Therefore, reversible therapies are typically recommended as the first-line treatment for patients with temporomandibular disorders.^{3,7} A multimodal approach is considered the appropriate management in treating temporomandibular joint disorders, namely counseling, acupuncture, exercise therapy, and occlusal splint therapy. In cases of severe acute pain or chronic pain, pharmacotherapy and minimally invasive procedures may also be performed.^{8,9}

Occlusal splint treatment is generally considered to be a basic treatment for temporomandibular disorders. There are several types of occlusal splints, but the most commonly used are stabilization splints and anterior repositioning splints. The primary goal of occlusal splints therapy is to change the biomechanical load on the temporomandibular joint and reduce parafunctional activity, change joint position by increasing the vertical dimension of the mouth, influence motor control by changing the activity pattern of the jaw-closing muscles and reduce masticatory muscle activity which is the therapeutic effect of occlusal splint therapy.^{10,11}

Another conservative treatment option commonly used is physical therapy. This non-invasive intervention includes exercise therapy, manual therapy, cold and heat therapy, acupuncture, ultrasound, TENS, biofeedback, and so on.¹² Exercise therapy is often recommended as a treatment for temporomandibular disorders to increase joint and muscle strength, mobilization, coordination, stretching and relaxation as well as posture exercises to reduce pain. Exercise therapy can be done by the patient himself at home or by a physiotherapist.¹⁰

Based on previous research, List et al.,¹³ stated that conservative treatment including exercise therapy and occlusal splint therapy can effectively relieve pain in temporomandibular joint disorders and increase jaw opening. The success of exercise therapy compared with occlusal splint therapy is still controversial. In a study conducted by Shousha, et al.,¹⁴ significant results were obtained after 18 treatment sessions over 6 consecutive weeks, patients who received conservative physiotherapy treatment in the short term showed greater pain reduction and improvements in temporomandibular joint movement compared to patients who underwent occlusal splint treatment.

However, research by Zhang et al.,¹⁰ stated that patients in the exercise therapy group received exercises under the supervision of a physiotherapist and the results of this review showed that no significant differences were found in eliminating pain between exercise therapy and occlusal splint therapy.

Patients with temporomandibular disorders can use several techniques, such as physical therapy exercises, to alleviate pain and stress, potentially reducing the long-term need for occlusal splints.¹⁵ Based on these problems, this systematic review needs to be carried out to analyze the latest references in line with the development of science and technology in discussing the evaluation of the effectiveness of occlusal splint therapy treatment and therapy exercises for temporomandibular disorders. This study aims to evaluate the effectiveness of occlusal splint therapy and exercise therapy in managing TMD through a systematic review.

METHODS

A systematic review is a structured approach to collecting, critically evaluating, integrating, and presenting findings from multiple research studies related to specific research questions or topics.¹⁶ This research collects data from online databases, including PubMed, ProQuest, and Google Scholar, covering

the past 10 years. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) methodology is employed to identify and select relevant articles for analysis.

The PRISMA process consists of four stages: identification, screening, eligibility, and inclusion.¹⁷ In the identification stage, articles are sourced from the PubMed, ProQuest, and Google Scholar databases. Subsequently, these articles are filtered based on the PICOS (Population, Intervention, Comparison, Outcome, and Study design) framework (Table 1), ensuring alignment with the research objectives. This systematic approach enhances the reliability and validity of the findings by rigorously evaluating the literature.

Table 1. PICOS

Population	Patients who have temporomandibular disorders
Intervention	Patients who carry out treatment of occlusal splint therapy
Comparison	Patients who do exercise therapy treatments
Outcome	Decrease in pain and limited mouth-opening
Studies	Randomized Controlled Trials (RCT)

Two independent reviewers (RC and IC) performed the search and evaluated every potentially relevant article according to the criteria listed above after an original screening of titles and abstracts. After the screening, the articles were checked for eligibility, where the article contained a discussion of the effectiveness of occlusal splint therapy treatment and exercise therapy for temporomandibular disorders, which is in accordance with PICOS and inclusion criteria.

