BMC Musculoskeletal Disorders

SYSTEMATIC REVIEW

Open Access

The effect of friction massage on pain intensity, PPT, and ROM in individuals with myofascial trigger points: a systematic review

Mehrdad Sadeghnia[1], Mehrnaz Kajbafvala[2] and Azadeh Shadmehr[3*]

Abstract

Introduction Friction massage (FM) is a conservative treatment for managing myofascial trigger points (MTrPs). Although many studies have demonstrated the effects of FM, this manual technique significantly loads the therapist's hands. Therefore, there is a need to evaluate FM compared to other physical therapy methods to help clinicians choose the best one.

Objective This systematic review aimed to investigate the effect of FM on pain intensity, pressure pain threshold (PPT), and joint range of motion (ROM) in individuals with MTrPs.

Methods PubMed/Medline, Scopus, Web of Science, Science Direct, and Google Scholar were searched from inception to 15 April 2024. All randomized control and clinical trials that assessed the effect of FM on pain intensity, PPT, and joint ROM in individuals with MTrPs were included.

Results Twelve studies were included. The within-group results showed that FM could significantly improve pain intensity, PPT, and joint ROM, but compared to the control group, there was no significant superiority for improving pain intensity and PPT, and the results were inconclusive for the effect of FM on joint ROM improvement because of controversial findings.

Conclusion In the short term, there is level C evidence indicating that FM may effectively reduce VAS and the PPT of MTrPs in upper trapezius. Nonetheless, high-quality and long-term research is needed to address improvements in ROM and NPRS. Due to nature of level C evidence, future well-designed RCTs should overcome the existing limitations using adequate sample sizes, long intervention periods, and long-term follow-up.

Keywords Friction massage, Trigger point, Myofascial pain, Review

*Correspondence:
Azadeh Shadmehr
shadmehr@tums.ac.ir
[1]Department of Physiotherapy, School of Medical Sciences, Tarbiat Modares University, Tehran, Iran
[2]Iranian Center of Excellence in Physiotherapy, Rehabilitation Research Center, Department of Physiotherapy, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran
[3]Department of Physiotherapy, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran

Introduction

A myofascial trigger point (MTrP) is a hypersensitive nodule usually found in the taut band of the skeletal muscle or fascia with a local twitch response which produces localized pain in or around the affected muscles [1]. Myofascial trigger points (MTrPs) are classified into two categories: active and latent trigger points. The active trigger point causes pain at rest but the latent one just produces pain at manual examination. Active trigger points play a role in initiating muscle cramps, limiting range of motion (ROM), inducing muscle weakness, and causing fatigue [2]. The integrated trigger hypothesis, as proposed by Simons, encompasses an "energy crisis" resulting from localized damage due to repetitive microtrauma. This trauma prompts the release of additional acetylcholine, contributing to persistent muscle fiber contraction in the vicinity of an abnormal motor endplate. Consequently, this sustained contraction places elevated metabolic requirements on the area and exerts excessive pressure on capillary circulation. This diminished blood flow causes the sarcomeres to become locked in a state of hypercontraction [3, 4].

The prevalence of MTrPs has been documented with different occurrence rates, ranging from 10 to 18%, and a lifetime incidence of 30–50% [5]. Additionally, it has been noted that MTrPs are present in 45% of individuals referred to pain clinics and in 95% of patients experiencing chronic pain [6].

Some evidence has demonstrated the effectiveness of consensus clinical strategies for MTrPs including friction massage, dry needling, myofascial release, ultrasound therapy, extracorporeal shock wave therapy, and ischemic compression techniques [1, 7, 8]. Friction massage (FM) is recommended as a traditional conservative treatment for addressing MTrPs. Ciriax et al. at first, presented FM technique in 1992 [9, 10]. The therapeutic mechanisms of FM include equalizing the length of sarcomeres and making hyperemia in the MTrP region. In addition, pain gate theory and a spinal reflex theory that relieves muscle spasms are noted [11].

Several studies reported the efficacy of FM on improving pain, ROM, and pressure pain threshold (PPT) [9, 11, 12]. A clinical trial showed that subjects with MTrPs benefit from the immediate effects of deep transverse friction massage with ischemic pressure on upper trapezius trigger points in terms of improvement in pain intensity and pressure pain threshold (PPT). However, no significant difference was shown between groups [13].

Although there is strong evidence that FM is beneficial for individuals with MTrPs, no systematic review has yet investigated the efficacy of FM on MTrPs. Considering the load applied to the physical therapist's hands, there is a need to compare the effects of FM with other physical therapy treatments to better understand the applicability and effectiveness of FM on MTrPs. Therefore, this systematic review was conducted to clarify the effect of FM on pain intensity, PPT, and ROM in individuals with MTrPs.

Methods

Identifying and selecting studies

Eligibility criteria

The current systematic review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guideline [14]. This review includes randomized control Trials (RCTs), and clinical trials on subjects who suffered from MTrPs in neck, upper back, lower back, hip, knee, shoulder muscles and underwent FM treatment protocols. All studies assessed pain intensity, PPT, and joint ROM as the main outcomes.

