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Systematic review

Effectiveness of myofascial release for adults with chronic neck pain: a meta-analysis

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Abstract

Background Every second human will experience a phase of neck pain in their lifetime and a high rate of chronicity exists. Because of the complexity and multiple influencing factors, chronic pain conditions are associated with a long treatment and diagnostic process. This leads to a prolonged healing process and high costs.
Objective To evaluate the effect of myofascial release on the variables of pain and range of motion in patients with chronic neck pain.
Method Selection criteria were set to create a search algorithm for a systematic search in the databases: PubMed, Google Scholar, EBM Reviews, Medline, CINAHL, PEDro, and Science Direct. The risk of bias and the methodological quality was analyzed with the PEDro scale.
Result Ten randomized controlled trials, with 549 participants met the eligibility criteria. The methodological quality was ranked from good to excellent. The myofascial release showed a significant difference in pain ($p = 0.03$), rotation to the right ($p = 0.05$), and lateral flexion to the right ($p = 0.04$), compared to other treatment methods. No significant effect was found for improvements in pressure pain threshold.
Conclusion Modest effects are observed in pain reduction, suggesting potential benefits of myofascial release in managing chronic neck pain. Further research with standardized protocols and direct comparisons to established therapies is crucial for a comprehensive understanding of myofascial release efficacy.

Contribution of the paper

- **Effective pain reduction:** Myofascial release might significantly impact the reduction of neck pain.
- **Uncertain Impact on PPT and ROM:** Outcomes for Pressure-Pain Threshold (PPT) and Range of Motion (ROM) remain inconclusive, requiring further research.
- **Treatment Diversity Complexity:** Diverse treatment comparators pose challenges in isolating MFR effects, emphasizing the need for standardized protocols and caution when interpreting the results.

What does the meta-analysis add to the current literature.

- **Scientific Gap and Need for Further Research:** The meta-analysis highlights a significant scientific gap in definitive evidence supporting myofascial release treatments for chronic neck pain. The identified shortage of studies underscores the need for further research to establish MFR's efficacy, emphasizing standardized protocols, long-term effects, and direct comparisons with established therapies.
- **Consideration of Treatment Modality Variations:** The analysis contributes to understanding the complexity introduced by variations in treatment modalities. The meta-analysis emphasizes the importance of homogeneous study designs to enhance outcome comparability. This insight is valuable for researchers and clinicians aiming to interpret and apply findings from diverse studies in the field of MFR and chronic neck pain.

Keywords: Myofascial release; Chronic pain; Range of motion; Pressure-pain-threshold; Fascia

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Introduction

The prevalence of chronic pain in Western societies is estimated at 8% [1]. Neck pain is a common experience, with a high incidence of chronic cases [2]. Chronic primary pain, as classified by the International Classification of Disease (ICD), persists or recurs for longer than 3 months and affects one or more anatomical regions of the body [3]. Middle-aged females with sedentary lifestyles are particularly affected [4]. The head and neck regions are known for their susceptibility to pain syndromes [5]. A survey conducted in Western societies involving 4839 participants revealed that 46% experienced constant pain lasting over 2 years, and 19% had lost their jobs due to chronic pain conditions [6]. The German Federal Statistical Office highlights the association of chronic pain with prolonged treatment and diagnostic processes, resulting in delayed healing and increased costs [7]. In recent decades, the treatment approach for chronic neck pain has shifted towards interdisciplinary pain management that includes physiotherapy as a first-line treatment [2].

An anatomical structure that is hypothesized, to be strongly related to the intensity of pain is the fascial continuum [9]. Even though it has great versatility, scientific research is still sparse [10]. Trauma, inflammations or infections, and structural imbalance of the body lead to a tightening of the fascial strain. If this condition becomes long-term, the loss of physiological adaptability leads to a lack of flexibility, pain, and limitation in movement [11]. At the structural level, the fascia solidifies, the collagen becomes dense and fibrous, and the elastin loses its resiliency, impacting physiological and biomechanical processes and activating nociceptors [9]. Myofascial release (MFR) influences these fascial alterations and is therefore recommended in the treatment of chronic pain [12]. The purpose is to alleviate pain, restore the optimal length of a muscle, improve function, and relieve tissue tenderness of the myofascial system [13]. MFR involves applying a low-load and long-duration stretch to the barriers in the myofascial tissue, with one therapist providing treatment to a single person at a time [14].

Webb and Rajendran 2016 conducted a meta-analysis, to evaluate the effectiveness of MFR in joint ROM and pain, across various body regions.

The MFR group showed significant differences in all outcome domains [15].

Comparable results were found in a meta-analysis regarding the effectiveness of MFR in chronic low back pain [16]. The thoracolumbar fascia has received the most attention in studies on low back pain, while research on the deep fascia of the neck is limited [17]. Current evidence indicates a strong correlation between the facial system and the generation and sustaining of pain, therefore investigating the effectiveness of MFR specifically for the neck is crucial. The objectives of this meta-analysis are to review the existing literature on chronic neck pain and evaluate the effectiveness of MFR. The research question guiding this analysis is: "Does MFR have a significant impact on reducing pain and improving cervical spine range of motion in patients with chronic neck pain?".

Method

The present meta-analysis elaborated on the foundation of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [18].

Selection criteria

The PICO Worksheet was used to create the research question and determine keywords for databases, used to carry out an advanced search. The study's content was centered on the combination of "Myofascial Release" and "Chronic neck pain" with a focus on "Randomized Controlled Trials." Synonyms for these terms included: "Soft tissue massage", "Soft tissue manipulation", "MFR", "MFT", and "Fascia". Further keywords were:

"Indirect myofascial release", "Hands-on myofascial release", "Randomized Controlled Trials as Topic", "Clinical Trial", "Randomized trials", "Pain", "Pain perception", "Pain management", "Nociception". The therapeutic intervention utilized in this study is referred to as passive MFR or "hands-on" MFR. Manual techniques are employed by a therapist without the aid of tools or instruments, such as a foam roller. Throughout passive MFR, the therapist utilizes their hands to apply gentle and sustained pressure to targeted areas of the body, with a specific focus on the fascial system. This tactile approach enables the therapist to discern subtle changes within the fascial layers, allowing for a responsive application to facilitate the release of tension. Randomized controlled trials (RCT) in peer-reviewed journals published in English or German language before May 2022 were included. Studies were analyzed in the case of a control group, that received a placebo treatment or different physiotherapeutic interventions. The outcome measures must be the intensity of the pain (VAS or PPT) and/or ROM of the cervical spine. The statistical analysis had to present the mean (M), standard deviation (SD), p-value, and effect size. The methodological quality was examined with the PEDro scale [19]. The trials had to accomplish a score of six (Risk-of-Bias Rating). Studies that did not report pain and/or ROM were excluded, in addition to a variety of pathologies, for example, craniomandibular dysfunction (CMD), migraine, and tension-type headaches.