Table 2. The jadad criteria

No.	Questions	Answer	Point
1.	Was the study randomized?	Yes	1
		No	0
2.	Was the method of randomization appropriate?	Yes	1
		No	0
		Not described	-1
3.	Was the study described as blinded?	Yes, double blind	1
		Yes, single blind	0,5
		No	0
4.	Was the method of blinding appropriate?	Yes	1
		No	0
		Not described	-1
5.	Was there a description of withdrawals and dropouts?	Yes	1
		No	0
6.	Was there a clear description of the inclusion/exclusion criteria?	Yes	1
		No	0
7.	Was the method used to assess adverse effects described?	Yes	1
		No	0
8.	Was the method of statistical analysis described?	Yes	1
		No	0

The inclusion criteria for this review were articles from PubMed, ProQuest, and Google Scholar published between 2012 and 2022 in English. Only full-text journal articles, accessible either for free or for a fee, were considered. High and medium-quality journals were included. The exclusion criteria in this study were journals published before 2012, those not published in English, and journals with low quality.

All articles were screened, along with checking for duplication and assessing eligibility criteria. Reviewing the quality of articles was carried out using the Jadad criteria for Randomized Controlled Trials (RCT) studies (Table 2). The Jadad criteria consists of eight questions and each question is given points - 1, 0, or 1. Then the points are added up and the article can then be put into 2 categories, namely high quality journals (4-8 points) and low quality journals (0-3 points).¹⁸

RESULTS

The PRISMA study results are categorized into four stages: identification, screening, eligibility, and inclusion (Figure 1). At the identification stage, a total of 1,707 articles were retrieved from three databases: PubMed (18 articles), ProQuest (27 articles), and Google Scholar (1,662 articles). Search filters were applied within each database. During the screening process, the identified articles were imported into a citation manager (e.g., Mendeley), and duplication checks were conducted. This step identified 38 duplicate entries, reducing the total number of articles to 1,669.

Further filtering involved reading the abstracts to exclude articles that did not meet the inclusion criteria based on the PICOS framework. This process excluded 1,643 articles, leaving 26 for further consideration. The remaining 26 articles underwent a full-text review, during which 19 articles were deemed unsuitable, leaving 7 articles that met all criteria. These articles were then evaluated for quality

using assessment criteria appropriate for their research designs. Articles with a randomized controlled trial (RCT) design were assessed using the Jadad scale (Table 3).

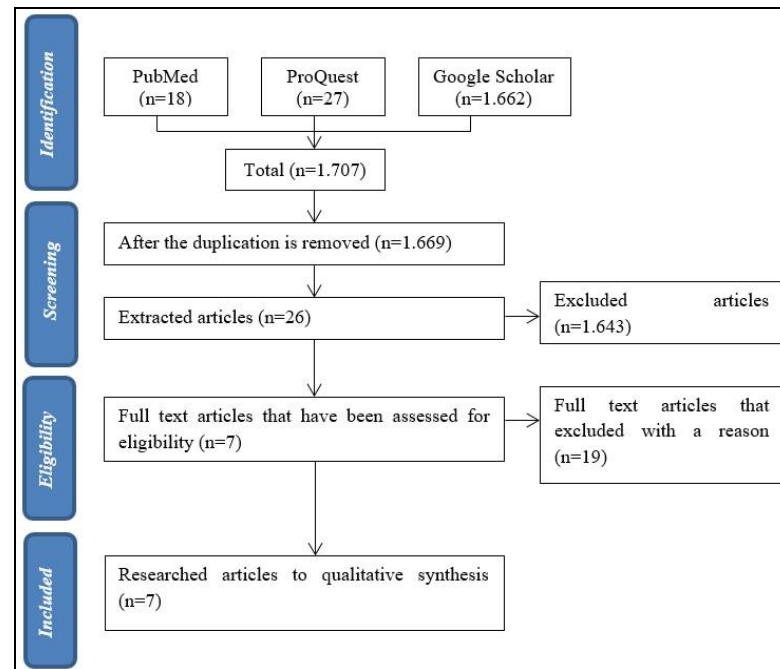


Figure 1. PRISMA Flowchart

Finally, the data from the selected articles were synthesized, combining and comparing the effectiveness of occlusal splint therapy and exercise therapy for temporomandibular disorders (Table 4). This comprehensive review provides a robust comparison of treatment outcomes, offering valuable insights into therapeutic approaches for managing temporomandibular disorders.