Search strategy

Electronic databases PubMed/Medline (NLM), Scopus, Science Direct, Web of Science (WoS), Google Scholar were searched from inception to 15 April 2024, and the search was subsequently updated to 9 November 2024. Other databases, including ProQuest and World Wide Science, were searched for gray literature. Furthermore, the reference list of included studies was checked for other relevant studies. The combination of the following keywords "friction", "trigger point", "myofascial pain", "deep friction", "cross friction", and "transverse friction", was used. Supplementary 1 lists the complete search strategy in PubMed.

Study selection and data extraction

Studies assessing the effect of FM on tennis elbow and pelvic floor muscles were not included. Non-randomized control trial, non-clinical trial designs, reviews, cross-sectional studies, case series, and commentaries were excluded.

In the first stage, the titles and abstracts of all retrieved studies were imported into EndNote X9.1 software and then screened by two independent reviewers (MS, MK), and all unrelated publications were ruled out. In the second stage, the full texts of all selected articles were assessed regarding the eligibility criteria by the same reviewers. In addition, two reviewers (MS, MK) executed the data extraction according to the objectives and population, intervention, outcomes, and study design criteria of the review independently. Any disagreements between the reviewers were resolved through discussion session with the third reviewer (AS). The following information was extracted from the included studies: authors, publication year, country, study design, participant, intervention, outcome measures, and main results.

Risk of bias assessment

The methodological quality of included studies based on PEDro scale items was assessed by two independent reviewers (MS, MK). The PEDro scale is defined as a reliable and valid measure of the methodological quality of clinical trials which evaluates 11 domains: Items 2–9 show the internal validity of the article, and items 10 and 11 provide the quality of statistical information. Item 1 demonstrated the trial's external validity and is not included in the total score. For each item, the answer must be either yes or no [15].

Results

The flowchart of PRISMA (Fig. 1) illustrates the studies' selection process. A total of 3570 studies were recovered from all proposed databases. After screening the titles and abstracts, duplicate and non-relevant articles ($n = 2265$) were excluded. The eligibility of 30 full-text articles was assessed. Several studies were excluded based on specific criteria. One study did not address the main target. Eleven studies did not use FM on trigger points, instead adopting a more generalized approach. Two studies evaluated the effect of other treatment methods as the main treatment, although both groups also received FM. Additionally, one study lacked the design of a randomized clinical trial. One study presented discrepancies between the reported results and the data in the tables. Another study included three groups undergoing various treatments, along with different adjunctive therapies, which made comparisons challenging. Furthermore, two studies had only English abstracts available, with full texts in another language. Consequently, 12 trials demonstrating the relationship between FM and the changes in pain intensity, PPT, and ROM in individuals with MTrPs were included in the current systematic review [9, 11, 12, 16–24].

Study characteristics

The current systematic review was conducted to summarize the effect of FM on pain intensity [9, 11, 16, 19, 20, 22, 23], PPT [9, 11, 17, 20, 22–24], and ROM [11, 16, 18, 19, 21–23] in individuals with MTrPs.

The included studies had a total of 480 subjects of both genders, diagnosed with mechanical neck pain, subacromial syndrome, mechanical low back pain, quadratus lumborum strain, and hamstring tightness, all with MTrPs, and the age ranged from 18 to 68 years. The following information was extracted from the included studies: authors, publication year, country, sample size, diagnosis, type of trigger points, involved muscles, type and dosage of intervention, outcomes and measurements used, and study results (Table 1).

Type of trigger points and involved muscles

Most studies worked on active trigger points [11, 12, 16, 18–22, 24], two studies considered latent trigger points [17, 23], and one study applied FM on both active and latent trigger points [9]. The involved muscles that were targeted for treatment in the studies were: the upper trapezius [9, 11, 12, 16, 17, 19, 22], supraspinatus [12, 16], rhomboids [12], splenius capitis [12], splenius cervicis [12], scalene [19], gluteus medius [20, 24], sternocleidomastoid [19], infraspinatus [16], subscapularis [16], levator scapula [16], iliopsoas [18], quadratus lumborum [18, 21, 23], hamstrings [23], and gastrocnemius [23].

Treatment protocol characteristics

The intervention duration varied from immediately after treatment to one month, with a weekly frequency of 1 to 6 times and sessions of 1 to 3 min, and more than 12 weeks follow-up (Tables 1 and 2.

Different treatment protocols were used in the studies consisting FM alone as a treatment of intervention group [9, 11, 16–18, 21, 22], and a combination of FM and other treatment protocols (Hot pack, traditional physical therapy (stretching of gluteus medius, proprioceptive neuromuscular facilitation (PNF)) [12, 19, 20, 23]. Comparator interventions were ischemic compression [9, 12], kinesio tape [17], dry needling [16], positional release technique (PRT) [18, 20, 21], high-power pain threshold ultrasound [11, 22], whole body vibration [11], static stretching [19] and PNF [23].