Literature research

The literature search was conducted from March 2022 to June 2022, utilizing MeSH terms on the PubMed database to facilitate a comprehensive exploration employing standardized medical vocabulary. The search algorithm applied was as follows: ("Myofascial Release"[MeSH Terms] OR

"Myofascial Release" OR "indirect myofascial release" OR "hands-on myofascial release") AND ("Randomized Controlled Trials as Topic"[Mesh] OR "Randomized Controlled Trial" OR "Clinical Trials as Topic"[Mesh] OR "Clinical Trial" OR "randomized trials" OR "clinical trials") AND ("Pain"[MeSH Terms] OR "Pain" OR "pain perception" OR "pain management" OR nociception) AND Humans [Mesh] AND English[lang]. Subsequently, a secondary search was executed on Google Scholar. However, due to limitations in supporting complex search algorithms akin to those in PubMed, a simplified approach was adopted. Various databases, including EBM Reviews, MEDLINE, Cochrane Library, PEDro, and Science Direct, were incorporated. The screening process initially involved title and abstract assessment, followed by the application of inclusion criteria. Lastly, articles underwent critical evaluation for scientific methodology and risk of bias, as detailed in Table 1. The search was conducted by a single researcher without the use of automated tools.

Data extraction

Specified variables were extracted from the studies: Year of publication, sample size, type of intervention, follow-up period, primary outcomes, and secondary outcomes (see Table 2). The following scales and measures were used to determine and evaluate the outcomes:

1) **Visual Analog Scale:** The variable pain was evaluated with a VAS scale in which a numerical scale was added. It is a straight line with the endpoints; no pain (1) and pain as bad as it could be (10). The patient must classify the perception of the severity of the pain. The VAS is a valuable instrument to assess subjective pain intensity and changes due to therapy [20].
2) **Pressure-Pain-Threshold:** The PPT is measured with the application of a pressure algometer. The sensitivity of the deep muscular tissue of the trapezius and sternocleidomastoid muscle is examined. A steadily increasing pressure is given to the muscle tissue until the patient mentions a painful sensation. Higher PPT values are indicative of better outcomes. It is a reliable tool for the assessment of the effect of a treatment, aimed at reducing pain caused by muscle tenderness [21].
3) **Range of motion:** The range of motion (ROM) of the cervical spine refers to the maximum extent of joint movement, which includes active and passive mobility [22]. ROM assessment involves active movements in four directions, including flexion, extension, rotation, and lateral flexion, with measurements typically reported in degrees. Higher degrees of ROM are associated with better clinical outcomes.

Risk-of-bias rating

The PEDro scale was used for the analysis of the methodological quality. The internal and external validity in the form of generalizability and applicability were examined in addition to the quality of the statistical information provided. It consists of the following 10 items: Random allocation, concealed allocation, baseline comparability, blind subjects, blind therapists, blind assessors, adequate follow-up, intention-to-treat analysis, between-group comparison, point estimates, and variability. The “eligibility criteria” was included as a requirement but not considered in the total score. The items were rated with “Yes” if they were clearly described. Otherwise, they were interpreted as insufficient and rated with “No”. A maximal score of 10 could be reached; higher scores indicated a lower risk of bias and higher methodological quality. Scores between six and eight were “good” and the scores above were “excellent”. If a study met less than five criteria, it was judged as “poor”. In the validation study by Cashin and McAuley, the inter-rater reliability of the PEDro scale was estimated to be fair to excellent (ICC range 0.53 to 0.91). Despite the potential variability in the reliability coefficients, the PEDro scale is a widely used and accepted tool for evaluating the methodological quality of clinical trials in physiotherapy [19].

Statistical analysis

On condition that at least two studies were available on a specific outcome, pooled analyses were conducted, using R software version 4.2.2 and the meta-package [23]. M and SD were calculated from median, range, interquartile range, minimum, maximum, and first or third quartile if necessary. At first, the M, sample size, and SD were outlined from the pre-and post-measurements of the MFR and control group. Based on these values, the confidence interval from 95% was calculated, if not described in the outcomes of the study. Furthermore, Cohen´s (d) was analyzed to evaluate the effect size and detect differences in the mean of the outcomes of the interventions [24]. Heterogeneity (I^2) was used to identify the diversity of the outcomes of the studies [25]. Additionally, the p-value was used to analyze if a statistical significance between the groups exists [26]. To provide a more adequate accounting for uncertainty when pooling treatment effects from a smaller number of heterogeneous studies, the Hartung-Knapp correction was used in this meta-analysis [27].

Results

Conducting an advanced literature search on the PubMed Database, we initially identified 66 articles. After thoroughly reviewing titles and abstracts, four articles that met the eligibility criteria were selected. The exclusion of 62 articles was based on technique-related factors or articles addressing specific pathologies or general unspecific pain. Google Scholar yielded 1700 results. After removing duplicates and screening titles and abstracts against eligibility

Table 1
PEDro Scale.