Table 3. Article quality review results

Author and Year	Questions								Total	Quality
	1	2	3	4	5	6	7	8		
Niemela K, et al., ²⁰	1	1	0	-1	1	1	0	1	4	High
Wahlund K, et al., ²⁴	1	1	1	-1	1	1	0	1	5	High
Qvintus V, et al., ²⁵	1	1	0	0	1	1	0	1	5	High
Nagata K, et al., ²⁶	1	1	0.5	1	1	1	0	1	6,5	High
Van Grootel RJ, et al., ²³	1	1	1	1	1	0	0	1	6	High
Kokkola O, et al., ¹⁹	1	1	0	-1	1	1	0	1	4	High
Shousha TM, et al., ¹⁴	1	1	0,5	1	0	1	0	1	5,5	High

Keterangan:

*High Quality Journal = 4-8

*Low Quality Journal = 0-3

Tabel 4. Data analysis presentation

Author and Year	Title	Purposes	Treatment	n	Follow-up	Conclusion
Niemela K, et al., ²⁰	Efficacy of Stabilization Splint Treatment On Temporomandibular Disorders	The aim to assess the efficacy of stabilization splint treatment on TMD	Stabilisation splint+ counseling+ instructions for masticatory muscle exercise	39	1 month	The findings of this study do not indicated that splint stabilization therapy combined with counseling and masticatory muscle exercise has additional benefits in reducing facial pain and increasing mandibular mobility than counseling and masticatory muscle exercise only in short time intervals
			Counseling+ instructions for masticatory muscle exercise	41		
Wahlund K, et al., ²⁴	Treating Temporomandibular Disorders in Adolescents: A Randomized, Controlled, Sequential Comparison of Relaxation Training and Occlusal Appliance Therapy	The aim to compare the effects of occlusal splint and relaxation training on temporomandibular disorder (TMD) pain in explore whether additional therapy administered in a crossover sequential design improves treatment outcomes	Occlusal appliance therapy	33	6 months	This finding showed that in adolescents with TMD pain, the use of standard clinical treatments with occlusal splint is more effective than relaxation training
			Relaxation training	31		
Qvintus V, et al., ²⁵	Efficacy of Stabilization Splint Treatment On Facial Pain – 1 Year Follow Up	The aim to assess the effectiveness of splint therapy stabilization on TMD related facial pain during a 1 year follow-up	Stabilisation splint+counseling+instructions for masticatory muscle exercises	39	1,3,6,12 months	The findings of this study do not showed therapy for splint stabilization with guidance and exercise of mastic muscles have additional benefits to the intensity of facial pain in patients with TMD compared to only counseling and exercise of mastic muscles
			Counseling+ instructions for masticatory muscle exercise	41		
Nagata K, et al., ²⁶	Efficacy of Stabilisation Splint Therapy Combined with Non-Splint Multimodal Therapy for Treating RDC/TMD Axis I Patients: A Randomized Controlled Trials	The aim of this study was to determine the efficacy of stabilisation splint therapy combined with non-splint multimodal therapy for TMD	Non-splint multimodal therapy+ stabilisation splint (NS+S)	96	4 weeks	There is no difference between NS treatment and NS+S treatment with limitations to open the mouth, orofacial pain, and joint sound at TMJ
			Non-splint multimodal therapy (NS)	85		
Van Grootel RJ, et al., ²³	Towards an Optimal Therapy Strategy for Myogenous TMD, Physiotherapy Compared with Occlusal Splint Therapy in an RCT with Therapy-And-Patient-Specific Treatment Durations	Aim of the study was to examine whether physiotherapy or splint therapy may be preferred as an initial treatment in stepped-care	Splint therapy	35	10-21 weeks	Physiotherapy and Splint Occlusal Therapy has the same level of success and effectiveness. Because the duration of physiotherapy is shorter than that of splint therapy, physiotherapy may be more recommended as an initial therapy than occlusal splint therapy in gradual treatment of TMD Myogenous
			Physiotherapy	37	12-30 weeks	
Kokkola O, et al., ¹⁹	Efficacy of Stabilization Splint Treatment on the Oral-Health Related Quality Of Life – A	The aim of this study was to assess the efficacy of stabilization splint	Stabilization splint	39	12 months	Splint stabilization treatment does not show a beneficial effect on OHRQoL

