Is the use of manual therapy in the craniomandibular and cervical regions beneficial for reducing orofacial pain and increasing mandibular mobility? Systematic review

O uso de terapia manual na região craniomandibular e cervical é benéfico para redução da dor orofacial e aumento da mobilidade mandibular? Revisão sistemática

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ABSTRACT

BACKGROUND AND OBJECTIVES: The use of manual therapy in the craniomandibular and cervical regions in the treatment of patients with temporomandibular disorders (TMD) has become common practice, and the literature supports the use of these techniques to relieve pain and improve the range of mandibular movement. Therefore, the organization of scientific findings can help clinicians make informed decisions. Thus, the objective of this systematic review was to evaluate the effectiveness of manual therapy in the craniomandibular region in patients with TMD and to compare it with manual therapy in the cervical region in terms of pain intensity and range of mandibular movement.

CONTENTS: Following PRISMA guidelines, Randomized Clinical Trials were included with a population of adults of both genders with signs and symptoms of TMD. Case reports, pilot studies, case series, editorials, opinion letters, letters to the editor, literature reviews, cohort studies, and case-control studies were excluded. The search strategy was created using MESH and synonyms for TMD, cervical treatment, manual therapy, physiotherapy, exercise, pain, and mandibular range of motion. The databases Medline, Embase, Pubmed, Cochrane Library, Virtual Health Library, PEDro, Scielo, LILACS and Central were used. The Cochrane ROB2 risk of bias and the PEDro scale were used to assess the methodological quality of the included studies. Eight studies were eligible, published between 2013 and 2022, totaling 339 individuals with TMD aged between 18 and 65 years. The results of the present review showed that patients undergoing manual therapy in the craniomandibular and cervical regions, with or without the addition of exercises and/or patient education, present a progressive reduction in the intensity of orofacial pain and gains in mandibular range of motion.

CONCLUSION: The results expand the data reported by other systematic reviews that investigated different aspects of the application of manual therapy in individuals with TMD. Manual therapy in the craniomandibular and cervical regions, whether associated with exercises and/or patient education, presents a clinically relevant improvement in the intensity of orofacial pain and mandibular range of motion.

Keywords: Cervical vertebrae, Musculoskeletal manipulations, Pain, Rehabilitation, Temporomandibular joint dysfunction syndrome.

RESUMO

JUSTIFICATIVA E OBJETIVOS: O uso de terapia manual nas regiões craniomandibular e cervical no tratamento de pacientes com disfunção temporomandibular (DTM) tornou-se uma prática comum, sendo que a literatura apoia o uso dessas técnicas para alívio de dor e melhora da amplitude de movimento mandibular. Portanto, a organização dos achados científicos pode

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HIGHLIGHTS

- This review highlighted significant improvements in pain and mandibular range of motion with manual therapy in the craniomandibular region, compared to the cervical region, in TMD patients.
- Manual therapy in the upper cervical spine with exercises reduced orofacial pain in women with TMD.
- Some studies combined manual therapy with various exercises, offering a comprehensive overview of the therapeutic approaches evaluated.
- This review offers valuable insights into the effectiveness of different manual therapy modalities on TMD, helping professionals to choose the most effective treatments.

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auxiliar o clínico na tomada de decisão. Assim sendo, o objetivo deste estudo foi avaliar a eficácia da terapia manual na região craniomandibular em pacientes com DTM e compará-la com a terapia manual na região cervical em desfechos de intensidade de dor e amplitude de movimento mandibular.

CONTEÚDO: Seguindo as diretrizes do PRISMA, foram incluídos Ensaios Clínicos Randomizados com uma população de adultos, de ambos os gêneros, com sinais e sintomas de DTM. Foram excluídos relatos de casos, estudos-piloto, séries de casos, editoriais, cartas de opinião, cartas ao editor, revisões de literatura, estudos de coorte e estudos de caso-controle. A estratégia de busca foi criada utilizando MESH e sinônimos para DTM, tratamento cervical, terapia manual, fisioterapia, exercício, dor e amplitude de movimento mandibular. Foram utilizadas as bases Medline, Embase, Pubmed, *Cochrane Library*, Biblioteca Virtual da Saúde, PEDro, Scielo, LILACS e Central. Foi utilizado o risco de viés da Cochrane ROB2 e a escala PEDro para avaliar a qualidade metodológica dos estudos incluídos. Oito estudos publicados entre 2013 e 2022 foram elegíveis, totalizando 339 indivíduos com DTM, com idade entre 18 e 65 anos. Os resultados da presente revisão mostraram que pacientes submetidos à terapia manual na região craniomandibular e região cervical, com ou sem adição de exercícios e/ou educação ao paciente, apresentaram redução progressiva na intensidade da dor orofacial e ganho na amplitude de movimento mandibular.

CONCLUSÃO: Os resultados ampliam os dados reportados por outras revisões sistemáticas que investigaram diferentes aspectos da aplicação da terapia manual em indivíduos com DTM. A terapia manual na região craniomandibular e a terapia manual na região cervical, associada ou não a exercícios e/ou educação do paciente, contribui para uma melhora clínica em relação à intensidade da dor orofacial e amplitude de movimento mandibular.

Descritores: Dor, Manipulações musculoesqueléticas, Reabilitação, Síndrome da disfunção da articulação temporomandibular, Vértebras cervicais.

INTRODUCTION

Temporomandibular disorders (TMDs) are one of the most common musculoskeletal conditions that cause disability[1], pain, joint sounds, jaw movement dysfunction, muscle sensitivity and joint tenderness, and can be unilateral or bilateral[2]. The etiology of TMD is related to structural, psychological and functional factors[3,4]. TMD is considered the most frequent cause of chronic orofacial pain of non-odontogenic origin, with 39% of the general population presenting at least one sign or symptom[5], and the second most common musculoskeletal condition, after chronic low back pain, associated with pain and disability, with a prevalence in children/adolescents of 18% (95% CI: 14-22%) and 17% (95% CI: 16-18%) among adults[6-8].