Methodological quality of RCTs

The quality assessment based on the PEDro scale is presented in Table 3. Of 12 trials, Six studies had good quality [9, 11, 17, 22, 23], four studies had fair quality [12, 18, 19, 21], and two studies had poor quality [20].

Blinding of subjects were absent in all included studies. In addition, adequate follow up, intention to treat and between-group statistical comparisons were scored positive in majority of included studies.

Quality of evidence

Three experts conducted a thorough critical analysis of the selected publications, classifying them based on criteria adapted from the guidelines established by the European Federation of Neurological Societies [25, 26]. The studies were divided into four categories (I–IV), representing a descending hierarchy of evidence quality. To evaluate the effectiveness of FM on trigger points, the experts compared their classifications, reached a consensus, and assigned evidence levels (A to C), excluding studies categorized as Class IV.

Regarding grading of the "level of evidence", we always considered recommendations for a specific indication.

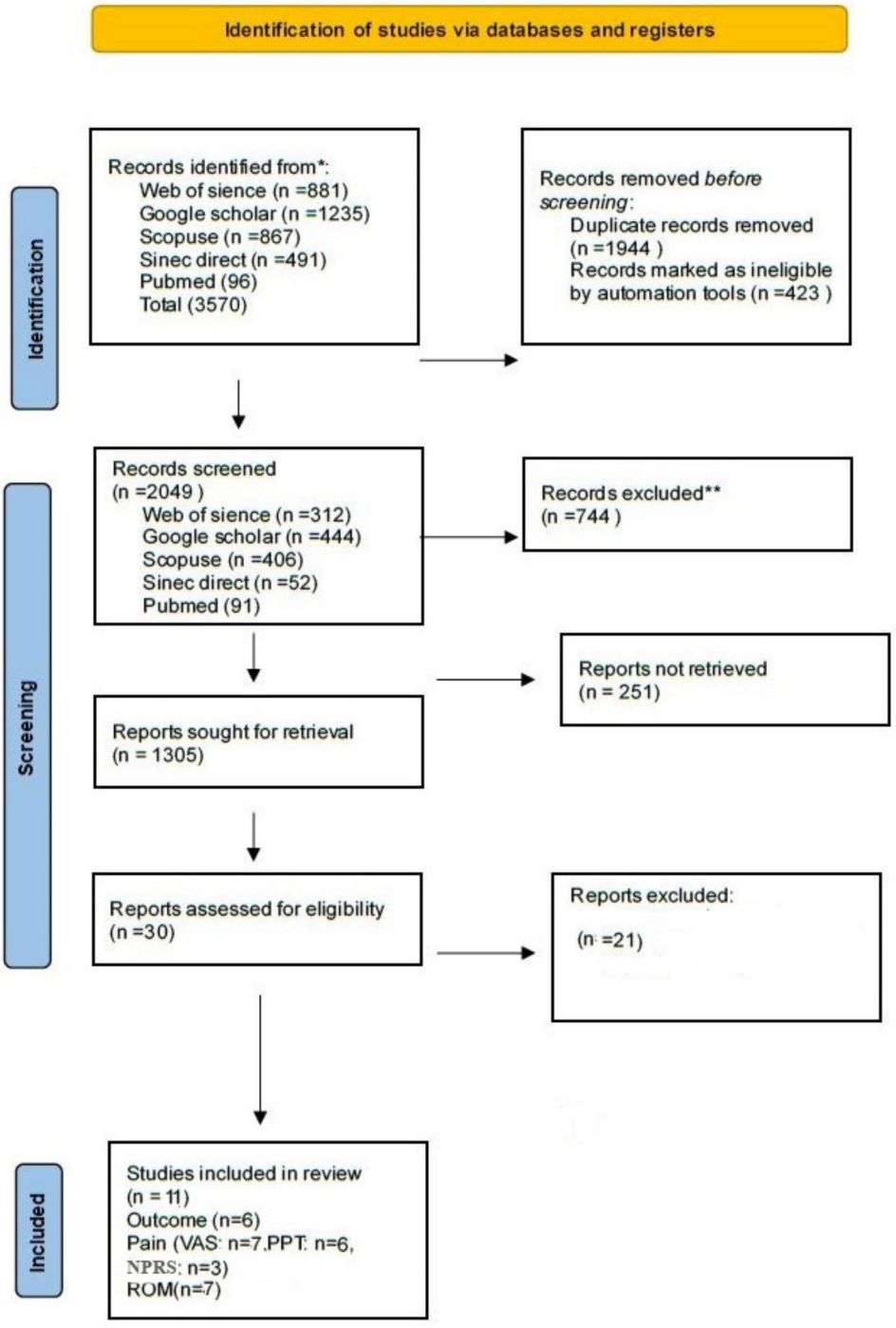

Fig. 1 Identifications of studies via databases and registers

Outcomes

Effect of FM on pain

Ten poor to good quality studies [9, 11, 12, 16, 18–23] evaluated the effect of FM on pain intensity in upper back, neck, lower back, hip and knee muscles with MTrPs in individuals diagnosed with mechanical neck pain [9, 11, 12, 19, 22], subacromial syndrome [16], mechanical low back pain [18, 20], quadratus lumborum strain among IT workers [21] and hamstrings tightness [23]. Seven studies used a visual analog scale (VAS) measure [9, 11, 16, 19, 20, 22], and three studies used the numeric pain rating scale (NPRS) to assess pain intensity [12, 18, 21].