Study	Random allocation	Concealed allocation	Baseline Comparability	Blind subjects	Blind therapist	Blind assessors	Adequate follow-up	Intention to treat analysis	Between- group comparison	Point estimate and variability	Total (0 to 10)
Bakar et al. (2014)	Y	Y	Y	N	N	Y	N	Y	Y	Y	7/10
Brück & Jacobi (2021)	Y	Y	Y	N	N	Y	N	Y	Y	Y	7/10
Celenay & Kay (2016)	Y	Y	Y	Y	N	N	N	Y	Y	Y	7/10
El-Gendy & Lasheen et al. (2019)	Y	Y	Y	Y	N	N	N	Y	Y	Y	7/10
Gauns & Gurudut (2018)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	9/10
Namvar & Olyaei et al. (2016)	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	9/10
Retamal & Seijo et al. (2021)	Y	Y	Y	Y	N	Y	N	Y	Y	Y	8/10
Rodríguez-Fuentes et al. (2016)	Y	Y	Y	Y	N	N	Y	Y	Y	Y	8/10
Rodríguez-Huguet et al. (2018)	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8/10
Rodríguez-Huguet et al. (2020)	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8/10

criteria, six additional RCTs remained for inclusion in the meta-analysis. No compatible articles were identified from other sources. A detailed summary can be seen in the PRISMA-Flowchart (see Fig. 1):

Study characteristics

The articles were published between May 2014 and August 2021. All in all, 549 patients with chronic neck pain participated in the studies. The sample sizes varied between 34 and 96 participants. Participants' ages ranged from 18 to 69 with a mean value of 40 years. The gender distribution showed a higher number of females (65.63%). Three studies only assured equal distribution of gender but did not present the exact number [28, 29, 30]. The average duration of the treatment sessions was 23 minutes and varied between 10 to 45 minutes. The intervention and control group received between one to twelve treatment sessions. Some of the following interventions were applied in the control group: stability training, strength training, high-velocity low-amplitude techniques (HVLA), laser therapy, stretching, massage, electrotherapy, and manual therapy. One study included a cross-over of the groups. The first group did not receive any intervention, while MFR was applied in the second group. After two weeks the groups made a cross-over [28]. The studies included pre- and post-measurements in which the primary and secondary outcomes were taken directly before and after the intervention. Three articles provided a follow-up period from six days to one month [30,31,32]. Nine articles provided pain as the primary outcome, and six included the ROM of the cervical spine. Three articles dealt with PPT as the primary outcome [28,33,34], while three articles included PPT as the secondary outcome for the assessment of pain [30,38,37]. The clinical studies were conducted in private practices for physiotherapy or hospitals and healthcare centers and were executed by specialized physicians or physiotherapists.

Methodological quality

The total score for the rating of the risk of bias assessment and methodological quality of the ten RCTs ranged between seven to nine points, with a mean of 7.8 (see Table 1). Two studies received nine points and were classified as excellent [28,32]. The other studies were assigned as "good", as they gained a score between seven and eight points. The item with the lowest rating was the "Blinding of the therapist". One article met the criterion [32]. The outcomes of the studies were taken directly before and immediately after the intervention. An adequate follow-up period was sufficiently fulfilled in three articles [32,35,36]. The random and concealed allocation were met in all articles. Less than 10% of the participants were lost during the follow-up period. The statistical results of the between-group comparison reported more than one key outcome.

Table 2
Summary of included studies.

Study	Participants	Intervention	Primary Outcome (Mean/ Change from baseline)	Secondary Outcome (Mean/Change from baseline)	Follow-up		Outcome Measures
Bakar et al. (2014)	45 Age = 25-45	Ex = Myofascial Release 1 Treatment Sessions of 20 Min. Con = Massage 1 Treatment Sessions of 20 Min.	PPT right M. Sternocleidomastoid (SCM): Ex: − 0.6, Con: − 1,01 PPT left M. SCM Ex: − 1.12, Con: − 1.37	Electromyography biofeedback (EMG-BF) EMG-BF SCM right: Ex: 2.91, Con: - 2.04 EMG-BF SCM left: Ex: 2.14, Con: − 0.91	Pre- and post-Measurement, No follow-up	Pain = PPT, Function= Muscle relaxation response Follow-up = Pre- and Post-Measurement	Pain = PPT, Function= Muscle relaxation response Follow-up = Pre- and Post-Measurement
Brück & Jacobi (2021)	60 Age = 30-65	Ex = Myofascial Release 2 Treatment Session of 15-20 Min. Con1 = HVLA 2 Treatment Session of 15-20 Min. Con2 = No treatment	VAS: Ex: − 2.1, Con1: − 2.8, Con2: 0.0 ROM of the cervical spine: Flexion: Ex: 9.5, Con1: 6.7, Con2: 0.1 Extension: Ex: 11.1, Con1: 9.9, Con2: 0.5 Lateral flexion left: Ex: 9.2, Con1: 7.2 Con2: − 0.2 Lateral flexion right: Ex: 9.9, Con1: 4.8, Con2: 0.8 Rotation left: Ex:10.3, Con1: 8.8, Con2: 0.1 Rotation right: Ex: 8.9, Con1: 8.5, Con2: − 0.5	Neck Pain and Disability Scale (NPDS) NPDS: Ex: − 11.3, Con1: - 11.3, Con2: 1.1	Pre- and post-Measurement, No follow-up	Pain = VAS, Function = ROM, Neck Pain and Disability Scale Follow-up = Pre- and Post-Measurement	Pain = VAS, Function = ROM, Neck Pain and Disability Scale Follow-up = Pre- and Post-Measurement
Celenay, & Kaya (2016)	60 Age = 18-65	Ex = Myofascial Release, Stability Training 12 Treatment Sessions, 3 per week of 40-45Min. Con = Stability Training 12 Treatment Sessions, 3 per week of 40-45Min.	VAS Rest: Ex: − 2.52, Con: − 2.64 Activity: Ex: − 2.43, Con: 3.00 Night: Ex: − 3.45, Con: - 1.42 PPT M. Trapezius right: Ex: 2.34, Con: 0.38 M. Trapezius left: Ex: 2.75, Con: 0.46	Level of anxiety (SSTAI) State Anxiety: Ex: − 6.26, Con: − 2.27 Trait Anxiety: Ex: − 3.53, Con: − 1.44 Quality of life (SF-36) Physical component summary (PCS): Ex: 3.89, Con: 2.99 Mental component summary (MCS): Ex: 5.61, Con: 1.91	Pre- and post-Measurement, No follow-up	Pain = VAS, PPT, Level of Anxiety = SSTAI, Quality of Life = SF-36 Follow-up = Pre- and Post-Measurement	Pain = VAS, PPT, Level of Anxiety = SSTAI, Quality of Life = SF-36 Follow-up = Pre- and Post-Measurement
El-Gendy & Lasheen et al. (2019)	60 Age = 18-40	Ex = Myofascial Release, Stretching, Strength training 12 Treatment Sessions, 3 per week Con1 = Electrotherapy (Low level laser, ultrasound), Stretching, Strength	VAS: Ex: − 3.25, Con1: − 3.15, Con2: − 1.55 ROM of the cervical spine: Flexion: Ex: 12.75, Con1: 12.95, Con2: 2.65 Extension: Ex: 13.1, Con1: 11.85, Con2: 2.55 Lateral flexion right: Ex:	Neck Disability index (NDI) Ex: − 9.23, Con1: − 9.3, Con2: − 2.9	Pre- and post-Measurement, No follow-up	Pain = VAS, Function = ROM, Neck Disability Index (NDI) Follow-up = Pre- and Post-Measurement	Pain = VAS, Function = ROM, Neck Disability Index (NDI) Follow-up = Pre- and Post-Measurement