	Randomized One-Year Trial	Controlled Follow-Up	treatment on the oral health-related quality of life (OHRQoL) during a one-year follow-up	Counselling+ instructions on masticatory muscle exercises	41	(Oral Health Related Quality of Life) compared to only counselling and mastic muscle exercise
Shousa TM, et al., ¹⁴	The Effect of a Short Term Conservative Physiotherapy Versus Occlusive Splinting On Pain and Range Of Motion in Cases Of Myogenic Temporomandibular Joint Dysfunction: A Randomized Controlled Trial		This study compared the effects of a short-term conservative physiotherapy program versus those of occlusive splinting on pain and range of motion in cases of Temporomandibular Joint Dysfunction	Splint Therapy Physiotherapy	56 56	During the treatment period of 6 consecutive weeks, conservative physiotherapy can be a better initial treatment than occlusal splint therapy in relieving pain and increasing the range of motion in cases

DISCUSSION

Temporomandibular disorders are dysfunction and pain within the masticatory system, including structures related to the masticatory muscles, temporomandibular joints or both.¹⁹ Several treatment methods can be applied to temporomandibular disorders. Considerations about the costs and benefits must also be taken into account when choosing a treatment strategy for temporomandibular disorders.²⁰ Occlusal splint therapy is usually used as the basic treatment for temporomandibular disorders.

Occlusal splint therapy could change the position of the temporomandibular joint by increasing the vertical dimension of the mouth and changing the pattern of jaw muscle activity.²¹ Another conservative treatment option is exercise therapy, which is used to improve strength, mobility, coordination and reduce pain in the joints and muscles.²² Patients who attend physiotherapy can learn exercise techniques to avoid stress and relieve pain so as to avoid the need to use intraoral devices in the long term.²³

Temporomandibular disorder pain is most prevalent in adults, with its occurrence increasing from adolescence to adulthood. Based on research by Wahlund, et al.,²⁴ this study involved 64 adolescents who would be divided into two groups to receive occlusal splint therapy (OA) and relaxation training (RT) and evaluated for 6 months until the treatment phase ended. After phase 1, it showed that the group of adolescents who received occlusal splint therapy treatment was significantly higher (62.1%) compared to the group of adolescents who received relaxation training (17.9%), with subjective report results of "very good/very improved/much improved" in measuring pain. Similar differences were also found in self-reports of treatment effects after phase 2.

These could be supported by varying levels of compliance between the two treatments. Compliance in the training group was lower because the treatment required a greater commitment from adolescents in their daily lives, which resulted in less time available for training. This was reflected in the lower treatment evaluation results. Another possible reason is that exercise treatment is not an effective treatment for adolescents with temporomandibular disorders. The findings from this study indicated that occlusal splint therapy treatment for adolescents with temporomandibular disorders is more effective than relaxation training.²⁴

Different results were found in research conducted by Van Grootel RJ, et al.,²³ which involved 72 patients who were randomly given occlusal splint therapy and physiotherapy treatment. Even though the two therapies produce similar treatment results, physiotherapeutic treatment may be recommended as the initial treatment for temporomandibular disorders for several reasons. First, with the same success rate and effectiveness, the duration of physiotherapeutic treatment is shorter than occlusal splint treatment. Second, the overall success rate of treatment does not depend on the sequence of therapy so the success rate of subsequent therapy is not influenced by previous therapy.

Third, physiotherapy treatment techniques can be applied to reduce pain or functional disorders related to pain in parts of the body other than the face, such as the neck and shoulders. Fourth, the cost of physiotherapy treatment is cheaper than occlusal splint therapy. Physiotherapy has several disadvantages, including the need for frequent visits and limited availability due to factors such as location, transportation, and time constraints. However, with the development of internet-based technology, physiotherapy treatment can now be delivered directly or through online platforms.

Therefore, this study showed that physiotherapy and occlusal splint therapy have the same level of success and effectiveness, but due to several considerations, physiotherapy is recommended as initial therapy compared to occlusal splint therapy in the gradual treatment of temporomandibular disorders.²⁵ The results of this study can be supported by research that conducted by Shousha TM, et al.,¹⁴ which showed that after 18 treatment sessions over 6 consecutive weeks with 2 different treatments compared to patients diagnosed with myogenic temporomandibular disorders, the patients treated with conservative physiotherapy treatments short-term demonstrated greater pain reduction and greater improvement in

TMJ movement than patients treated with occlusal splints as measured by VAS (visual analog scale) and TOI (temporomandibular joint opening index).¹⁴