The greatest difficulty in identifying TMD stems from its complex relationship with other structures of the head, neck and shoulder girdle, as well as the wide variety of signs and symptoms that can be related to these structures[6], such as headache, otological symptoms, cervical spine dysfunction, toothache[8] and changes in head and neck posture[9], as well as changes in the stomatognathic system that can be caused by disorders of the cervical spine[10]. Epidemiological studies have reported that TMD patients often have symptoms of neck pain and that patients with neck pain can also suffer from symptoms in the orofacial region[11,12].

The literature shows that 70 per cent of TMD patients have neck discomfort without reports of pain, but have a higher incidence of problems related to the cervical spine, such as limited movement, tenderness in the cervical muscles and reduced capacity of the deep neck flexor muscles, compared to the general population[13].

There is an association between TMD and craniocervical conditions[14-16] which can be explained by their anatomical, neurological and biomechanical relationship. This is due to the nociceptive afferents of the path traveled by the facial, pericranial and upper cervical spine muscles, which have a common innervation that depends on the primary afferent neurons of the trigeminocervical complex[17-19]. The neuroanatomical and functional relationship between the temporomandibular joint (TMJ) and the cervical spine also contributes to the association between craniofacial and cervical pain[16].

According to the literature[14,17] this relationship is the basis that connects the normal functioning of the craniomandibular system and its pathological aspects[19;21-23]. As TMD is multifactorial[24], there is no single approach to treating it. However, physiotherapy treatment, including manual therapy, is among the 10 most common approaches for TMD[25], and aims to reduce joint and muscle pain (in the face and cervical spine), improve mandibular range of motion (ROM), allow relaxation of the masticatory and cervical muscles, reduce hyperactivity, restore muscle function and mobility of the TMJ, maintaining healthy function and promoting self-management strategies[26].

Manual therapy is a broad concept that encompasses a variety of techniques designed to impact musculoskeletal structures with the aim of reducing pain and improving function[27]. Within this context, it is important to clarify two terms that are often confused and referred to as manual therapy: manipulation and mobilization. Manipulation involves applying a localized, high-velocity, low-amplitude force to the joint segments. Mobilization, on the other hand, consists of techniques that employ passive movements or neuromuscular techniques of low speed and intensity, with variable amplitude, within the patient's capacity for movement and control[28,29]. Among soft tissue techniques, the authors highlight massages and myofascial releases[28].

Manual therapy can trigger mechanical stimuli that result in neurophysiological responses within the peripheral and central nervous system responsible for inhibiting pain[29]. In TMD patients, manual therapy alone or combined with other techniques has been applied directly to the TMJ and masticatory muscles, the cervical region[30,31] or both[32]. The effectiveness of joint mobilizations in the upper cervical region in reducing pain and increasing mandibular ROM may be due to the neuroanatomical connection between these two segments in the trigeminocervical complex or to the biomechanical relationship between the cervical and orofacial regions[19,23].

There are studies in the literature evaluating the effectiveness of cervical treatment in TMD patients and the relationship between

TMJ and craniocervical posture[24;33-35], as well as studies reporting that individuals with TMD had higher levels of pain perception in all cervical muscles when compared to asymptomatic individuals[36], and that manual therapy and stretching exercises can help in the clinical improvement of TMD patients associated with headaches through biomechanical changes in the cervical spine[37].

Therefore, the present study's objective was to assess the effectiveness of manual therapy in the craniomandibular region in TMD patients and compare it with manual therapy in the cervical region on the outcomes of orofacial pain intensity and mandibular ROM. The hypothesis of this research is that patients undergoing manual therapy in the craniomandibular region will show a greater reduction in pain and a greater gain in range of motion compared to patients undergoing cervical manual therapy, with or without the addition of exercises and patient education.

CONTENTS

This systematic review was developed following the Preferred Items Reporting of Systematic Reviews and Meta-Analyses (PRISMA) guidelines[38], and was registered in the National Institute for Health Research's prospective online register of systematic reviews (PROSPERO - CRD4202125702). The PICOT strategy was used as the basis for the design of this study (patients with TMD; compare manual therapy in the craniomandibular region with or without the addition of exercises and/or patient education with manual therapy in the cervical region with or without the addition of exercises and/or patient education on pain intensity and mandibular ROM at any time). Randomized Clinical Trials (RCTs) with a population diagnosed with TMD and/or with self-reported signs and symptoms of TMD, published in a peer-reviewed journal, were included. The inclusion criteria followed the PICOT structure as suggested by the PRISMA checklist[38].

Participants: Adults (>18 years), of both genders, diagnosed with TMD according to the Research Diagnostic Criteria for TMD (RDC/TMD)[41] or Diagnostic Criteria for TMD (DC/TMD)[1]; or any trials reporting signs or symptoms of TMD[39,40].

Interventions: Manual therapy (mobilization, manipulation, myofascial releases and massage) applied to the craniomandibular region (masseter, temporalis and pterygoid muscles), TMJ, suprahyoid muscles and other parts of the head, associated or not with exercises (exercise program involving proprioceptive exercises, learning, coordination, strengthening and stretching), and/or patient education with home guidance associated with information on resting the TMJ and masticatory muscles, limiting mandibular movements (reducing speech, chewing, yawning), modifying parafunctional habits, correcting posture, minimising stress, anxiety and fear, a light diet and applying heat and/or ice therapy when necessary.

Comparisons: Manual therapy (mobilization, manipulation, myofascial releases and massage) applied to the cervical region (cervical mobilizations or high-speed manipulations, muscle techniques and neural mobilization, associated or not with exercises and patient education (exercise program involving mobility, learning, coordination, strengthening and stretching exercises), compared or not with placebo or sham groups.

Outcome measures: Mandibular range of motion according to the DC/TMD clinical examination protocol (using a ruler or caliper)[1]. Pain intensity according to the recommendations of the Initiative on Methods, Measurement and Assessment of Pain in Clinical Trials (IMMPACT), visual analogue scale (VAS) and numerical pain scale (NPS)[41].

Exclusion criteria: Trials that included patients with Eagle's syndrome, a history of traumatic injuries (fracture, whiplash syndrome), fibromyalgia, a diagnosis of systemic disease (rheumatoid arthritis, systemic lupus erythematosus or psoriatic arthritis), the presence of neurological disorders (trigeminal neuralgia) and other serious comorbidities (cancer). Case reports, pilot studies, case series, editorials, opinion letters, letters to the editor or literature reviews, cohort studies and case-control studies were excluded from the analysis.