Table 2 (*Continued*)

Study	Participants	Intervention	Primary Outcome (Mean/ Change from baseline)	Secondary Outcome (Mean/Change from baseline)	Follow-up		Outcome Measures
		training 12 Treatment Sessions, 3 per week Con2 = Stretching, Strength training 12 Treatment Sessions, 3 per week	10.6, Con1: 11.65, Con2: 4.8 Lateral flexion left: Ex: 10.05, Con1: 9.00, Con2: 4.65 Rotation right Ex: 14.0, Con1: 16.0, Con2: 5.25 Rotation left: Ex: 10.5, Con1: 11.5, Con2: 3.0				
Gauns & Gurudut (2018) **Namvar & Olyaei et al. (2016)**	40 Age = 20-50 34 Age = 18-55	Ex = Myofascial Release 15 Min, Conventional Treatment: Hot moist pack 20 Min. TENS 15Min. Stretching, strengthening 15Min. 1 Treatment Session Con = Conventional treatment 1 Treatment Session of 50 Min. Ex = Myofascial Release 4 Treatment Sessions of 20 Min. Con = No Treatment	ROM of the cervical spine: Lateral flexion: Ex: 15.11, Con: 4.32 Rotation: Ex: 17.67, Con: 4.37 VAS: Ex: − 3.41, Con: 0.11 PPT M. Trapezius right: Ex: - 5.56, Con: 0,23	Disability of arm shoulder and hand questionnaire (DASH- Score): Ex: 25.06, Con: 4.37 Extension Power: Ex: - 2.57, Con: - 0.23 NDI: Ex: − 24, Con: − 2,6	Pre- and post-Measurement, 6 days Pre- and post-Measurement, No follow-up	Function = ROM, DASH-Score Follow-up = Pre- and Post-Measurement + 6 days Pain = VAS, PPT, Function = Extension Power, NDI Follow-up = Pre- and Post-Measurement	Function = ROM, DASH-Score Follow-up = Pre- and Post-Measurement + 6 days Pain = VAS, PPT, Function = Extension Power, NDI Follow-up = Pre- and Post-Measurement
Retamal & Seijo et al. (2021)	96 Age = 18-40	Ex = Myofascial Release 2 Treatment Sessions of 10 Min. Con1 = Instrumental Myofascial Release 2 Treatment Sessions of 10 Min. Con2 = Instrumental Myofascial Release, Upper Cervical Manipulation 2 Treatment Sessions of 10 Min.	ROM of the cervical spine Flexion: Ex: 2.52, Con1: 1.00, Con2: 2.12 Extension: Ex: 1.87, Con1: 1.00, Con2: 2.21 Rotation right: Ex: 2.9, Con1: 2.97, Con2: 2.11 Rotation left: Ex: 1.84, Con1: 2.83, Con2: 2.68 Lateral flexion right: Ex: 1.13, Con1: 0.9, Con2: 1.17 Lateral flexion left: Ex: 1.26, Con1: − 0.47, Con2: 1.95 VAS (active) Flexion: Ex: − 0.27, Con1: 0.15, Con2: − 0.68 Extension: Ex: - 0.75, Con1: 0.19, Con2: − 1.09	PPT Suboccipital right: Ex: 0.18, Con1: 0.20, Con2: 0.17 Suboccipital left: Ex: 0.22, Con1: 0.23, Con2: 0.16 M. Trapezius right: Ex: 0.08, Con1: 0.15, G3: 0.00 M. Trapezius left: Ex: 0.08, Con1: 0.09, Con2: 0.00 NDI: Ex: − 2.52, Con1: − 2.33, Con2: − 3.47	Pre- and post-Measurement, 2 weeks	Pain= VAS, PPT, Function = ROM, NDI Follow-up = Pre- and Post-Measurement + 2 weeks	Pain= VAS, PPT, Function = ROM, NDI Follow-up = Pre- and Post-Measurement + 2 weeks

Table 2 (*Continued*)

Study	Participants	Intervention	Primary Outcome (Mean/ Change from baseline)	Secondary Outcome (Mean/Change from baseline)	Follow-up		Outcome Measures
			Rotation right: Ex: – 0.58, Con1: – 0.03, Con2: – 0.63 Rotation left: Ex: – 0,52, Con1: – 0.22, Con2: – 0.83 Lateral flexion right: Ex: – 0.78, Con1: – 0.54, Con2: – 1.14 Lateral flexion left: Ex: - 0.06, Con1: - 0.45, Con2: – 1.19				
Rodríguez-Fuentes et al. (2016)	59 Age = 18-69	Ex = Myofascial Release 10 Treatment Sessions of 15 Min Con = Manual Therapy 10 Treatment Sessions of 15 Min	VAS: Ex: – 1.5, Con: - 3.62 ROM of cervical spine Flexion: Ex:3.3, Con: 8.14 Extension: Ex: 4.24, Con: 7.41 Lateral Flexion right: Ex: 2.97, Con: 6.24 Lateral Flexion left: Ex: 4.07, Con: 7.17 Rotation right: Ex: 4.14, Con: 9.17 Rotation left: Ex: 6.17, Con: 11.48	SF-36 PSC: Ex: 1.99, Con: 6.41 MSC: Ex: 1.43 Con: 11.52 Costovertebral (C-V) Angle: Ex: 2.83, Con: 5.0 NDI: Ex: – 4.65, Con: – 11.53	Pre- and post-Measurement, 5 weeks	Pain = VAS, Function = ROM, NDI, Craniovertebral Angle, Quality of Life = SF-36, Follow-up = Pre- and Post-Measurement + 5 weeks	Pain = VAS, Function = ROM, NDI, Craniovertebral Angle, Quality of Life = SF-36, Follow-up = Pre- and Post-Measurement + 5 weeks
Rodríguez-Huguet et al. (2018)	41 Age = 20-60	Ex = Myofascial Release 5 Treatment Sessions of 45Min. Con = Multimodal Physiotherapy: Ultrasound 10 Min. TENS 20 Min. Massage 20Min. 5 Treatment Sessions	VAS: Ex: - 4.75, Con: - 3.76	PPT Suboccipital right: Ex: 0.76, Con: 0.36 Suboccipital left: Ex: 0.63, Con: 0.35 M. Trapezius right: Ex: 0.73, Con: 0.35 M. Trapezius left: Ex: 0.68, Con: 0.43	Pre- and post-Measurement, 4 weeks	Pain = VAS, PPT Follow-up = Pre- and Post-Measurement + 4 weeks	Pain = VAS, PPT Follow-up = Pre- and Post-Measurement + 4 weeks