Table 1 Details of included studies

Reference	Study Design/ Country	Sample's characteristics (Mean age)	Intervention description (Duration)	Outcome measures	Results	class
Fernández-de-las-Peñas et al. 2006	RCT/ Spain	Active and Latent TP (Upper trapezius) DX: mechanical neck pain (19–38) TG: 20 (27.7) CG: 20 (29.7)	TG: Friction massage (3 min, immediate effect) CG: Ischemic compression (90 s, immediate effect)	- VAS - Algometer	Both groups show significant improvement in outcomes after the intervention. No significant difference was observed between groups.	III
Mohamadi et al. 2017	RCT / Iran	Latent TP (Upper trapezius) DX: No disease (18–30) TG: 29 (21.06) CG: 29 (22.04)	TG: Friction massage (90 s, 3 sessions on 3 successive days) CG: Kinesio tape (one time - for 72 h)	- Algometer - Hand Held Dynamometer	PPT decreased significantly after intervention in treatment group. Hand grip power just improve significantly in kinesio tap group. No significant difference was observed between groups.	III
Ekici et al. 2021	RCT/ Turkish	Active trigger points (infraspinatus, supraspinatus, subscapularis, the upper part of the trapezius and levator scapula) Dx: Subacromial Pain Syndrome (18–65) TG: 19 (50.90) CG: 19 (52.04)	TG: Friction massage (6 sessions, twice a week for 3 weeks, Follow-up: more than 12 weeks) CG: Dry needling (6 sessions over 4 weeks)	-VAS -Goniometer	Both groups show significant improvement in outcomes after the intervention. No significant difference was observed between groups. Just FM intervention showed earlier improvements as the treatments could be carried out in 3 weeks, rather than the 4 weeks required for the trigger point dry needling therapy sessions	III
Ammara et al. 2023	RCT/ Pakistan	Active TP (at least one trigger point in the iliopsoas muscle on the anterior lumbar aspect and one in the quadratus lumborum muscle lateral to transverse processes of L1-L5) Dx: mechanical low back pain (20–40 years) TG: 18 CG:18	TG: Friction massage (3 sets, 2 min and 1 min rest between sets) CG: Positional Release Technique (90 s Hold/ 90 s Rest 3 times per week, for 4 weeks(	-NPRS - Goniometer	Both groups show significant improvement in outcomes after the intervention. No significant difference was observed between groups.	III
Sadeghnia, et al. 2023	RCT/ Iran	Active TP (Upper trapezius) Dx: mechanical neck pain (18–45) TG: 30 (29.00) CG:30 (32.14)	TG: Friction massage (3 min) CG: High-power pain threshold ultrasound (3 min, Immediate effect)	-VAS - Algometer - Goniometer	Both groups show significant improvement in outcomes after the intervention. ROM of CLF increased significantly more in the HPPTUS group	III
Sadeghnia, et al. 2023	RCT/ Iran	Active TP (Upper trapezius) Dx: mechanical neck pain (18–45) TG: 22 (28.40) CG1: 22 (32.04) CG2: 22 (28.77)	TG: Friction massage (3 min) CG1: High-power pain threshold ultrasound (3 min) CG2: whole body vibration (5 sets, 1 min, and 1 min rest between sets) Immediate effect	- VAS - Algometer - Goniometer	All groups show significant improvement in outcomes after the intervention. ROM of CLF increased significantly more in the HPPTUS and WBV groups.	III

Table 1 (continued)

Reference	Study Design/ Country	Sample's characteristics (Mean age)	Intervention description (Duration)	Outcome measures	Results	class
Bukhari 2020	RCT/India	Active TP (Upper trapezius, supraspinatus, rhomboids, splenius capitis and splenius cervicis muscles) Dx: Neck and Upper Back (18–36) F = 36 TG: (18) CG: (18)	TG: Deep friction massage+ Hot pack (at least 7 min) CG: Ischemic compression + Hot pack (Hold: 60 s, repeat 3times, 15 s rest between sets) twelve sessions, four weeks on alternative days	-NPRS - NDI - Goniometer	All groups show significant improvement in outcomes after the intervention. NPRS and ROM of CLF increased significantly more in the FM. No significant difference was observed between groups on NDI.	III
Yasin 2019	RCT /Pakistan	Active trigger point (upper part of the trapezius, scalene, and sternocleidomastoid) (35–50) (age mean40.96 ± 5.79) Dx: mechanical neck pain F = 32 M = 24 TG: (28) CG: (28)	TG: Friction massage + hot pack (not reported) CG: Static stretching + hot pack (not reported) 2 sessions per weeks, 3 weeks	-VAS -NDI	All groups show significant improvement in outcomes after the intervention. NDI increased significantly more in the FM. No significant difference was observed between groups on VAS.	III
Basu 2017	comparative/India	Active trigger point (gluteus medius) Dx: mechanical low back pain	TG: Transverse friction massage + traditional physical therapy (stretching of gluteus medius). (10 min) CG: Positional release technique + traditional physical therapy (stretching of gluteus medius) (comfort position held for 90 s) alternate days for 3 days	-VAS -Oswestry Low Back Pain(ODI) Disability Index Questionnaire -Pressure Algometer -Pelvic Inclinometer	VAS and ODI in FM group and VAS, ODI and PPT in PRT improved significantly but comparing both group, PPT in PRT group improved significantly	III
Rizwana 2024	RCT/ India	Active trigger Points (quadratus lumborum) Dx: quadratus lumborum strain among IT workers (25–45) TG:30 CG:30	TG: Friction massage (not reported) CG: Positional release technique (Hold: 90 s, rest 60 s rest between sets, set not reported) five times/week for two weeks 5 sessions per week for 2 weeks	-NPRS -ALROM	Both groups show significant improvement in outcomes after the intervention. NPRS and ALROM improved significantly more in PRT.	III

