



Original Article

Impact of Therapeutic Interventions in Temporomandibular Disorders; A Systematic Review

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ABSTRACT

Background: Temporomandibular disorders which are also known as craniomandibular disorders are defined as the group of disorders that affect the masticatory muscles, the temporomandibular joint and other associated structures. It is recognized as a musculoskeletal masticatory pathology that has been known to affect more than 25% of the population globally. The cervical and temporomandibular mobilization (Maitland approach), pulsed radio frequency energy, dry needling, acupuncture, and NAG/SNAG are manual interventions employed to treat the temporomandibular disorder. **Objective:** Our systematic review aims to determine the effectiveness of the therapeutic interventions on temporomandibular joint disorders. **Methods:** A systematic review was conducted using various databases for searching from January 2011 to September 2020. Databases included the Cochrane Library, PubMed, PEDro and APTA, EMBASE and MEDLINE for most recently conducted studies on treatment approaches including Manual therapy, exercise therapy and electrotherapy for temporomandibular joint disorders. Those randomized controlled trials which focused on determining the effects of therapeutic interventions on temporomandibular joint disorders and which met our inclusion criteria were included in our review. **Results:** After assessing assessment-based eligibility a total of twelve studies were included in our review. All the included studies were randomized control trials. All the included studies had their score which varied significantly between 7 and 10 on the PEDro scale score which represented a higher methodology quality. All the included studies showed improvement in the quality of life after employing therapeutic interventions for treating temporomandibular joint disorders. The risk of bias in all the included studies was altered in selection bias and detection bias. **Conclusion:** Our systematic review concluded that all the included randomized control trials and studies supported the effects of therapeutic interventions on temporomandibular disorders positively. Our review supported the fact that improvements were observed in the quality-of-life outcomes of these patients after the application of therapeutic disorders.

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INTRODUCTION

Temporomandibular joint (TMJ) disorders which are also known as craniomandibular disorders are a collection of diseases that are recognized to affect the masticatory muscles, the temporomandibular joint and other associated structures.¹ These disorders are pathologies of the musculoskeletal masticatory system which has been recognized to affect more than 25% of the population globally.² The TMJ pain, jaw movement restriction, clicking joint sounds, and tenderness in the joint and the muscle are the signs and symptoms that are normally observed to accompany temporomandibular joint disorders.^{1,2} They are also often observed to be associated with other symptoms that might affect the head and neck region, such as ear pathologies, headaches and some other disorders of the cervical spine.^{3,4} Patients who suffer from chronic TMJ disorders often come with complaints of fatigue, poor sleep quality and depression.¹

The Minnesota Dental Association and the American Academy of Craniomandibular Disorders have cited physical therapy as a substantial treatment.⁵ Physical therapy is known as a treatment that is intended to relieve musculoskeletal pain, restore oral motor function and reduce inflammation. A large number of physiotherapy interventions are known to be potentially effective for managing temporomandibular joint disorders. That might include various exercises, electrophysical modalities and numerous manual therapy techniques. The electrophysical modalities might comprise interventions like microwave, laser, ultrasound, and transcutaneous electrical nerve stimulation. Therapeutic exercises might also be employed to improve the strength of the cervical spine and masticatory muscles and to enhance mobility in these regions.⁶ The manual therapy techniques that are very commonly employed for reducing pain and

restoring mobility. Oral exercise devices, like The Therabite Jaw motion rehabilitation system are recognized as mechanical aids that are known to give passive stretch to the temporomandibular joint resulting in improving the range of motion. Physical therapy interventions might also focus on the associated impairments of the craniocervical system like, cervical muscle spasms, cervical pain, poor posture or radiating pain from the cervical spine.⁶ Acupuncture was also included as an intervention in our current review as it is recognized as a specialty field that is within the scope of practice for a large number of physical therapists working in countries like the UK and Australia. Managing and treating temporomandibular joint disorders consists of a multidisciplinary approach. Orthodontists, dentists, psychologists, physical therapists, and physicians work with each other to discuss the issue of the patient suffering with the disorder.