Table 2 (*Continued*)

Study	Participants	Intervention	Primary Outcome (Mean/Change from baseline)	Secondary Outcome (Mean/Change from baseline)	Follow-up		Outcome Measures
Rodriguez-Huguet et al. (2020)	54 Age = 20-60	Ex = Myofascial Release 5 Treatment Sessions of 45Min. Con = Multimodal Physiotherapy: Ultrasound 10 Min. TENS 20 Min. Massage 20Min. 10 Treatment Sessions	VAS: Ex: − 4.82, Con: − 3.78 ROM of cervical spine Flexion: Ex: 11.26, Con: 12.11 Extension: Ex: 11.70, Con: 12.85 Lateral flexion left: Ex: 6.48, Con: 7.00 Lateral flexion right: Ex: 10.85, Con: 10.33 Rotation right: Ex: 8.63, Con: 5.26 Rotation left: Ex: 9.15, Con: 5.33	PPT Suboccipital left: Ex: 0.62, G2: 0.41 Suboccipital right: Ex: 0.72, Con: 0.41 Thoracic left: Ex: 0.63, Con: 0.49 Thoracic right: Ex: 0.72, Con: 0.41	Pre- and post-Measurement, 4 weeks	Pain = VAS, PPT Function = ROM Follow-up = Pre- and Post-Measurement + 4 weeks	Pain = VAS, PPT Function = ROM Follow-up = Pre- and Post-Measurement + 4 weeks

Ex= Experimental Group; Con= Control Group, Con1 = Control Group 1; Con2 = Control Group 2

Effects on the outcome domains

Pain

In our examination of pain outcomes extracted from seven RCTs involving 368 participants, a significant difference emerged (d= −1.15, 95% CI = [−2.11 to 0.2], p = 0.03) with a calculated mean difference (MD) of −1.15 on the pain rating scale (see Fig. 2). A sensitivity analysis was conducted, excluding the Namvar et al. study, which uniquely compared myofascial release with no treatment. Despite the exclusion of this study, the results retained statistical significance (p = 0.04) and exhibited a substantial effect size (d= 0.86, 95% CI= [−1.64 to −0.09]), underscoring the robustness of our findings.

Pressure pain threshold

The PPT was measured at the trapezius and the suboccipital areas on the left and the right side. The results of five RCTs with 285 participants were analyzed. A medium overall effect was shown at the left trapezius, 230 participants were included (d = 0.59, 95%CI = [−0.24 to 1.41], $p = 0.12$). The PPT of the right trapezius was evaluated with the data of 254 participants and represented in four RCTs. There was a medium overall effect size with a non-significant difference (d = 0.50, 95%CI = [0.48 to 1.47], $p = 0.20$). Three studies manifest a significant difference on both sides. Four RCTs were included for the evaluation of the PPT of the suboccipital area (N = 205). There was no overall effect and significant difference regarding the right (d = 0.17, 95%CI = [−0.84 to 1.19], $p = 0.62$) and left (d = 0.11, 95%CI = [−0.66 to 0.88], $p = 0.68$) suboccipital area (see Fig. 3).

Range of motion

Five RCTs provided results including rotation and lateral flexion to the right. The outcomes of 318 participants were included in the evaluation. Lateral flexion to the right showed a significant difference between the groups and a medium effect size (d = 0.68, 95%CI = [0.04 to 1.32], $p = 0.04$) as well as the rotation to the right (d = 0.52, 95%CI = [−0.01 to 1.05], $p = 0.05$). Four RCTs provided results of the degree of flexion, extension, rotation, and lateral flexion to the left. 270 participants were included in the assessment. Four studies were included for the evaluation of the ROM in flexion of which two studies showed significant differences. One favoring the MFR and one favoring the control group. All in all, there was no significant difference and a medium overall effect (d = 0.70, 95%CI = [−0.36 to 1.77], $p = 0.15$). The in-between group comparison of extension based on four studies showed a medium overall effect and was rated as non-significant (d = 0.54, 95%CI = [−0.54 to 1.62], $p = 0.24$). Similarities were found in four studies, that provided the outcomes of rotation to the left (d = 0.26, 95%CI = [−0.54 to 1.05], $p = 0.42$) and lateral flexion to the left (d = 0.48, 95%CI = [−0.21 to 1.16], $p = 0.12$). There was no identification of significant

