Ann Med Res

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Investigating the effects of percussion massage therapy on pain, functionality, kinesiophobia, and quality of life in individuals with non-specific low back pain

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ARTICLE INFO

Keywords:
Exercise
Mechanical low back pain
Local vibration
Percussion massage therapy

Received: Aug 26, 2024
Accepted: Jan 27, 2025
Available Online: 26.02.2025

DOI:
10.5455/annalsmedres.2024.08.177

Abstract

Aim: This study aimed to investigate the effects of percussion massage therapy applied to the paravertebral muscles on pain, functionality, flexibility, kinesiophobia, and quality of life in individuals with mechanical low back pain.

Materials and Methods: The study enrolled 40 individuals diagnosed with non-specific low back pain. Participants were randomly assigned to one of two groups: percussion massage therapy (PMT) or conventional therapy (CT). Both groups participated in a 6-week treatment program. Pain levels were evaluated using the Visual Analog Scale (VAS), functionality was assessed with the Oswestry Disability Scale (ODS), flexibility was measured via the Sit-and-Reach Test, kinesiophobia was assessed using the Tampa Scale for Kinesiophobia (TSK), and quality of life was measured with the Short Form-36 (SF-36). Assessments were performed both before and after the treatment period. The CT group engaged in exercises focused on strengthening, stabilization, and stretching of the lumbar region, while the PMT group received percussion massage therapy targeting the paravertebral muscles in addition to conventional physiotherapy.

Results: Post-treatment, both groups significantly improved all assessment parameters ($p<0.05$). However, the PMT group demonstrated greater effectiveness compared to the CT group in terms of ODS, TSK, VAS, Sit-and-Reach Test, and the physical role limitation, emotional function, social function, pain, and general health subscales of the SF-36 ($p<0.05$).

Conclusion: This study concluded that incorporating percussion massage therapy, a novel approach in literature, into the rehabilitation program for individuals with mechanical low back pain may be an effective treatment addition.

Introduction

Non-specific low back pain (NLBP) is a significant health issue and one of the leading causes of chronic pain problems in adults, with no established specific rehabilitation program for its treatment. Epidemiological studies have shown that psychosocial and work-related factors play a significant role in the occurrence and recurrence of low back pain [1]. Low back pain is a common condition with various etiologies, affecting an estimated 70-80% of the global population. The majority of these cases (approximately 95%) are attributed to mechanical causes [2]. Unlike other types of low back pain, mechanical low back pain typically worsens with movement and improves with rest. Causes include poor posture, excessive strain, and structural predisposition. Non-mechanical causes of low back pain, such as infections, tumors, fractures, metabolic disorders, and referred pain from internal organs, must be excluded before a diagnosis of mechanical low back pain can be made [3]. Medical interventions and physiotherapy are frequently employed in the management of NLBP, with the primary goal of both approaches being to optimize pain relief and improve the patient's quality of life [4]. A systematic review found that, among pharmacological interventions for NSLBP, NSAIDs and muscle relaxants offer the most favorable risk-benefit ratio for pain and disability management. However, exercise and manual therapy are considered more effective first-line treatments and should be prioritized over pharmacological options [5]. Exercise therapy is an effective treatment for NLBP, with studies demonstrating its ability to reduce chronic pain and improve functional capacity. Recommended exercises in-