Table 1 (continued)

Reference	Study Design/ Country	Sample's characteristics (Mean age)	Intervention description (Duration)	Outcome measures	Results	class
Trampas 2010	RCT/ Greece	latent trigger Points (quadratus lumborum hamstrings, lateral head of gastrocnemius, medial head of gastrocnemius) Dx: tight hamstrings with at least one tight hamstrings (19 and 24) TG: 10 CG1: 10 CG2: 10	TG: Friction massage + PNF (until there was no tension/tenderness or 90 s) CG1: PNF (hold15s, contraction 7s, new position 10s, three set, 30 s of rest between et) CG2(control): laying on table (7 min) immediately after treatment, at 10 and 30 min.	-PPT -goniometer - inversed stretch perception (ISP) with algometer and NPR -pain intensity (PI) elicited by 3.0 kg/cm2 of pressure	significant improvement in all outcomes after the intervention in TG. Immediately: PI improved significantly more in TG compare to CG1. Fallow up: ROM improved significantly more in CG1 compare to TG. PPT, ROM, ICP and PI improved significantly more in TG compare to CG2. PPT, ROM, ISP and PI improved significantly more in CG1 compare to CG2.	III
Doley 2013	comparative/India	Active trigger point (gluteus medius) Dx: mechanical low back pain (20–40) TG: (15) 26.47 CG: (15) 28.07	TG: Friction massage (10 min) CG: Positional release technique (90 s, 5 times)	- Pressure Algometer	Assessments were conducted on the first, fifth, and seventh days. Each group showed significant differences after treatment, but when comparing the groups, only in the seventh session did friction massage show significant improvements in PPT	III

RCT; Randomized Control Trial, TG; Treatment Group, CG; Control Group, VAS; Visual Analog Scale, PPT; Pain pressure threshold, NPRS; Numerical Pain Rating Scale, ROM; Range of Motion, CLF; Cervical Lateral Flexion, FM; Friction massage, HPPTUS; High-power pain threshold ultrasound, WBV; Whole Body Vibration,

All studies demonstrated significant within-group improvements in pain intensity(VAS and NPRS) following the intervention. However, no significant differences were observed when compared to the control group, except in Rizwana's study, which found that PRT was significantly more effective than FM on the NPRS [21].

Effect of FM on PPT

Six poor to good quality studies [9, 11, 17, 20, 22, 23] evaluated the effect of FM on PPT in neck, hip and knee muscles with MTrPs in individuals diagnosed the mechanical neck pain [9, 11, 17, 22], mechanical low back pain [20], and hamstrings tightness [23]. All studies used an algometer as a measurement tool to assess the PPT. All of them demonstrated a significant within-group improvement in PPT [9, 11, 17, 20, 22, 23]. Three studies investigated the immediate [11, 22] and short-term effects [20], while the others explored the impact of a 4-week intervention [9, 17].

All studies showed significant within-group improvement in PPT following the intervention, but in between-group comparisons, four studies showed no significant differences, while one study demonstrated that PRT was significantly more effective than FM on PPT [20] and one study demonstrated that FM was significantly more effective than PRT on PPT [24].

Effect of FM on ROM

Seven fair to good quality studies [9, 11, 17, 20, 22, 23] evaluated the effects of FM on active range of motion (AROM) of cervical, lumbar, shoulder and knee [11, 12, 16, 18, 21–23] in individuals diagnosed with mechanical neck pain [11, 19, 22], subacromial pain syndrome [16], mechanical low back pain [18], quadratus lumborum strain among IT workers [21], and hamstrings tightness [23]. A goniometer was used to evaluated joint ROM. Three studies assessed ROM of cervical lateral flexion [11, 12, 22]. One study evaluated cervial fletion, extention and rotation [12]. Additionally, Two studies evaluated AROM of lumbar fletion and extention [18, 21], while one study evaluated AROM of lumbar lateral fletion [21]. One study evaluated the range of shoulder internal rotation [16], while another study focused on passive knee extension [23].