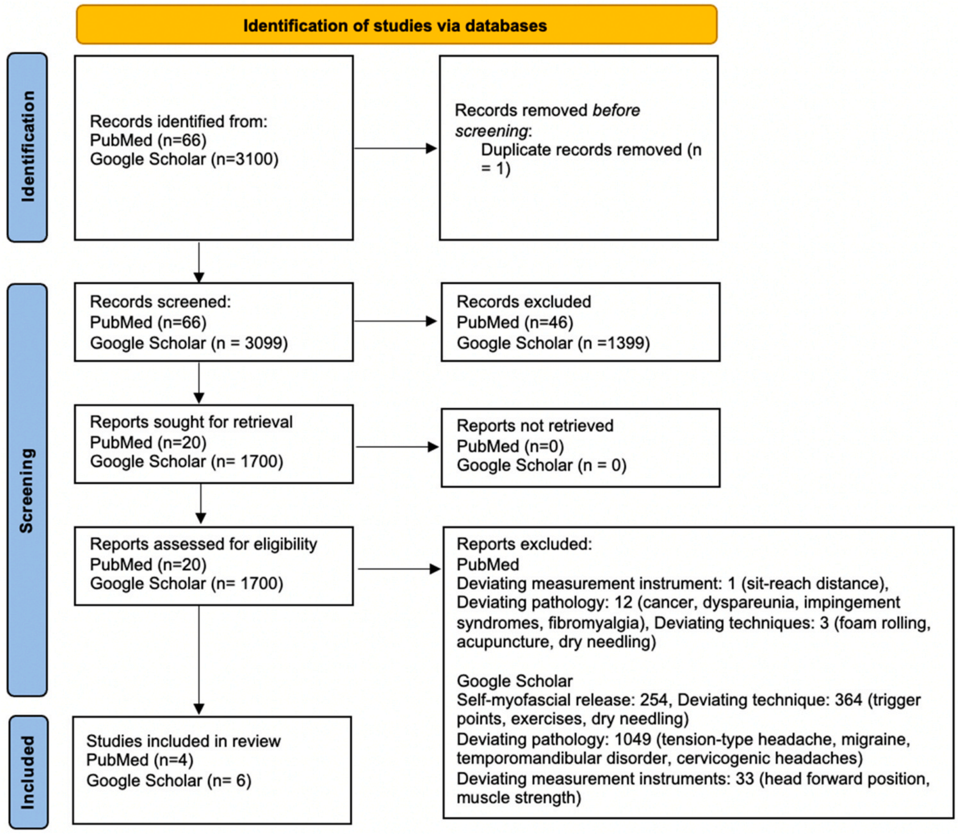

Fig. 1. PRISMA- Flowchart of literature search.

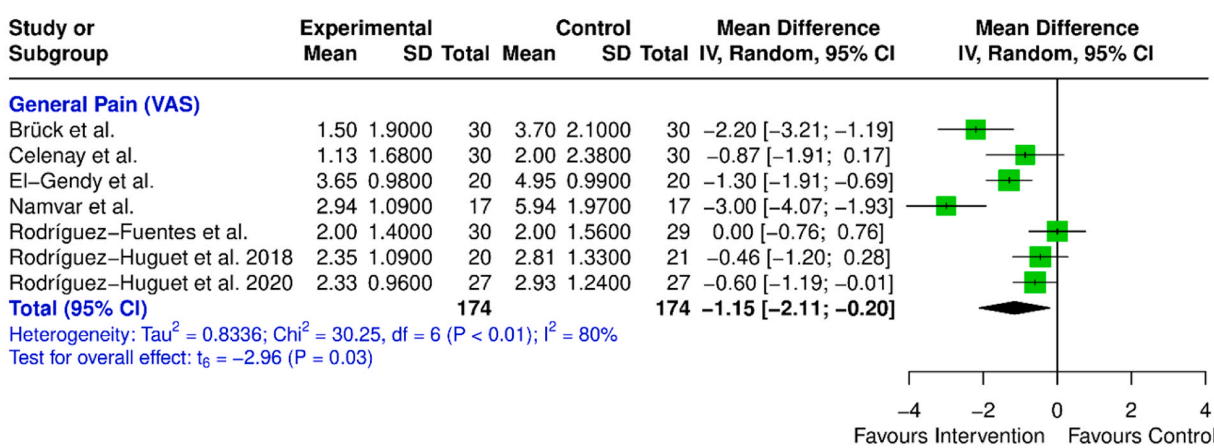

Fig. 2. Results of a meta-analysis of VAS.

differences and a small overall effect size between the control and MFR group (see Fig. 4).

Discussion

This meta-analysis provides a comprehensive assessment of MFR efficacy in managing chronic neck pain, drawing evidence from ten RCTs. The results highlight a significant reduction in pain, reflected in VAS scores. However, findings for PPT and ROM were inconclusive. In contrast to Guo et al.'s study (2023), which reported no significant differences in ROM, our meta-analysis identified slight significance, in lateral flexion and rotation to the right, though with slight variances (0.04 and 0.05, respectively) [39]. These marginal changes, especially the 0.03 minimal difference in VAS, may not be perceptible to patients, underscoring the importance for clinicians to

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Std. Mean Difference IV, Random, 95% CI
Pressure Pain Threshold suboccipital right							
Bakar et al.	13.76	3.3400	23	15.73	4.2400	22	−0.52 [−1.11; 0.08]
Retamal et al.	1.76	0.5700	31	1.90	0.7900	34	−0.20 [−0.69; 0.29]
Rodríguez–Huguet et al. 2018	2.17	0.7300	20	1.69	0.4000	21	0.82 [0.18; 1.46]
Rodríguez–Huguet et al. 2020	1.99	0.7300	27	1.62	0.3900	27	0.63 [0.09; 1.18]
Total (95% CI)			**101**			**104**	**0.17 [−0.84; 1.19]**
Heterogeneity: $Tau^2 = 0.3195$; $Chi^2 = 14.05$, df = 3 (P < 0.01); $I^2 = 79\%$							
Test for overall effect: $t_3 = 0.55$ (P = 0.62)							
Pressure Pain Threshold suboccipital left							
Bakar et al.	14.64	3.5900	23	15.81	4.6700	22	−0.28 [−0.87; 0.31]
Retamal et al.	1.67	0.5400	31	1.86	0.6800	34	−0.31 [−0.80; 0.18]
Rodríguez–Huguet et al. 2018	1.98	0.6500	20	1.65	0.4300	21	0.60 [−0.03; 1.23]
Rodríguez–Huguet et al. 2020	1.84	0.6200	27	1.59	0.4000	27	0.48 [−0.06; 1.02]
Total (95% CI)			**101**			**104**	**0.11 [−0.66; 0.88]**
Heterogeneity: $Tau^2 = 0.1512$; $Chi^2 = 8.62$, df = 3 (P = 0.03); $I^2 = 65\%$							
Test for overall effect: $t_3 = 0.45$ (P = 0.68)							
Pressure Pain Threshold M. Trapezius right							
Celenay et al.	10.08	4.3500	30	6.29	2.7400	30	1.04 [0.50; 1.58]
Retamal et al.	1.55	0.4600	31	1.79	0.8300	34	−0.35 [−0.84; 0.14]
Rodríguez–Huguet et al. 2018	2.52	0.7700	20	2.03	0.5700	21	0.73 [0.09; 1.36]
Rodríguez–Huguet et al. 2020	2.35	0.7500	27	1.94	0.5500	27	0.62 [0.08; 1.17]
Total (95% CI)			**108**			**112**	**0.50 [−0.48; 1.47]**
Heterogeneity: $Tau^2 = 0.3062$; $Chi^2 = 16.03$, df = 3 (P < 0.01); $I^2 = 81\%$							
Test for overall effect: $t_3 = 1.63$ (P = 0.20)							
Pressure Pain Threshold M. Trapezius left							
Celenay et al.	9.80	3.9000	30	6.20	2.9600	30	1.04 [0.50; 1.58]
Namvar et al.	35.41	7.2000	17	27.17	4.1700	17	1.40 [0.65; 2.16]
Retamal et al.	1.60	0.4700	31	1.81	0.7100	34	−0.35 [−0.84; 0.14]
Rodríguez–Huguet et al. 2018	2.43	0.7500	20	2.03	0.5900	21	0.59 [−0.03; 1.22]
Rodríguez–Huguet et al. 2020	2.21	0.7400	27	1.95	0.5500	27	0.40 [−0.14; 0.94]
Total (95% CI)			**125**			**129**	**0.59 [−0.24; 1.41]**
Heterogeneity: $Tau^2 = 0.3519$; $Chi^2 = 20.93$, df = 4 (P < 0.01); $I^2 = 81\%$							
Test for overall effect: $t_4 = 1.98$ (P = 0.12)							