Research strategy

The research strategy was created using Medical Subject Headings from the National Library of Medicine (MESH) and synonyms for TMD, cervical treatment, manual therapy, physiotherapy, exercise, pain and mandibular range of motion. Boolean operators AND, OR and NOT were used in some databases. The following electronic databases were searched: Medline, Embase, Pubmed, Cochrane Library, Virtual Health Library, PEDro, Scielo, LILACS and Central. The last search was carried out in March 2024. References of previous systematic reviews and randomized clinical trials (RCTs) on this topic were examined to include supplementary articles.

Criteria for selecting studies

Two reviewers screened titles and abstracts separately with the help of the RAYYAN program, a web and mobile application for systematic reviews, classifying them as eligible and ineligible following predetermined eligibility criteria42. The order in which the studies were selected was as follows: (1) participants, (2) study design, (3) type of intervention, (4) outcome measures and (5) absence of exclusion criteria. Articles that could not be excluded on the basis of title and abstract were considered potentially included and the full texts were selected. The evaluation of the full text was managed in the same independent manner. Articles were included if both reviewers agreed on eligibility.

When there was disagreement, the differences between the assessors were resolved by consensus with an available third assessor.

Data extraction

Two reviewers independently extracted the review data using a standardized form, adapted to the model proposed by the Cochrane Collaboration[43,44], including information on the study (authors, year of publication and location), patients (sample size, type of TMD, TMD diagnostic criteria and inclusion/exclusion criteria), intervention (duration, follow-up and details of manual therapy techniques), comparison group (type of comparison), outcome measures (pain intensity and jaw range), results (differences between groups).

Integrity of the description of interventions

The completeness of the treatment descriptions of the included studies was extracted using the Template for Intervention Description and Replication (TIDieR), a checklist made up of 12 items (name, justification, materials, procedures, supplier, how, where, when and how much, customization, modification, how well planned and how current), designed to identify and promote the improvement of the description of interventions in RCTs, with sufficient detail to allow their replication[45].

Methodological quality assessment

The methodological quality of eligible studies was assessed using the PEDro scale[46], whose reproducibility of the Portuguese version is adequate (intraclass correlation coefficient - ICC - of 0.82) and similar to the English version (ICC of 0.78)[46]. The scale has 11 criteria, 8 of which are related to methodological quality (random allocation, secret allocation, proven baseline, blinded subjects, blinded therapist, blinded evaluator, adequate follow-up and intention-to-treat analysis) and 2 criteria related to statistical description (intergroup statistical comparisons and measures of precision and variability).

The first criterion (eligibility criterion) is not considered for the sum of the total score, as it refers to external validity. Two reviewers independently applied the PEDro - Physiotherapy Evidence-Based Database scale to estimate the risk of bias in the included articles[47] independently and to compare possible discrepancies if the eligible articles were not evaluated on the PEDro website. Disagreement was managed with the same procedure used in the inclusion/exclusion process and a third reviewer was available to mediate in case of discrepancies. The literature suggests that high-quality studies should achieve a total score of more than 50 per cent of the maximum possible[46]. All eligible studies were included in the review, regardless of their PEDro score.

Risk of bias assessment

Two independent reviewers assessed the risk of bias using the "Cochrane risk of bias 2", considering the five domains (randomization process, deviations from the proposed interventions, loss of data, measurement and selection of results) which highlight different aspects of study design, conduct and reporting. Each domain contains a series of questions (flagging questions) aimed at clarifying relevant information about the risk of bias. The judgment of each domain, as well as the determination of the absolute risk of bias, was made by an algorithm based on the answers to the flag questions, which can be considered "low" or "high risk of bias", or even expressing "some reservations"[48,49]. Differences between evaluators were resolved by consensus with an available third evaluator.

Data analysis

Data on orofacial pain intensity and mandibular range of motion were extracted from the included studies and structured according to their respective follow-up times. Studies with a follow-up of up to 3 months were characterized as having short-term follow-up, medium-term follow-up 3 to 6 months after randomization and long-term follow-up over 6 months after randomization. To analyze the effect of the interventions on the variables, the mean difference between the groups and the 95% confidence interval (CI) were extracted for each study[50]. When the study showed no difference in the mean between groups and the CI, both were calculated using the CI calculator provided by PEDro[46].

RESULTS

Using the previously defined search strategy based on PRISMA, 9,258 manuscripts were obtained. However, after checking for duplicates, titles, abstracts, full reading and implementation of the eligibility criteria, 8 studies[51-58] met the eligibility criteria for this systematic review (figure 1).

Characteristics of the study population

The eligible studies were published between 2013 and 2022. In total, the manuscripts included 339 individuals with TMD (288 female, 51 male), aged between 18 and 65, with a minimum of 10 and a maximum of 61 participants per study. Two studies[51,54] included patients with TMD, headaches and/or migraines (table 1).

Characteristics of the studies

One study[52] compared two groups, multimodal treatment including transcutaneous electrical nerve stimulation, ultrasound and massage with multimodal treatment added with manual TMJ