The AROM of the cervical, lumbar, and shoulder regions, as well as the passive range of motion (PROM) of the knee, significantly improved within each group when comparing pre- and post-intervention results. In comparison with other physical therapy groups, three studies reported significantly better results for FM [12, 16, 18], while four studies showed superior outcomes for physical therapy groups [11, 21–23]. However, due to conflicting findings, the overall results were inconclusive [11, 16, 18, 22, 23].

Table 2 Details of included studies

Intervention Duration	Reference	Outcome measures	Results
immediate	Fernández-de-las-Peñas et al. 2006	- VAS - Algometer	Both groups show significant improvement in outcomes after the intervention. No significant difference was observed between groups.
	Sadeghnia, et al. 2023	-VAS - Algometer - Goniometer	Both groups show significant improvement in outcomes after the intervention. ROM of CLF increased significantly more in the HPPTUS group
	Sadeghnia, et al. 2023	- VAS - Algometer - Goniometer	All groups show significant improvement in outcomes after the intervention. ROM of CLF increased significantly more in the HPPTUS and WBV groups.
	Trampas 2010	-PPT -goniometer - inversed stretch perception (ISP) with algometer and NPR -pain intensity (PI) elicited by 3.0 kg/cm2 of pressure	significant improvement in all outcomes after the intervention in TG. Immediately: PI improved significantly more in TG compare to CG1. Fallow up: ROM improved significantly more in CG1 compare to TG. PPT, ROM, ICP and PI improved significantly more in TG compare to CG2. PPT, ROM, ISP and PI improved significantly more in CG1 compare to CG2.
Short-term	Mohamadi et al. 2017	- Algometer - Hand Held Dynamometer	PPT decreased significantly after intervention in treatment group. Hand grip power just improve significantly in kinesio tap group. No significant difference was observed between groups.
	Basu 2017	-VAS -Oswestry Low Back Pain(ODI) Disability Index Questionnaire -Pressure Algometer -Pelvic Inclinometer	VAS and ODI in FM group and VAS, ODI and PPT in PRT improved significantly but comparing both group, PPT in PRT group improved significantly
	Rizwana 2024	-NPRS -ALROM	Both groups show significant improvement in outcomes after the intervention. NPRS and ALROM improved significantly more in PRT.
long-term	Ekici et al. 2021	-VAS -Goniometer	Both groups show significant improvement in outcomes after the intervention. No significant difference was observed between groups. Just FM intervention showed earlier improvements as the treatments could be carried out in 3 weeks, rather than the 4 weeks required for the trigger point dry needling therapy sessions
	Ammara et al. 2023	-NPRS - Goniometer	Both groups show significant improvement in outcomes after the intervention. No significant difference was observed between groups.
	Bukhari 2020	-NPRS - NDI - Goniometer	All groups show significant improvement in outcomes after the intervention. NPRS and ROM of CLF increased significantly more in the FM. No significant difference was observed between groups on NDI.
	Yasin 2019	-VAS -NDI	All groups show significant improvement in outcomes after the intervention. NDI increased significantly more in the FM. No significant difference was observed between groups on VAS.

RCT; Randomized Control Trial, TG; Treatment Group, CG; Control Group, VAS; Visual Analog Scale, PPT; Pain pressure threshold, NPRS; Numerical Pain Rating Scale, ROM; Range of Motion, CLF; Cervical Lateral Flexion, FM; Friction massage, HPPTUS; High-power pain threshold ultrasound, WBV; Whole Body Vibration,

Discussion

The present study systematically reviewed the effect of FM on MTrPs. The within-group results showed that FM could significantly improve pain intensity, PPT, and joint ROM. The results of the present study are affected by the methodological limitations present in the included studies, particularly regarding blinding procedures. According to the PEDro scores, many of these studies did not effectively implement proper blinding techniques. This deficiency can significantly impact the validity of the findings and the interpretation of the results. The lack of adequate blinding may introduce biases in the effects observed, resulting in findings that do not accurately reflect clinical reality.

All included articles were graded as Level III, indicating that the overall level of evidence could be classified as Level C. Level C evidence, which points to weaknesses in study design and methodology, should be used cautiously in clinical decision-making. Clinicians must recognize that applying this evidence in clinical practice should be done judiciously and in conjunction with other resources.

This study appears to be the first systematic review evaluating the effects of FM on MTrPs. Direct comparisons with other review studies are limited due to a lack of previous systematic reviews on this topic.