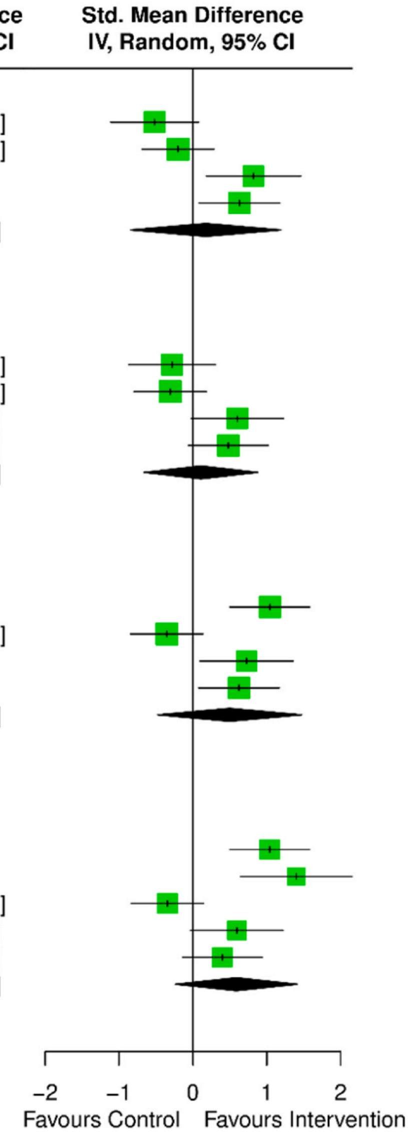

Fig. 3. Results of a meta-analysis of pressure pain threshold.

consider the minimal clinically important difference within the specific population under study. The observed significance in pain outcomes compared to the non-significant findings in PPT and ROM prompts careful consideration. Limited trials focusing on PPT may contribute to the absence of significant differences, raising questions about the clinical relevance of MFR for enhancing neck mobility, particularly given the heterogeneity in interventions. The incorporation of diverse interventions, such as a multimodal approach combining MFR with stability training, as demonstrated by previous studies, introduces clinical relevance but complicates the interpretation of results. The combined approach makes it challenging to isolate the specific effects of MFR alone [29,34]. Despite good-to-excellent methodological quality (see Table 1), inconsistency between studies prompts a critical analysis of observed effects and their clinical significance. Treatment modality variations in control groups contribute to observed heterogeneity, necessitating more homogeneous study designs for enhanced outcome comparability. Additionally, the absence of blinding, except for Gauns & Gurudut (2018), introduces complexity, warranting careful consideration of potential biases, as seen in other systematic reviews [14].

Chronic pain is a pervasive healthcare problem in industrialized countries and is associated with high societal and individual costs [8,38]. Prolonged diagnostic processes remain a common burden, while conventional treatment modalities such as surgeries and medications, including opioids and analgesics, continue to be utilized