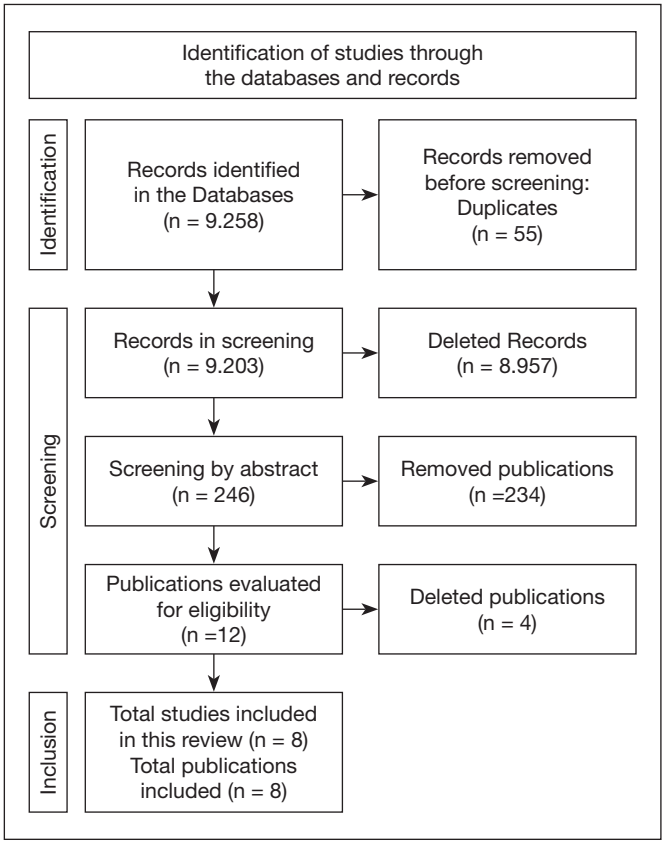

Figure 1. Flowchart of study selection

Table 1. Characteristics, outcomes and main results of the included studies

Authors	Participants	Diagnosis (scale/ instruments)	Intervention Groups	Control Groups	Outcome	Follow-up	Results
Rezaie et al.[52]	30 patients Group A: 7 men 8 women Age:27.65(4.04) Pain:4.2(0.78) ROM:48.27 (3.19) Group B: 6 men 9 women Age:28.33(5.43) Pain:5.4(1.06) ROM:47.33(5.63)	Diagnostic Criteria for TMD (DC/TMD); VAS >3.	GROUP A: intervention (manual therapy (mobilization of the TMJ and cervical spine) plus routine conservative treatment (TENS for 15 minutes, ultrasound for 5 minutes and gentle massage for 25 minutes in each session).	GROUP B: control (routine conservative treatment).	DC/TMD; Maximum pain intensity based on visual analog scale (VAS) greater than 3 for at least 3 months prior to the study. Mandibular range of motion was measured with a calibrated caliper.	Ten treatment sessions for each group were carried out over 8 weeks by a physiotherapist. Patients received the first 4 sessions over 2 weeks.	Comparisons between groups showed that, compared to the Control Group, patients in the Intervention Group (manual therapy on the TMJ and cervical spine, plus routine conservative treatment) experienced a significant reduction in pain, 1.67(0.62) and a significant increase in mandibular range of motion 53.20 (2.96) and cervical flexion range after the end of treatment and after the follow-up period. GROUP B (routine conservative treatment): The results of the analysis within the control group showed that, compared with the baseline value, after the end of treatment and after follow-up, there was a significant reduction in the intensity of jaw pain, 4, 2 (0.78), and a slight increase in mandibular amplitude, 48.27(3.19). There was a statistically significant difference between the groups ($p<0.001$).
Reynolds et al.[53]	50 patients Group A: 5 men 20 women Age:32.2(11.3) Pain:3.7(1.5) ROM:37.8 (5.1) Group B: 2 men 23 women Age:38.8(14.8) Pain:3.7(1.5) ROM:37.2 (6.7)	TMD screening tool (DC/TMD); NPS>2; Mandibular range < 50mm.	GROUP A (AVBA) :After receiving 2 minutes of suboccipital release, education, and a home exercise program, participants received upper cervical manipulation.	GROUP B (sham): After receiving 2 minutes of suboccipital release, education, and a home exercise program, participants received sham manipulation.	Numerical pain scale (END); Maximum mouth opening was measured with a disposable ruler. Tampa Scale of Kinesiophobia for TMD (TSK-TMD); Jaw Functional Limitation (JFLS); Global Classification of Change (GROC); Patient Acceptable Symptom Status (PASS).	4 sessions in 4 weeks.	Both groups improved over time, however, differences between groups were not significant. GROUP A: (AVBA): upper cervical manipulation and suboccipital release, education and home exercise program. JFLS, TSK-TMD and Perception of Change/Success - There was an immediate decrease in pain to 2.4 (2.2) as well as after 1 week 2.9 (1.5) and 4 weeks 1.69 (1.6) .and increase in immediate mandibular ROM to 40.88(7.2) as well as after 1 week 41.12 (10) and 4 weeks 45.84(8.3). In GROUP B (Sham): Simulated Manipulation. - There was a decrease in immediate pain to 3.56(2.3) as well as after 1 week 3.15 (1.9) and 4 weeks 2.69(1.9). and an increase in immediate mandibular ROM to 38.68 (7.8) as well as after 1 week 39.52 (7.4) and 4 weeks 42.08(9).
Calixter et al.[54]	61 patients Group A: 30 women Age:26.1(5.7) Pain: 7(2.0) ROM:36.3 (8.8) Group B: 31 women Age:26.3(4.6) Pain:7(2.5) ROM:33.1 (9.2)	TMD (RDC/TMD), myalgia with pain lasting 3 months.	GROUP A: upper cervical mobilization, motor control exercises.	GROUP B: no intervention and suboccipital release, education and exercise in the form of instruction and home exercise program.	Pain intensity (VAS).	10 sessions in 5-week follow-up.	GROUP A (mobilization + exercises) showed a decrease in orofacial pain to 2.1(2.2) when compared to GROUP B (without intervention and suboccipital release, education and exercise in the form of instruction and home exercise program), there was no difference 3.1 (2.3) after 5 weeks of intervention, with a significant difference of 30% in pain intensity, $p<0.05$.
Garrigos-Pedro et al.[51]	45 patients Group A: 20 women 3 men Age:46(9.1) Pain: 73.5(13) ROM:32.87 (7.16) Group B: 19 women 3 men Age:48.2(11.3) Pain:69.6(12.8) ROM:31.41 (8.75)	Myofascial TMD (RDC/TMD).	GROUP A: mobilization of the neck and TMJ, masticatory muscles and nervous tissue.	GROUP B: cervical manual therapy, therapeutic and home exercises.	Craniofacial Pain and Disability Inventory (CF-PDI), Headache Impact Test (HIT-6); pressure pain thresholds (PPTs) Pain intensity (VAS), maximum opening (MMO) without pain (caliper).	6 sessions over 3-6 weeks. Each session lasted 30 minutes.	GROUP A (mobilization in the cervical and TMJ region, masticatory muscles and nervous tissue) had a 30% decrease in pain intensity, reaching 59.65 (14.26) and an increase in ROM 37.22 (5.98) . GROUP B (cervical manual therapy, therapeutic and home exercises) had a decrease in pain intensity to 59.86 (14.26) and there was no difference in ROM 31.64 (8.48). There was a statistical difference between the groups $p<0.001$.