The conservative treatment for this disorder is recognized to be the treatment of choice due to the symptomatology of the condition which is mostly improved by employing the use of physical therapy, medication, occlusal splints and orthodontic treatment.⁷ Numerous reviews have already been published that worked on conservative treatments, which usually recommend a multidisciplinary approach for treating the TMJ disorder, although authentic evidence to support this approach is usually not provided.⁸⁻¹¹ Naming physical therapy exercises and interventions employed might include, isokinetic exercises, coordination exercises, massage and trigger point treatment which are used to reinforce the scapulothoracic muscles and deep cervical neck flexors. These physical therapy exercises also help in maintaining proper posture.¹² Names of manual therapy interventions are pulsed radio frequency energy, cervical and temporomandibular mobilization (Maitland approach), Dry needling, acupuncture and

NAG/SNAG.^{13,14,15-17} According to the findings of Evane Goncalves de Toledo the feasibility of an interdisciplinary work in physiotherapy and dentistry for temporomandibular joints has been tested properly. There is not a substantial need to have an interdisciplinary care plan, in which the physiotherapy interventions help in managing pain and dentistry tends to treat stomatognathic system disorders.¹⁸ Our current review also supports these findings and encourages the interdisciplinary work plan, especially in countries like Pakistan. The question that whether physiotherapy interventions are successful in treating temporomandibular joint disorders is still unanswered. The main aim of our systematic review was to assess the methodological quality of randomized controlled trials that worked on determining the efficiency and efficacy of physiotherapy interventions for treating temporomandibular disorders and to summarize the evidence.

METHODS

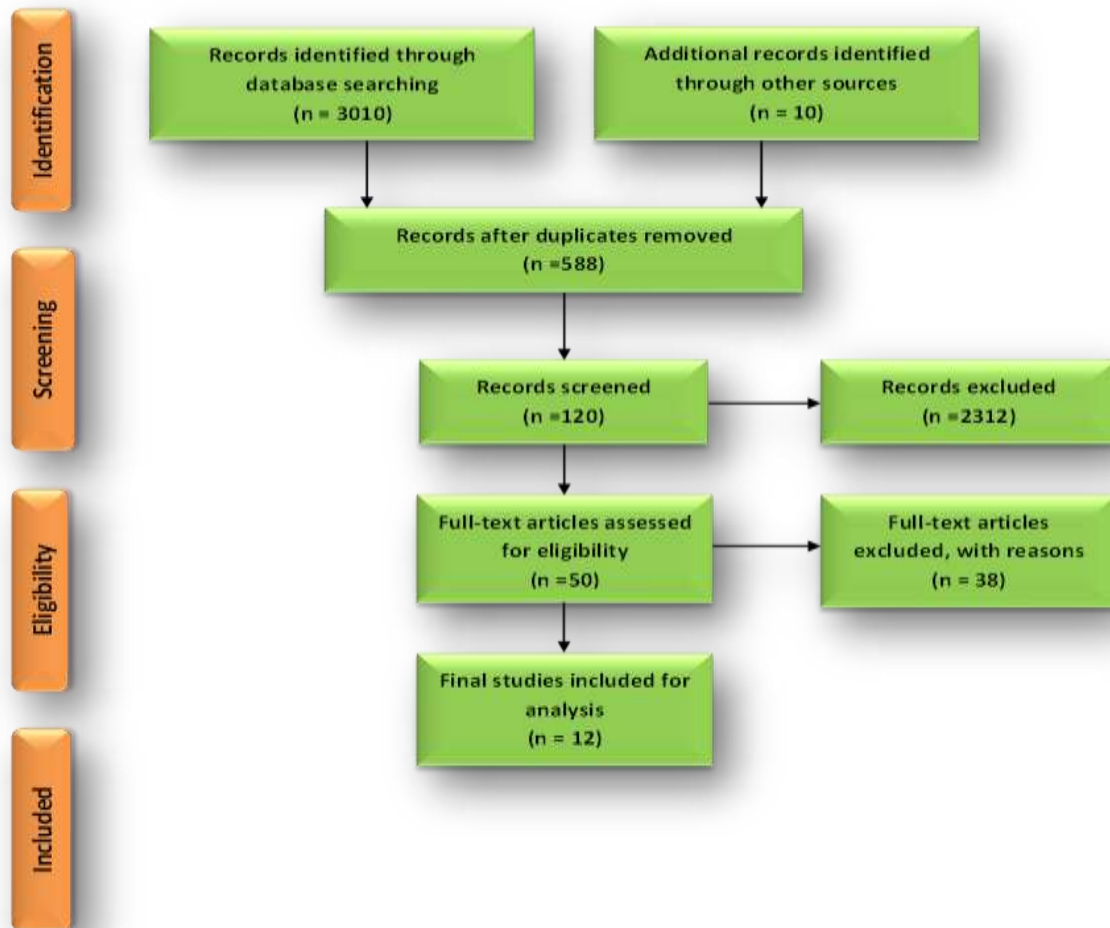
In this systematic review, the databases employed were, PubMed, PEDro, APTA, The Cochrane Library, EMBASE and MEDLINE. The interventions whose effects were reviewed on temporomandibular disorders and studied in our review were low-level laser therapy, manual therapy, Transcutaneous Electrical Nerve Stimulation, strengthening exercises and dry needling. The outcome measures of our review were Range of motion, Visual analog scale, Functional Oral Intake scale, algometer, side flexion test and rotation test. A comprehensive study was performed by two authors individually from January 2011 to September 2020 using a search approach designed for various databases mentioned already above. For each database, the searching approach was built by adding the key terms and Boolean operators for example OR, AND and NOT were aligned to the objectives of the research. Encoding