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Std. Mean Difference IV, Random, 95% CI
Flexion							
Brück et al.	52.70	12.1000	30	46.70	10.8000	30	0.52 [0.01; 1.04]
El–Gendy et al.	57.40	3.7400	20	48.55	4.1400	20	2.24 [1.44; 3.04]
Retamal et al.	60.71	11.2800	31	60.12	11.8000	34	0.05 [−0.44; 0.54]
Rodríguez–Fuentes et al.	44.00	3.8900	30	40.00	6.2400	29	0.77 [0.24; 1.30]
Rodríguez–Huguet et al. 2020	63.15	7.9200	27	62.15	8.1200	27	0.12 [−0.41; 0.66]
Total (95% CI)			**138**			**140**	**0.70 [−0.36; 1.77]**
Heterogeneity: $Tau^2 = 0.6009$; $Chi^2 = 24.35$, df = 4 ($P < 0.01$); $I^2 = 84\%$							
Test for overall effect: $t_4 = 1.83$ ($P = 0.14$)							
Extension							
Brück et al.	61.20	12.6000	30	54.30	10.3000	30	0.60 [0.08; 1.12]
El–Gendy et al.	67.65	5.6700	20	57.05	4.1900	20	2.13 [1.34; 2.91]
Retamal et al.	67.74	10.5000	31	66.15	18.9000	34	0.10 [−0.38; 0.59]
Rodríguez–Fuentes et al.	45.00	2.3400	30	45.00	7.7800	29	0.00 [−0.51; 0.51]
Rodríguez–Huguet et al. 2020	58.81	9.2700	27	58.30	7.3800	27	0.06 [−0.47; 0.59]
Total (95% CI)			**138**			**140**	**0.54 [−0.54; 1.62]**
Heterogeneity: $Tau^2 = 0.6168$; $Chi^2 = 24.51$, df = 4 ($P < 0.01$); $I^2 = 84\%$							
Test for overall effect: $t_4 = 1.39$ ($P = 0.24$)							
Rotation right							
Brück et al.	63.70	10.5000	30	56.20	11.6000	30	0.68 [0.16; 1.20]
El–Gendy et al.	69.75	6.5800	20	60.00	6.6800	20	1.47 [0.77; 2.17]
Gauns & Gurudut	66.61	12.2300	20	59.59	7.9300	20	0.68 [0.04; 1.32]
Retamal et al.	70.64	9.0000	31	68.73	6.9600	34	0.24 [−0.25; 0.73]
Rodríguez–Fuentes et al.	72.00	5.4500	30	69.00	10.9100	29	0.35 [−0.16; 0.86]
Rodríguez–Huguet et al. 2020	70.63	8.5400	27	71.15	6.2200	27	−0.07 [−0.60; 0.46]
Total (95% CI)			**158**			**160**	**0.52 [−0.01; 1.05]**
Heterogeneity: $Tau^2 = 0.1551$; $Chi^2 = 13.81$, df = 5 ($P = 0.02$); $I^2 = 64\%$							
Test for overall effect: $t_5 = 2.52$ ($P = 0.05$)							
Rotation left							
Brück et al.	61.60	11.2000	30	55.70	7.7000	30	0.61 [0.10; 1.13]
El–Gendy et al.	65.50	6.6200	20	58.25	5.4400	20	1.20 [0.52; 1.87]
Retamal et al.	68.65	9.3300	31	71.47	9.1400	34	−0.31 [−0.80; 0.18]
Rodríguez–Fuentes et al.	70.00	7.0100	30	68.00	8.5800	29	0.26 [−0.26; 0.77]
Rodríguez–Huguet et al. 2020	68.63	9.6000	27	71.78	8.0000	27	−0.36 [−0.89; 0.18]
Total (95% CI)			**138**			**140**	**0.26 [−0.54; 1.05]**
Heterogeneity: $Tau^2 = 0.3179$; $Chi^2 = 19.05$, df = 4 ($P < 0.01$); $I^2 = 79\%$							
Test for overall effect: $t_4 = 0.91$ ($P = 0.42$)							
Lateral flexion right							
Brück et al.	36.20	6.5000	30	31.50	6.7000	30	0.71 [0.19; 1.23]
El–Gendy et al.	47.05	5.4400	20	41.50	4.0900	20	1.15 [0.48; 1.83]
Gauns & Gurudut	47.39	10.7300	20	43.32	9.4500	20	0.40 [−0.22; 1.03]
Retamal et al.	42.87	5.5300	31	40.59	9.6900	34	0.29 [−0.20; 0.77]
Rodríguez–Fuentes et al.	44.00	2.3400	30	38.00	4.6800	29	1.63 [1.04; 2.22]
Rodríguez–Huguet et al. 2020	48.63	7.7800	27	48.93	8.3200	27	−0.04 [−0.57; 0.50]
Total (95% CI)			**158**			**160**	**0.68 [0.04; 1.32]**
Heterogeneity: $Tau^2 = 0.2868$; $Chi^2 = 21.81$, df = 5 ($P < 0.01$); $I^2 = 77\%$							
Test for overall effect: $t_5 = 2.71$ ($P = 0.04$)							
Lateral flexion left							
Brück et al.	38.20	9.3000	30	31.00	7.4000	30	0.86 [0.33; 1.39]
El–Gendy et al.	46.90	6.9100	20	41.40	3.1800	20	1.02 [0.36; 1.68]
Retamal et al.	46.77	9.3600	31	48.24	7.4600	34	−0.17 [−0.66; 0.31]
Rodríguez–Fuentes et al.	42.00	4.6700	30	38.00	5.4600	29	0.79 [0.26; 1.32]
Rodríguez–Huguet et al. 2020	47.96	7.0000	27	48.11	7.5300	27	−0.02 [−0.55; 0.51]
Total (95% CI)			**138**			**140**	**0.48 [−0.21; 1.16]**
Heterogeneity: $Tau^2 = 0.2262$; $Chi^2 = 15.98$, df = 4 ($P < 0.01$); $I^2 = 75\%$							
Test for overall effect: $t_4 = 1.94$ ($P = 0.12$)							

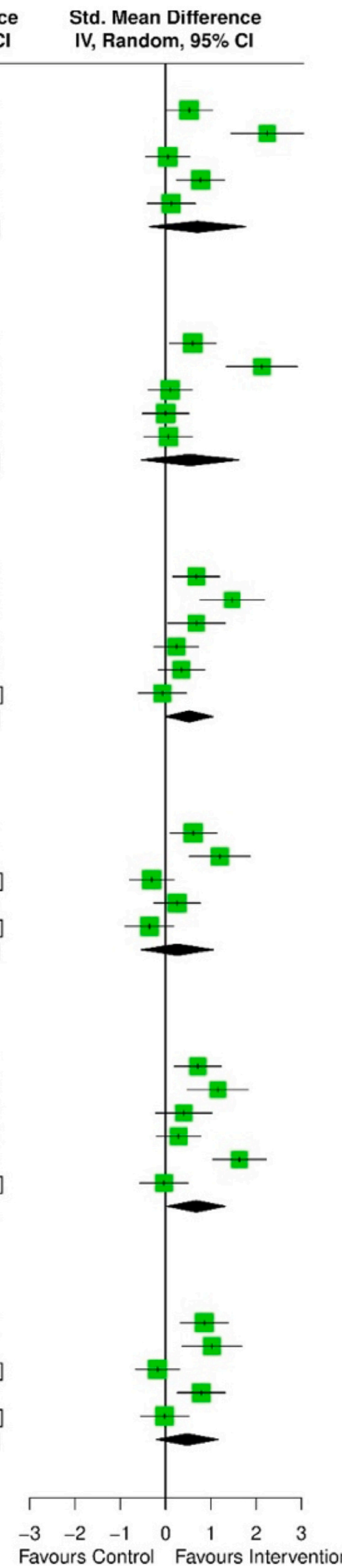

Fig. 4. Results of a meta-analysis of different range of motion outcomes.

despite limited evidence supporting their long-term efficacy and cost-effectiveness [8]. In contrast, MFR offers advantages regarding time efficiency and the absence of specialized equipment required, potentially contributing to cost reduction [31].

This study proposes that MFR may be an effective treatment for chronic neck pain. Nevertheless, definitive evidence supporting MFR treatments for chronic neck pain is lacking due to the existing shortage of studies, underscoring a significant scientific gap. Subsequent investigations should prioritize identifying independent predictors, conducting direct comparisons with established therapies, standardizing MFR protocols for enhanced reproducibility, and assessing long-term effects to foster a more comprehensive understanding of its efficacy.

Funding Statement & Competing Interest

The research leading to these results has not received funding.

There was no declaration of interest in the form of financial competition or personal relationships, that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.physio.2023.12.002.

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