Continue...

Table 1. Characteristics, outcomes and main results of the included studies – continuation

Authors	Participants	Diagnosis (scale/ instruments)	Intervention Groups	Control Groups	Outcome	Follow-up	Results
Corum et al.[56]	60 patients Group A: 20 women Age:27(6.3) Neck Pain: 14 Headache: 14 Group B: 20 women Age:26(7.9) Neck Pain: 16 Headache: 16 Group C: 20 women Age:28.8(7.6) Neck Pain: 14 Headache: 15	Diagnosis of myofascial TMD (RDC/TMD), with pain lasting 6 months.	GROUP A: upper cervical manipulation + exercise.	GROUP B: Simulated manipulation (sham) + exercise. GROUP C: patient education.	Orofacial pain intensity (NPS) mandibular range of motion (AMM) (ruler in millimeters).	1 month.	GROUP A: (high cervical manipulation + exercise) obtained a decrease in pain intensity 1.6(1.5) as well as an increase in ROM 36.6(7.8). There was a statistically significant difference when comparing pre- and post-treatment moments ($p<0.001$). GROUP B (simulated manipulation (sham) + exercise) obtained a decrease in pain intensity 4.1(2.2) as well as an increase in ROM 36.8(7.8). There was no statistical difference between pre and post- treatment. GROUP C (patient education) obtained an increase in pain intensity 4.6(2.7) as well as a decrease in ROM 32(8.8). There was no statistical difference between pre- and post-treatment.
Bortolazzo et al.[55]	10 patients Group A: 5 women Age:25.8(6.8) ROM:27.6(8.56) Group B: 5 women Age:25.8(6.8) ROM:40.6(11.76)	Diagnosis of myogenic TMD (RDC/TMD) Pain or fatigue in the masticatory muscles for a period between 1 and 5 years of pain.	GROUP A: upper cervical manipulation.	GROUP B: placebo maneuvers.	Pain-free mandibular range of motion (MRM) (caliper).	48 hours after the last intervention.	GROUP A (upper cervical manipulation) showed an increase in mandibular range of movement, reaching 37.6(11.15), with a statistically significant $p<0.05$. GROUP B (placebo), which presented a post-intervention ROM of 42.4(14.67), but it was not statistically significant.
Tuner et al.[57]	40 patients Group A: 15 women 5 men Age:34.8(12.4) Pain: 17.5(21.5) Group B: 16 women 4 men Age:37(14.6) Pain:23(23.6)	Stomatognathic examination.	GROUP A: home exercises (education and postural exercises).	GROUP B: Manual Therapy, education and home exercises (postural exercises and TMJ and soft tissue mobilization).	Orofacial pain intensity (VAS).	Each session lasted 30 minutes and 3 times a week.	GROUP B: (Manual Therapy, education and home exercises) had a 30% decrease in pain intensity, reaching 0.5(2.2). GROUP A (Home exercises (education and postural exercises) had a decrease in pain intensity, reaching 4.5(10). There was a statistical difference between the groups ($p<0,001$).
Von Piekartz et al.[58]	43 patients Age: 36(7.7) 27 women 16 men Group A: 21 patients Pain in C1:4 Pain in C2:29 Pain in C3:30 Group B: 22 patients Pain in C1:6 Pain in C2:27 Pain in C3:32	Headache for more than 3 months, Neck Disability Index (NDI) score of more than 15%; 1 of 4 TMD signals (RDC/TMD); visual analogue scale (VAS). .	GROUP A: Orofacial manual therapy associated with cervical manual therapy, TMJ mobilization, masticatory muscle techniques and therapeutic exercises; the therapist can also add cervical treatment.	GROUP B: (cervical manual therapy).	Orofacial pain intensity - Visual Analogue Scale (VAS); Cervical range of motion (cervical ROM).	Each session lasted 30 minutes and 3 times a week.	GROUP A: (TMJ mobilization, masticatory muscle techniques and therapeutic exercises) had a 30% decrease in pain intensity, i.e. Pain in C1:0; Pain in C2:04 and Pain in C3:02. GROUP B (cervical manual therapy) had a decrease in pain intensity, i.e. Pain in C1:1; Pain in C2:17 and Pain in C3:11. The group that received orofacial treatment, in addition to general cervical manual therapy care, showed a significant reduction in all aspects of cervical involvement after the treatment period ($p<0.05$).

and cervical therapy (mobilizations and exercises). Another study[53] compared manipulation of the upper cervical region (high--velocity, low-amplitude impulse - HVA), suboccipital release, education and a home exercise program with guidance versus simulated manipulation. One study[54] compared manual therapy in the cervical region versus no intervention. Another study[55] compared upper cervical manipulation (occipital, atlas and axis manipulation) with placebo. One study[51] performed manual therapy in the cervical region compared to orofacial and cervical manual therapy with the addition of exercises.

Another study[56] compared three groups: high cervical manipulation with added exercise, simulated manipulation with added exercise and a patient education group. One study[57] compared home exercises that included patient education, postural exerci-

ses, self-massage, stretching of the masticatory and cervical muscles, mandibular exercises, TMJ and head coordination exercises with a manual therapy that included patient education, postural exercises and joint mobilization. Another study[58] compared orofacial treatment associated with cervical manual therapy with cervical manual therapy alone (table 1).

Assessment of risk of bias and methodological quality

The risk of bias in eligible studies, established by Cochrane ROB2[48,49], is shown in figure 2. The methodological quality determined by the PEDro scale[46] obtained an average score ranging from 5 to 8 points, with the least satisfied criteria being: blinding of subjects, therapists and intention-to-treat analysis (table 2).

Description of interventions

The analysis inherent in the completeness of the descriptions of the interventions (TIDieR) is shown in table 3.

In the included studies, the intensity of orofacial pain was measured using the VAS[51,52,54;57-58] and NPS[53,56]. The range of mandibular movement was measured using a pachymeter[51,52,55] or a millimetre ruler[53,56].