The mechanism of action of FM could result from hyperemia or reciprocal inhibition [27]. It may decrease the transmission of pain signals through the activation of

Table 3 The PEDro scores of included studies

Author	Year	1	2	3	4	5	6	7	8	9	10	11	Total PEDro Score	Quality
Fernández-de-las-Peñas	2016	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	8	Good
Mohamadi	2017	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	6	Good
Ekici	2021	Y	Y	N	Y	N	Y	Y	Y	N	Y	N	6	Good
Ammara	2023	Y	Y	Y	N	N	N	N	Y	Y	Y	N	5	Fair
Sadeghnia	2023	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	9	Good
Sadeghnia	2023	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	9	Good
Bukhari	2020	Y	Y	Y	N	N	N	N	Y	Y	Y	N	5	Fair
Yasin	2019	Y	Y	N	Y	N	N	N	Y	N	Y	N	4	Fair
Basu	2017	Y	Y	N	N	N	N	N	Y	Y	N	N	3	poor
Rizwana	2024	Y	Y	N	N	N	N	N	Y	Y	Y	N	4	Fair
Trampas	2010	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	7	Good
Doley	2013	Y	Y	N	N	N	N	N	Y	Y	Y	N	4	poor

Items: (1) Eligibility criteria were specified, (2) Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received), (3) Allocation was concealed (4) The groups were similar at baseline regarding the most important prognostic indicators, (5) There was blinding of all subjects, (6) There was blinding of all therapists who administered the therapy, (7) There was blinding of all assessors who measured at least one key outcome, (8) Measures of at least one key outcome were obtained from > 85% of the subjects initially allocated to groups, (9) All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome were analyzed by intention to treat, (10) The results of between-group statistical comparisons are reported for at least one key outcome, 11. The study provides both point measures and measures of variability for at least one key outcome

mechanoreceptors and the release of specific neurotransmitters along with temporarily impeding blood flow. Subsequently, there is a swift surge in oxygenated blood flow. FM could normalize muscle fiber length by applying mechanical pressure [28]. Additionally, Hong et al. have hypothesized that deep massage could stretch and mobilize trigger points [29].

Studies have utilized various assessment methods to verify the influence of FM on MTrPs, including VAS, ROM, PPT, VAS per pressure, NPRS, NDI, and grip power. In this review, pain, PPT, and ROM were considered the primary outcomes.

Most studies focused on active trigger points, but Fernandez et al. applied FM to both active and latent trigger points [9], while Trampas Mohamadi applied FM specifically to latent trigger points [17, 23].

Level C evidence indicates a possible short-term effect of FM on the VAS in individuals with MTrPs [9, 11, 20, 22, 23]. Sadeghnia et al. revealed that FM immediately reduces pain in patients with active trigger points [11, 22]. Regarding the result of the study by Ekici et al., six treatment sessions during three weeks for the 12-week follow-up resulted in a notable alleviation of pain compared to the group that received dry needling [16]. Additionally, Ammara et al. have suggested that four weeks of FM led to a significant reduction in NPRS. The results showed no significant differences compared to myofascial release in patients with back pain [18]. The effectiveness of FM in reducing pain may be due to the pain gate theory and stimulating the release of endorphins and enkephalins, which block the action of nociceptive neurotransmitters [30].

Studies of level C evidence support the possible effect of FM in reducing pain in the upper trapezius, pre-and post-treatment [9, 11, 12, 16, 22].

Considering pain intensity, 8 studies directly compared FM to other manual therapies, including ischemic compression [9, 12], PRT [18, 20, 21, 24], static stretching [19] and PNF [23]. The results showed significant within-group improvement in pain intensity following FM, with no significant effect in comparison to control groups, except in Rizwana's study, which found that PRT was significantly more effective than FM on the NPRS [21].

The results of the current study are similar to those of Mete et al., who systematically reviewed the effects of Western massage on neck pain and found that this treatment led to pain improvement; however, it did not demonstrate superiority over other therapeutic modalities [31].

The included studies of fair quality presented varying results regarding FM on NPRS in individuals with MTrPs. Trampas's study showed greater improvements in the treatment group, suggesting that the combination of FM and PNF may account for these enhanced effects

compared to PNF alone [23]. More high-quality studies are needed to make definitive conclusions.

Level C evidence indicates a possible effect of FM on PPT in individuals with MTrPs of upper trapezius in the short term [9, 11, 17, 22]. It seems pain gate theory and equalizing fiber of the taut band could explain the short-term duration effect of FM on PPT. The results of the present study are consistent with other studies, which have shown that the PPT decreases after manual therapy, but there is no significant superiority compared to other methods [32, 33].

Basu et al. demonstrated that PRT was significantly more effective than FM on PPT of gluteus medius [20] and Doley demonstrated that FM was significantly more effective than PRT on PPT of gluteus medius [24]. It seems active trigger points in Doley et al. study and latent trigger points in Basu et al. study could explain the differences of results.

Considering the small number of studies and the lack of long-term effects in studies that have assessed the effect of FM on PPT, more high-quality studies are necessary.

Although FM could significantly improve the ROM [11, 12, 16, 18, 21, 22], the results of this systematic review remain inconclusive for subjects with MTrPs when compared to the control group. Two studies reported less improvement in ROM compared to the control groups [16, 18]. It seems high power pain threshold ultrasound (HPPTUS) by hitting effects and whole- body vibration by effects on flexibility are more effective than local compression and stretching effects of FM [11, 22]. The study by Trampas showed greater improvement in the treatment group compared to PNF alone, possibly due to the combined use of FM and PNF [23]. Three studies with treatment durations of three weeks or more, reported similar effects of FM and other interventions. They suggested a longer treatment period may be necessary to obtain significant effect on ROM [12, 16, 18]. Guzmán-Pavón et al. investigated the impact of manual therapy on ROM in individuals with trigger points and demonstrated that manual therapy could improve ROM [23]. Considering that previous studies emphasized the effectiveness of manual therapy, like other treatments, on ROM, it seems that higher-quality studies are needed to demonstrate the effect of FM on joint ROM compared to other treatment methods [32, 33].