word substitutes and terms in the PICO format were employed and filters of full texts, Randomized control trials, Human and English were included in our review. Eligibility criteria were based on the PICO method. Studies were included only if, the age criteria were 10 to 40 years, both male and female, mixed temporomandibular joint disorders, pain impairments, studies had patients with no previous surgical history, studies with patients who had no serious comorbidities, randomized control trials, intervention vs placebo effect, intervention 1 vs intervention 2, intervention vs control studies and who employed Pedro scale score. Those studies were excluded if the age of participants was more than 40 years, participants had any previous surgical history, any chronic comorbidities, disorders other than TMJ and studies with language barriers. The records of studies were saved in Endnote X9 software. A detailed table was created to explain the differences between these groups to divide the outcome measures mentioned and the included studies were entertained according to the quality score. The PEDro scale was employed to assess the analytical quality. The total score ranged from one to ten. Every question had a rating of 1 for yes and 0 for number 1 stands for totally fulfilling the criteria and 0 for not fulfilling the criteria. A score of 10 indicated excellent methodological quality of related articles.

RESULTS

Out of twelve articles included in our review 11 articles, 91.6% had visibly mentioned the eligibility criteria, although one article, 8.4% did not visibly explain the eligibility criteria. All the articles included in this review had mentioned the randomization process represented by their descriptive statistics. No article was included in our review which did not showed randomization. Seven out of twelve articles (58.3%) mentioned that their allocation process was concealed however, 5

Figure 1: PRISMA Flow Chart



articles, 41.7% articles did not explain their allocation process clearly. Nine out of twelve articles, 75%, clearly mentioned that these studies had their subjects blinded. However, 3 articles, 25% articles did not clearly explain blinding the subjects in these studies. Nine studies (75%) included in this study showed that they had mentioned that therapists were blinded. Although three studies (25%) did not visibly show the blinding of the therapists. Ten out of twelve studies had mentioned that in them the assessors were blinded while two studies were not clear about the blinding of the assessors. Eight out of twelve studies showed us that all the subjects included in

them had appeared for their follow-up sessions. Although 2 articles included in this study did not mention the appearance of follow-up sessions of the subjects. The included studies in this review aimed to treat the patient. All the included studies showed a comparison between the groups. Outcomes measures were also represented in all the included articles. The total score for each question was included in all the studies. For our review, a score of 10 indicated excellent methodological quality of the related study. A score of all the studies included in our review lied between six till ten which showed a higher quality of methodology.

Table I: Quality Assessment of Included Studies Through PEDro Scale

Author Name	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total score
Harry von Piekartz 2012	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
Azam S. Madani 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
Ana Paula de Lima 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
Åke Tegelberg 2015	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	Yes	6
Lais Valencise Magri 2017	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	9
Hiroyuki Ishiyama DDS 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	9
Sophie Kraaijenga 2014	Yes	Yes	No	Yes	No	NO	No	No	Yes	Yes	Yes	6
Yuji KOYAMA 2017	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	8
Ji-Su Park 2020	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Bartosz Dalewski 2019	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	7
Vera LR. Zotelli 2017	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	7
Kazuhiro Nagata 2018	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	7

DISCUSSION

The major aim of our current review was to determine how effective therapeutic interventions are for temporomandibular joint disorders. To manage temporomandibular disorder therapeutic interventions are highly recommended. Both passive and active muscle stretching are employed to enhance the range of motion. Manual therapy has been employed to increase the range of motion, facilitate proprioception, diminish local ischemia, improve synovial fluid intake, lose fibrous adhesions and minimize pain. Acupuncture and dry needling has also been recognized to

be effective in managing pain and discomfort and accelerating the temporomandibular joint disorder. Low-level laser therapy has also been recognized to be substantial in reducing the pain in temporomandibular joint disorders and in improving the range of motion. H. Von Piekartz and co-workers conducted a study that concluded that therapeutic interventions of the mouth are beneficial interventions for eliminating myogenic temporomandibular-related symptoms and the outcomes of our review has recognized few randomized control trials conducted on myogenic TMJ disorders which support that therapeutic techniques show improvement in mandibular activity