In one study[53], participants were randomly assigned to receive manipulation of the upper cervical region (AVBA group) or simulated manipulation (sham group), after having received 2 minutes of suboccipital release, education and a home exercise programme. Both groups improved over time, and the differences between the groups were not significant (ROM p=0.28 and Pain p=0.059).

In another study[54], manual therapy and stabilization exercises targeting the neck reduced orofacial pain and the impact of headache in women with TMD when compared to a control group after 5 weeks of intervention. The results showed that the groups studied were different and that there was a statistically significant difference (p<0.05 - 95%CI -0.81 (-1.3;0.3)) and a minimal clinically important difference in the intervention group when comparing the time before and after 5 weeks of intervention, i.e. a 30 per cent reduction in pain intensity[59].

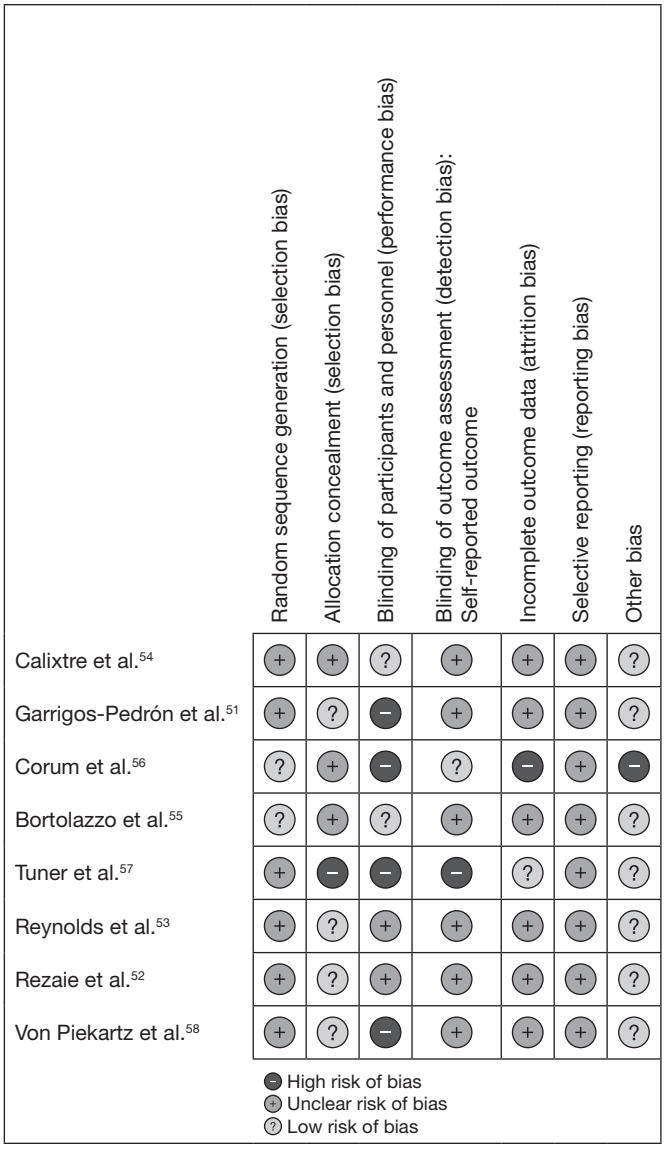

Figure 2. Risk of bias of included studies

Table 2. Methodological quality of eligible studies (PEDRo scale)

Authors	Election criteria	Random allocation	Hidden allocation	Comparability from baseline	Blinded subjects	Blinded therapists	Blinded measurers	Adequate follow-up	Intention-to-treat analysis	Comparisons between groups	Point estimates and variability	PEDRo score
Rezaie et al.[52]	S	S	S	S	N	N	S	N	N	S	S	6
Reynolds et al.[53]	S	S	N	S	N	N	S	N	S	S	S	6
Calixtre et al.[54]	S	S	S	S	N	N	S	S	S	S	S	8
Garrigos-Pedrón et al.[51]	S	S	N	S	N	N	S	S	N	S	S	6
Corum et al.[56]	S	S	S	S	N	N	S	S	N	S	S	7
Bortolazzo et al.[55]	S	S	S	S	N	N	S	S	N	S	S	7
Tuner et al.[57]	N	S	N	S	N	N	N	S	N	S	S	5
Von Piekartz et al.[58]	S	S	N	S	N	N	S	S	N	S	S	6

Y = yes; N = no

Table 3. Model for Intervention Description and Replication (TIDieR) checklist

Authors		Brief Name	Why	What--Materials	What-Procedures	Who Provided	How	Where	When and How Much	Tailoring	Modifications	How Well - Planned	How Well - Actual	Total TIDieR	% Per Group
Rezaie et al.[52]	E	S	S	NA	S	S	S	N	S	N	N	?	?	6	50,00%
	C	S	S	NA	S	S	S	N	S	N	N	?	?	6	50,00%
	T	2	2	0	2	2	2	0	2	0	0	0	0	12	50,00%
Reynolds et al.[53]	E	S	S	NA	S	S	S	S	N	N	N	S	S	8	66,70%
	C	S	S	NA	S	S	S	S	N	N	N	S	S	8	66,70%
	T	2	2	0	2	2	2	2	0	0	0	2	2	16	66,70%
Calixtre et al.[54]	E	S	S	NA	S	S	S	S	S	N	N	S	S	9	75,00%
	C	S	S	NA	S	S	S	S	N	N	N	N	S	7	58,30%
	T	2	2	0	2	2	2	2	1	0	0	1	2	16	66,65%
Garrigós--Pedron et al.[51]	E	S	S	NA	S	S	?	S	S	S	N	S	S	9	75,00%
	C	S	S	NA	S	S	?	S	S	S	N	S	S	9	75,00%
	T	2	2	0	2	2	0	2	2	2	0	2	2	18	75,00%
Corum et al.[56]	E	S	S	NA	S	S	?	?	?	N	N	?	N	4	33,30%
	C	S	S	NA	S	S	?	?	?	N	N	?	N	4	33,30%
	T	2	2	0	2	2	0	0	0	0	0	0	0	8	33,30%
Bortolazzo et al.[55]	E	S	S	NA	S	S	?	?	S	N	N	N	N	5	41,70%
	C	S	S	NA	S	S	?	?	S	N	N	N	N	5	41,70%
	T	2	2	0	2	2	0	0	2	0	0	0	0	10	41,70%
Tuncer et al.[57]	E	S	S	NA	S	N	?	?	S	?	N	?	S	5	41,70%
	C	S	S	NA	N	N	?	?	S	?	N	?	S	4	41,70%
	T	2	2	0	1	0	0	0	2	0	0	0	2	9	37,50%
Von Piekartz et al.[58]	E	S	S	NA	S	S	S	N	S	S	N	?	?	7	58,30%
	C	S	S	NA	S	S	S	N	S	S	N	?	?	7	58,30%
	T	2	2	0	2	2	2	0	2	2	0	0	0	14	58,30%
% of EACH		100,00%	100,00%	0,00%	93,70%	87,50%	50,00%	37,50%	68,70%	25,00%	0,00%	31,25%	50,00%	-	-
TIDieR ITEM (IC 95%)		(100-100)	(100-100)	(0-0)	(81,5-93,66)	(63-87,41)	(12,9-50)	(1,6-37,5)	(37-68,7)	(-7-68,7)	(0-0)	(-4-31,2)	(12,9-50)		