Measuring the degree of pain is crucial for determining both its intensity and the most effective therapy for the patient. Pain that is not treated properly can affect all aspects of a person's quality of life, including pain in temporomandibular disorders. In a study by Kokkola, et al.,¹⁹ involving 80 patients who were divided into a test group (n=39) who received occlusal splint therapy, counseling, and masticatory muscle training instructions and a control group (n=41) who received counseling and muscle training instructions alone without splint therapy during a follow-up period of 1 year. The results of this study showed that occlusal splint treatment does not provide benefits related to the quality of life or OHRQoL (Oral Health-Related Quality of Life) compared to masticatory muscle training seen from statistical results which showed there is no difference between the two treatments.¹⁹

The same research results were also found in research by Qvintus, et al.,²⁵ which conducted tests on 80 patients who were randomly divided into two groups, namely the splint group (n=39) and the control group (n=41). Patients in the splint group received stabilization splint treatment along with counseling and instructions for masticatory muscle exercises, while the control group only received counseling and instructions for masticatory muscle exercises within a research period of 1 year. The results of this study, stabilization splint therapy treatment did not provide significant changes in facial pain related to temporomandibular disorders compared with masticatory muscle training. The intensity of facial pain in both groups decreased but the difference in changes was not statistically significant.²⁵

When considering the effects of occlusal splint therapy and exercise, several previous research studies have yielded contradictory results. Based on research conducted by Niemela, et al.,²⁰ the aim was to assess the effectiveness of stabilization splint therapy in temporomandibular disorders. This study consisted of 80 patients who were randomly assigned to a splint group (n=39) and a control group (n=41). Subjects in the splint group received stabilization splint treatment and masticatory muscle training while subjects in the control group did not receive any treatment except counseling and masticatory muscle training.

The results of facial intensity measurements with a visual analog scale (VAS) measured after 1 month of the study, showed reduced facial pain, and most of the clinical findings of temporomandibular disorders resolved in both groups. The difference in visual analog scale (VAS) changes between the two groups was not statistically significant, indicating that stabilization splint treatment combined with counseling and masticatory muscle training does not offer additional benefits in reducing facial pain and increasing mandibular mobility compared to counseling and masticatory muscle training only in a short time interval.²⁰ These findings are supported by research by Nagata, et al.,²⁶ which involved 181 temporomandibular disorder patients who were randomly allocated to the non-splint multimodal therapy group (n=85) and the non-splint multimodal therapy group and stabilization splint therapy (n=96). This non-splint multimodal therapy includes jaw exercises, cognitive behavioral therapy, self-management education, and jaw manipulation.

The outcome measures were used to assess limited mouth opening, orophysical pain, and temporomandibular joint sounds. These three parameters decreased significantly between the two groups. The final results of this study indicated that stabilization splint therapy is not supportive for patients with temporomandibular disorders. However, therapy can be selected for patients depending on their pathophysiological state, because temporomandibular disorders are multifactorial. Non-splint multimodal therapy has been proven to be safe, low cost, and can be started immediately at the first visit so it can be taken into consideration.²⁶ There are several management strategies for temporomandibular disorders, including explanation and reassurance, education and self-care, medications, jaw physiotherapy, occlusal splint therapy, behavioral therapy, psychotherapy, traditional treatments, and surgery.²⁷ According to these guidelines, patients can start with exercise therapy and proceed with other treatments.

This review has several limitations. First, due to differences in subtypes within the RDC/TMD diagnostic criteria, assuming all TMD patients will respond the same to any intervention is not ideal. Second, only seven studies with 669 patients were included in the analysis. Third, other data sources that could have improved the quantity and quality of studies retrieved were not considered. The findings are not definitive or generalizable due to the small number of studies, and should be interpreted with caution. Further research is needed before applying these findings in clinical practice.

CONCLUSION

There is no difference in the effectiveness of occlusal splint therapy and exercise therapy for temporomandibular disorders (TMD). Physical therapy exercises may be considered an initial treatment for TMD due to their accessibility and ease of implementation, while occlusal splint therapy can be reserved for specific pathological conditions or more complex cases. Both therapies have been shown to be similarly effective in alleviating symptoms and improving functional outcomes. Implication of this result combining

exercise therapy with other treatments for TMD may lead to better outcomes, allowing patients to perform exercises at home under professional guidance, while receiving tailored medical interventions based on thorough clinical examinations and diagnoses.

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