Table II: Characteristics of Included Studies

Sr. #	Author Name	Participants (Gender, Age Range, Sample Size)	Intervention/ control or comparison group	Duration and Frequency	Outcome measures	Result (Mean, SD, p-value, Effect Size)	Pedro Score
1	Harry von Piekartz 2012	N-43, Female, 18-65 years	Cervical Manual Therapy, Orofacial Care vs Usual Care Group	6 months, 30 min each session	ROM: FRT, Rotation Test, Side Flexion Test	Left: 24.6 (6.2) 1.2±4.3, Right: 24.2 (7.4) 2.5±5.1 (p > 0.05), 64% of the experimental group	10
2	Azam S. Madani 2014	N-20, Both Male and Female	Low-level Laser Therapy, Laser vs Placebo	4 weeks, Three times a week for both groups.	VAS: Masticatory Muscles and TMJ	Laser: 1.87±1.78 Placebo: 1.50±2.59 (p>0.05), No significant difference between groups but within the group Laser: 42% improvement Placebo: 53% improvement	10
3	Ana Paula de Lima FERREIRA 2016	N-40 Both Male and Female	TENS Placebo Group vs TENS Active Group	3 times evaluation: Baseline, Immediately, After 48 hours	VAS: For Pain Algometer: For PPT Miotec: For EMG	Between groups: (p<0.05) Within Group: (p>0.05) No significant difference between groups but a significant difference only in the active TENS group	10
4	Åke Tegelberg 2015	N-28, Both Male and Female 20-79 years	Physical Training Program, Treatment Group (E) vs Control Group (C)	Evaluation after 3 weeks	Mann-Whitney U-test,	C Group RA Patients reported less severity of their TMJ symptoms (p = 0.012). AS Patients reported 5 individuals to have less severity 7 unaltered severity 1 impaired of TMJ. (p=0.032) E Group RA Reported 6 individuals have less severity 9 have unaltered severity of TMJ (p = 0.002). AS Patients reported 15 individuals to have less severity 74 unaltered severity of TMJ. (p=0.016)	6
5	Láís Valencise Magri 2017	N-64 Female 18-40 years	Laser Group vs Placebo Group vs Controls Group	Eight sessions, twice weekly for 4 weeks.	VAS	The laser group showed 80% of pain reduction, placebo 85% and without treatment 43% (p < 0.05)	9
6	Hiroyuki Ishiyama DDS 2017	N- 25, Both Male and Female, 20-70 years	Jaw-opening exercise vs Placebo exercise group	3-month with follow-up after 2 Weeks, 1 and 3 months	VAS Apnea Hypopnea Index, Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index	The mean exercise compliance was 90.7% for the JE group and 85.6% for the PE-group. No significant differences between groups (p>p0.05)	9

7	Sophie Kraaijenga, 2014	N-96 Both Male and Female, 17-73 years	Regular PT exercises vs TheraBite (TB) device	4 times in sessions of 30 minutes, 5 times a day	VAS, TB range of motion scale	Significantly greater and more rapid improvement of mandibular function. (p=0.0050)	6
8	Yuji Koyama 2017	N-16 Both Male and Female	Intervention vs Control Group	6 Weeks, 5 times/week	FOIS	Significant difference between groups (p<0.05)	8
9	Ji-Su Park	N-40, Both Male and Female	NMES, Experimental Group vs Control Group	6 weeks, 5 days/week, for 20 min/day	Masseter muscle thickness was measured using a portable ultrasound. Bite force was measured using the occluzer device	Both groups showed a significant improvement in masseter thickness. (p < 0.05) Change in the experimental group was significantly larger than that in the control group (p < 0.001)	8
10	Vera LR. Zotelli, 2017	N-40, Both Male and Female	Acupuncture Placebo vs Treatment Group	4 weekly sessions	NVAS	No significant difference between groups Placebo Group: (p=0.2261). Treatment Group: (p>0.05)	7
11	Bartosz Dalewski,	N-20 18- 65 years	Occlusal appliance With NSAID therapy vs occlusal appliance with dry needling (DN), and occlusal appliance therapy	3 weeks	VAS, Sleep and Pain Activity Questionnaire	Occlusal appliances in conjunction with NSAID showed better orofacial pain relief. OA and DN + OA groups were not found to be statistically significant	7
12	Kazuhiro Nagata, 2018	N-61 Both Male and Female	Conventional Treatment vs Conventional & Manipulation Group	18 Weeks	NRS	There is no statistical difference between both groups for any of the outcome measurement (p>0.05)	7
13	Leticia Bojikian CALIXTE, 2016	N- 19, Female, older than 18 years	Single-group pre-post test	9-week, 10 sessions Each	MFIQ, MMO, PPTs, VAS	Mandibular function improvement: E2 to E3 (p=0.02) No improvement: E1 to E2 (p=0.47), Significant differences between PPTs were found in both left temporalis and masseter muscles	6