E=experimental group; C = control group; T= total score; Y = yes; N = no; N/A = not applicable?; = not reported/not reported enough

In the reference study[51], manual therapy in the cervical region alone, as well as manual therapy in the cervical region associated with the orofacial region, showed a statistical difference when comparing pre and post, 6-week follow-up and 12-week follow--up, in relation to pain intensity (p<0.001). With regard to mandibular range of motion, the manual therapy group associated with exercise in the cervical region showed no statistical difference at any time. The group that received manual therapy combined with exercises in the cervical region with exercises in the orofacial region showed a statistically significant difference when comparing the pre and post moments, 6-week follow-up and 12-week follow-up (p<0.001); Visual Analogue Scale (VAS - 95%CI 16.65 (9.73;23.58)); ROM (95%CI -4.35; -6.35; -2.34). Both groups improved over time, however the differences between the groups were not significant (VAS p=0.06 and ROM p=0.54), despite the authors pointing out that combining techniques is more effective.

In one study[57], manual therapy in combination with patient education and postural exercises, as well as the group that received only home exercises, showed a statistically significant decrease in pain intensity (p<0.001). In the group that received manual therapy combined with patient education and postural exercises, the decrease in pain intensity was even greater (pre-treatment EAV 23 (23.6), post-treatment 0.5 (2.2)) when compared to the group that received only home exercises (pre-treatment EAV 17.5 (21.5), post-treatment 4.5 (10)).

In one study[56], upper cervical manipulation associated with neck exercises was more effective in improving pain intensity when compared to simulated manipulations associated with exercise (p=0.003), as well as when compared to pain education (p=0.000). However, when comparing simulated manipulation and exercise with patient education, there was no difference between the groups (p=0.281). With regard to range of motion, when comparing the upper cervical manipulation groups associated with neck exercises and patient education, there was a statistically significant difference between the groups (p=0.046), and the same was true when comparing the simulated manipulation plus exercise group with patient education (p=0.000). However, when comparing simulated manipulation and exercise with patient education, there was no difference between the groups (p=0.053).

In another study[55], upper cervical manipulation significantly increased mandibular range of motion (pre 27.5 (8.56), post 37.6 (11.15); p<0.05 ROM; 95%CI 10 (3.35;16.65)), and the placebo group (pre 40.6 (11.76), post 42.4 (14.67); p>0.05 ROM; 95%CI 1.80 (-4.85;8.45)). However, caution should be exercised when interpreting the results due to the small sample size presented in this study.

One study[52] compared two groups, the multimodal treatment group with the multimodal treatment group plus manual therapy of the TMJ and cervical spine (mobilizations and exercises). For each group, 10 treatment sessions were carried out over 8 weeks by a physiotherapist. Comparisons between groups showed that, compared to the control group (VAS pre 5.4 (1.6), post 4.2 (0.78); ROM pre 47.33 (5.63), post 48.27 (3.19)), patients in the intervention group experienced a significant reduction in pain and a significant increase in mandibular range of motion (VAS pre 5.6 (0.91), post 1.67 (0.62); ROM pre 46.27 (3.81), post 53.20 (2.96)) and cervical flexion range of motion after the end of treatment and after the follow-up period (p<0.001).

Another study[58] compared two groups: cervical manual therapy plus orofacial manual therapy and cervical manual therapy plus orofacial manual therapy to treat TMD. In the cervical manual therapy group, only upper cervical mobilization, stretching, muscle strengthening, and cervical-specific home exercises were performed. The group that received orofacial treatment in addition to cervical manual therapy showed a significant reduction in all cervical impairment movements after the treatment period. These improvements persisted during the 6-month follow-up but were not observed at any time in the group that only underwent cervical manual therapy. Therefore, it was observed that there was no significant difference between the two groups (p > 0.05) after the first session. However, after 3 months, all cervical movements were significantly better in the group that added orofacial manual therapy, with a significant reduction in pain (p<0.05).

Side effects

Most of the included studies reported no adverse effects after the intervention, however one study[58] lost three participants due to an increase in complaints[31], and another study[56] lost two patients due to headache and dizziness after the first manipulation.

DISCUSSION

Analyzing the 8 articles included using the TIDieR checklist[60,61] showed that 50% of the 12 items assessed were covered in at least 5 articles. However, examination of each item identified: the description of any physical or informational material used in the intervention; the description of the locations where the intervention took place; whether the intervention was planned to be individualized, specific or adapted; whether the intervention was modified during the execution of the study; and whether the adherence or fidelity of the intervention was assessed were poorly addressed. This scenario highlights the importance of future clinical trials adopting the TIDieR checklist in a comprehensive manner, especially on the points highlighted, in order to improve the transparency and replicability of the interventions studied. On the other hand, it is noteworthy that items such as a detailed description of the intervention, its essential objectives, procedures, those responsible for carrying it out and the frequency with which it was carried out were satisfactorily covered in the articles analysed (CI 100%-68.7%). This finding reinforces the need for a more complete and systematic approach to describing interventions, contributing to the quality and reliability of the results obtained.