Given that the minimum duration for applying FM is typically 3 min or more, which exerts significant pressure on the therapist's hands, further studies are needed to explore alternative methods. The article by Ammerha and et al. demonstrated that three sets of two minutes of FM have the same effect on the NPRS and ROM of lumbar as three sets of 90 s of PRT in patients with low back pain [18]. Basu et al. reported that 10 min of FM, compared to multiple repetitions of 90 s of positional release, had an equivalent effect on the VAS and oswestry disability index (ODI). However, PRT resulted in a greater improvement in PPT [20]. In the study by Rizwana et al., the NPRS and ROM of lumbar in the PRT group were reported to be significantly better. However, the duration of FM and the number of sets for PRT were not specified [21]. These results are consistent with the study by Nanesh et al., which reported superior effects of PRT on NPRS and the Neck Disability Index (NDI) in their study focused on mechanical neck pain [34].

In the study by Doley et al., ten minutes of FM showed superior effects compared to five repetitions of 90 s of the PRT on the PPT of the gluteus medius muscle [24]. Considering the results, particularly regarding NPRS, future studies should explore the PRT as an alternative to FM for treating trigger points. Additionally, these studies should examine its therapeutic effects and its impact on therapists, particularly in terms of fatigue and the physical load on their hands.

Fland et al. demonstrated that friction massage and ischemic compression have equivalent effects on trigger points. However, since ischemic compression is usually applied for shorter durations, it exerts less pressure overall. Further research is needed to evaluate the effects of both friction massage and ischemic compression on trigger points across various muscles [9, 12]. Sadeghnia et al. demonstrated that three minutes of HPPT US produces a more immediate effect on cervical ROM than three minutes of friction massage on upper trapezius with trigger points. However, the HPPTUS technique has the limitation of requiring effective communication with the patient [11, 22]. Given that ultrasound therapy places less pressure on the therapist's hands, future studies comparing the long-term effects and user-friendliness of ultrasound and other treatments could provide valuable insights for clinical decision-making.

Limitations

This systematic review has several limitations. The most significant limitation is the heterogeneity of the included studies, which vary widely in terms of diagnosis, conditions, and comparison groups. Notably, most studies focused predominantly on the upper trapezius muscle, indicating limited diversity in the muscle groups studied. The limited number of articles addressing other muscles restricts the generalizability of the findings across different muscle groups. In the discussion section, we attempted to limit the scope wherever possible to enhance the interpretability and relevance of the results. This restriction applies to treatment duration, the muscles targeted for manual therapy, and the type of manual therapy. Only randomized controlled trials were included in the review. Future research should aim to investigate the effectiveness of manual therapy across a broader

range of muscle groups to provide a more comprehensive understanding of its therapeutic potential. Another limitation is the small sample sizes of the studies, which may affect the results. Including studies with larger sample sizes might yield different outcomes. Additionally, there was an insufficient number of trials assessing the long-term effects of friction massage. This limitation may lead to a less comprehensive understanding of the sustained impact of FM on MTrPs. Future studies should investigate longer intervention periods and include long-term follow-up.

There is also a need for more research on the effects of FM on ROM and NPRS. Other techniques such as ultrasound and positional release, which may be easier to administer than FM, could help guide the selection of effective treatment options for patients and facilitate therapists' work. Further research should also explore newer methods such as high-power laser therapy and shockwave therapy.

Conclusion

In the short term, Level C evidence suggests that FM may reduce VAS and PPT in upper trapezius MTrPs, similar to other physical therapy methods. However, high-quality, long-term studies with better design, larger sample sizes, and extended follow-up are needed to address limitations and evaluate ROM and NPRS improvements.

Abbreviations

FM	Friction massage
HPPT US	High power pain threshold ultrasound
MTrPs	Myofascial trigger points
NDI	Neck disability index
NPRS	Numeric pain rating scale
PPT	Pressure pain threshold
PRT	Positional release therapy
VAS	Visual analog scale

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-025-08372-x.

Supplementary Material 1

Acknowledgements

Not applicable.

Author contributions

Mehrdad Sadeghnia: Conceptualization, Investigation, Methodology, Writing- draft preparation, Data extraction, prepared figures and tables. Mehrnaz Kajbafvala: Investigation, Data extraction, Writing, Reviewing and Editing, prepared figures and tables. Azadeh Shadmehr: Conceptualization, Methodology, Writing- Reviewing and Editing.

Funding

No funding was obtained for this study.

Data availability

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 23 May 2024 / Accepted: 29 January 2025
Published online: 13 March 2025

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