dysfunction and discomfort as well as help in improving the mouth opening with time.¹⁸ A study conducted by Akiko Shimada and co-workers observed that exercise therapy has beneficial effects on both the mobility of the

jaw and the severity of the pain. Voluntary jaw exercises, manual therapies and passive jaw mobilization with oral equipment have significant effects on diminishing the symptoms of TMJ disorders like arthralgia,

myalgia and posture correction.¹⁹ Our systematic review agrees with this. For treating temporomandibular joint disorders exercise therapy has been used for a long time. Therapeutic interventions were prescribed to address certain specific temporomandibular joint impairments and to improve the functioning of the joint.²⁰ Two out of twelve studies included in this review determined the effectiveness of correction exercises for patients with temporomandibular joint disorders. Both of these included studies tend to examine patients with myogenic temporomandibular joint disorders and employed the research diagnostic criteria of LeReche and Dworkin²¹ to accomplish the making the diagnosis. The optimistic results of these two studies showed a reduction in pain and improvement in the mouth-opening activity, therefore, these findings can be generalized to this specific group of patients and are also in line with the current approach for treating patients with temporomandibular joint disorders.²²⁻²⁴

Despite having numerous methodological limitations, the evidence supporting manual therapy and oral and posture-improving exercises employed to reduce pain and improve range of motion is of certain clinical attentiveness.^{8,25} Our current review and the review conducted by Margaret L. McNeely both agreed to the fact that more information is required to add to the optimal exercise prescription. Specifically, more details are needed on the intensity, frequency, time, and type of the specific exercises employed in treatment protocols is substantial for allowing for imitation in the clinical setting. Margaret and her co-workers' review and our review also conclude that further research is warranted before dismissing any effect of TENS.² Acupuncture has been increasingly being employed for treating musculoskeletal impairment in North America.²⁶ Currently, the underlying mechanisms representing the

action of acupuncture are still unclear.²⁷

Acupuncture has been recognized that it might stimulate the production of serotonin, endorphins and acetylcholine within the central nervous system and it might also relieve pain by performing its role as a noxious stimulus.²⁸ Two studies included in our systematic review showed improvements in pain after treatment with acupuncture, however, acupuncture w is not meaningfully better than sham acupuncture or occlusal splint therapy.²⁹⁻³¹ Kulekcioglu and co-workers reported that substantial improvements were observed in active and passive oral opening and lateral deviation range of motion after treating with laser therapy.³² Our review agrees with this observation.

In our systematic review when we evaluated the conclusions of the systematic analysis, there were some shortcomings to consider. The substantial heterogeneity of our review while considering interventions and measuring methods made it difficult to equate findings and then recognize clinically meaningful improvements. This might affect the potential to determine the effectiveness of therapeutic interventions in patients suffering from temporomandibular joint disorders. Moreover, a lesser number of studies were conducted that focused on multidimensional variables such as quality of life, and injury which might be useful for giving an insight into determining the effectiveness of treating this population with therapeutic interventions. Moreover, some studies included in our review had methodological limitations and had insufficient sample sizes which might reflect a bias that must be considered when inferring the results. Our systematic review recommends future researchers conduct a meta-analysis to assess the results of previously conducted studies systematically to derive more reliable and authentic

conclusions. **Conclusion** Our systematic review concludes that all the included studies positively support the effects of therapeutic interventions on temporomandibular disorders. Our review also supports the fact that therapeutic interventions show improvements in the quality of life of the patients.

DECLARATIONS

Consent to participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.

Competing interests: None

Funding: No funding source is involved.

Authors' contributions: All authors read and approved the final manuscript.

PRISMA Guidelines: All methods were performed following the relevant guidelines and regulations.

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