It is worth noting that of the 8 eligible studies, 7 studies evaluated the intensity of orofacial pain as outcome[51-54;56-58] and 5 studies evaluated mandibular ROM as outcome[51-53;55,56]. Only 4 studies evaluated both outcomes[51-53;56]. The results of the present review showed that patients undergoing manual therapy in the craniomandibular region and cervical region, with or without

the addition of exercises and/or patient education, present a progressive reduction in the intensity of orofacial pain and gains in mandibular range of motion, with the exception from a study[53], which did not offer a significant interaction for maximum mouth opening, pain intensity or secondary measures. There were significant two-way interactions for jaw functional limitation (JFLS) and Tampa scale of kinesiophobia for TMD (TSK-TMD). The high-velocity, low-amplitude impulse (AVBA) group showed less fear at 4 weeks and improved jaw function sooner (1 week). The global rating of change favored AVBA group, with significant differences in successful outcomes observed immediately after initial treatment and after 4 weeks of intervention.

The present results expanded the statements presented by other systematic reviews that investigated different aspects of the application of manual therapy in participants with TMD. One study[62] evaluated the methodological quality of RCTs and the effectiveness of manual therapy interventions and therapeutic exercises in TMD treatment, such as also investigated the magnitude of the effect of these interventions on TMD management. Their results showed that manual therapy improved jaw range of motion and reduced pain associated with myogenic temporomandibular disorder. However, the studies included in this review identified a lack of high quality in the studies analyzed, which raises doubts about the effectiveness of the therapy. This may be attributed, in part, to the absence of a validated diagnostic tool for TMD in the included studies.

Another systematic review[63] evaluated the effectiveness of manual therapy in the treatment of myofascial pain related to TMD and concluded that more studies are needed as the findings are inconclusive due to the low homogeneity between studies. As also occurred in the meta-analysis review[64] that evaluated the effectiveness of cervical rehabilitation interventions on pain intensity and sensitivity in adults with muscular TMD, in comparison with other interventions, such as placebo, simulated treatment, education or no intervention, and concluded that In the short term, cervical rehabilitation interventions, especially upper cervical mobilization, alone or in combination with a cervical exercise program, are effective in improving multiple pain outcomes in adults with muscular TMD.

In one study[65], the authors evaluated the effectiveness of manual therapy applied specifically to craniomandibular structures on pain and maximum mandibular opening in individuals with TMD, however, unlike this review, the authors excluded any studies that reported the effects of craniomandibular manual therapy combined with other treatment modalities, such as exercise, directed only to the craniomandibular area or not, and concluded that craniomandibular manual therapy successfully reduces pain and improves mandibular range of motion in the medium term.

The present study differs from others because it aims to evaluate the effectiveness of manual therapy (mobilization, manipulation, muscle releases and massage) in the craniomandibular region, associated or not with exercises (programs involving proprioceptive exercises, learning, cooperation, strengthening and stretching) and/or patient education (home guidance associated with information on tranquility of the TMJ and masticatory muscles, and about the limitations of mandibular movements in patients with TMD), and compare with manual therapy in the cervical region, associated or not with exercises and/or patient education, for the outcomes pain intensity and mandibular range of motion.

Unlike other reviews, in this review eligible studies showed significant clinical improvement in pain intensity, with a 30% decrease[59], as well as an improvement in mandibular range of motion, as was found in a study[54] which observed that manual therapy applied to the spine upper cervical and cervical motor control/stabilization exercises for 5 weeks reduce orofacial pain and the impact of headache in women with TMD, highlighting that there was a significant clinical improvement in the intensity of orofacial pain from the fourth week of intervention.

Corroborating the present review, a study[56] performed manipulation of the upper cervical spine combined with a cervical exercise program in patients with TMD, and observed a reduction in the intensity of orofacial pain, as well as an increase in mandibular range of motion after 6 weeks of treatment with one-month follow-up. The same happened in the study[57] that found a statistically significant decrease and a minimal clinically important difference in pain intensity in their groups, as well as in other studies that were eligible for this review[53-55]. Therefore, it can be inferred that this review brought more information to readers, offering important insights into which modality or combination of modalities is most effective in relieving orofacial pain, improving mandibular range of motion and reducing other symptoms associated with TMD in a way that is closer to clinical reality.

RELEVANT POINTS

The present systematic review has relevant points to highlight, including a carefully developed protocol and comprehensive search strategies without language or date limits. The majority of eligible studies used the gold standard tool for TMD diagnosis (DC/TMD). This helps reduce misdiagnosis in randomized controlled clinical trials through valid and reliable assessment.

LIMITATIONS

The studies reviewed presented varied methodologies and protocols, making their replication difficult. There is a need for standardization for more robust evidence and precise clinical application. In the present review, eligible studies showed high heterogeneity in the type, frequency and duration of their intervention design, in control groups and comparisons, which makes the synthesis of evidence difficult. There is a need for additional studies with more detailed treatment protocols, including placebo groups, longer follow-ups and a larger sample size, as well as addressing assessments of participants' global improvement and adverse events.

When considering the body of evidence, it is possible to state that manual orofacial therapy, with its variations and complements, offers clinically relevant benefits for patients with certain conditions. However, challenges persist regarding the standardization of protocols and the robustness of evidence, highlighting the continued need for research to improve the understanding and application of this therapeutic modality.

CONCLUSION

It can be concluded from the results of the present study that combining manual therapy in the craniomandibular region with manual therapy in the cervical region associated with exercises presented better results for the outcomes pain intensity and range of mandibular movement than the use of the two therapies alone, as it was also better than placebo or sham manual therapy.

AUTHORS' CONTRIBUTIONS

Rita de Cassia das Neves Martins
Data Collection, Research, Writing - Preparation of the original
Lais Silva Ferreira
Writing - Review and Editing
Nathalia Rodrigues de Mello Rosa
Data Collection
Juliana Leite da Silva
Data Collection
Fabiano Politti
Methodology, Supervision
Daniela Aparecida Biasotto-Gonzalez
Research, Methodology, Writing - Review and Editing, Supervision, Visualization

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