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clude strengthening, flexibility, and stabilization exercises [6]. Vibration therapy has become increasingly common in rehabilitation settings over the past decade. This therapy can be applied using WBV platforms, which deliver vibrations to the entire body, or through localized percussion massage devices for more targeted treatment [7]. Percussion massage therapy (PMT) is a widely used myofascial intervention that has been shown to reduce pain, increase blood circulation, enhance scar tissue healing, reduce muscle spasms, improve lymphatic drainage, inhibit the Golgi tendon reflex, and increase joint range of motion [8]. Despite their growing popularity among athletes and therapists, the evidence supporting the purported benefits of percussion massage devices remains limited. These devices, which combine traditional massage with vibration, are thought to enhance flexibility, performance, and recovery, but further research is needed to establish their definitive effects [9]. Percussion massage devices, typically powered by electricity or batteries, deliver rapid, compressive forces to myofascial tissue using a variety of attachments. 1 Popular brands like Theragun and Hypervolt offer devices for both self-massage and professional use. These devices operate at varying frequencies, with some models reaching up to 53 Hz, and offer interchangeable heads to target specific tissues [10]. A review of the literature indicates that studies on percussion massage therapy have predominantly involved healthy individuals and athletes, with a primary focus on assessing the effects of this therapy on flexibility, muscle strength, and range of motion [11]. Percussion massage devices are increasingly used in sports and clinical settings, but there is a gap between their popularity and the available evidence to guide their use. Limited research, a lack of clinical practice guidelines, and scarce information on how health professionals utilize these devices contribute to this gap. To date, most studies have focused on the effects of percussion massage therapy on joint range of motion and muscle stiffness [9,11–13]. This study investigated the effects of adding percussion massage therapy to a conventional exercise program for the management of NSLBP. We hypothesized that this combined approach would be superior to exercise alone in improving pain, flexibility, kinesiophobia, functionality, and quality of life.

Materials and Methods

Study design and participants

This single-blind, randomized controlled trial included 42 participants with non-specific low back pain (NSLBP) recruited from Yeni Huzur Hospital. The study protocol was approved by the Non-interventional Ethics Committee at Istanbul Medipol University (Approval Number: E-10840098-202.3.02-238/3), and all participants provided written informed consent. Participants were randomly assigned (1:1 ratio) to either a percussion massage therapy (PMT) group or a conventional therapy (CT) group using randomizer.org. A physical medicine and rehabilitation specialist diagnosed NSLBP based on clinical evaluation and exclusion of "red flag" indicators. Individuals with specific pathologies (e.g., disc herniation, spinal stenosis, fractures) or those who had received treatment for low back pain within the past six months were excluded. Assessments were conducted before and after the 6-week intervention period. The study flow diagram is presented in Figure 1.

Conventional therapy group

All participants received a standardized treatment program consisting of stretching and strengthening exercises, transcutaneous electrical nerve stimulation (TENS), and ultrasound (US) therapy. TENS was applied to the paravertebral muscles at 100 Hz for 20 minutes, while US was administered to the lumbar region at 1.5 W/cm^2 for 6 minutes. Stretching exercises targeted the quadratus lumborum, hamstrings, multifidus, and iliocostalis muscles, with each stretch held for 15 seconds and repeated five times. Strengthening exercises focused on the hip extensors, lumbar extensors, and abdominal muscles, consisting of three sets of 10 repetitions. The complete program was conducted over 6 weeks, with three sessions per week, and was tailored to individual tolerance and progression under the supervision of a physiotherapist.

Percussion massage therapy group

In addition to the conventional therapy program, the PMT group received percussion massage therapy using a Hypervolt device (Hyperice, CA, USA). The treatment was applied to the paravertebral muscles at 40 Hz and medium intensity (level 2) for 5 minutes per side, twice a week for 6 weeks, following the manufacturer's instructions [11,14,15] (Figure 2). The soft-top attachment (number 5 head) was used in a distal-to-proximal direction, with gentle skin contact and no additional pressure. This intervention was performed prior to the exercise program with participants in the prone position. After the study, participants in the CT group were offered the option to receive PMT.

Outcome measures

Outcome measurements were conducted before and after the 6-week treatment period by an independent, experienced physiotherapist blinded to group allocation.

Pain

Participants' pain levels during activity were assessed using the Visual Analog Scale (VAS), a self-reported measure of pain intensity. Participants marked their pain level on a 10-cm line, with 0 indicating "no pain" and 10 representing "unbearable pain." Higher VAS scores correspond to greater pain intensity [16,17].

Functionality

The Oswestry Disability Index (ODI) was used to assess functionality. This self-reported questionnaire evaluates the impact of low back pain on daily activities. It consists of ten items, each with six response options ranging from 0 to 5, with higher scores indicating greater disability. The total score is calculated as: ((total score / 10) x 5) x 100, with a maximum possible score of 50 [18].

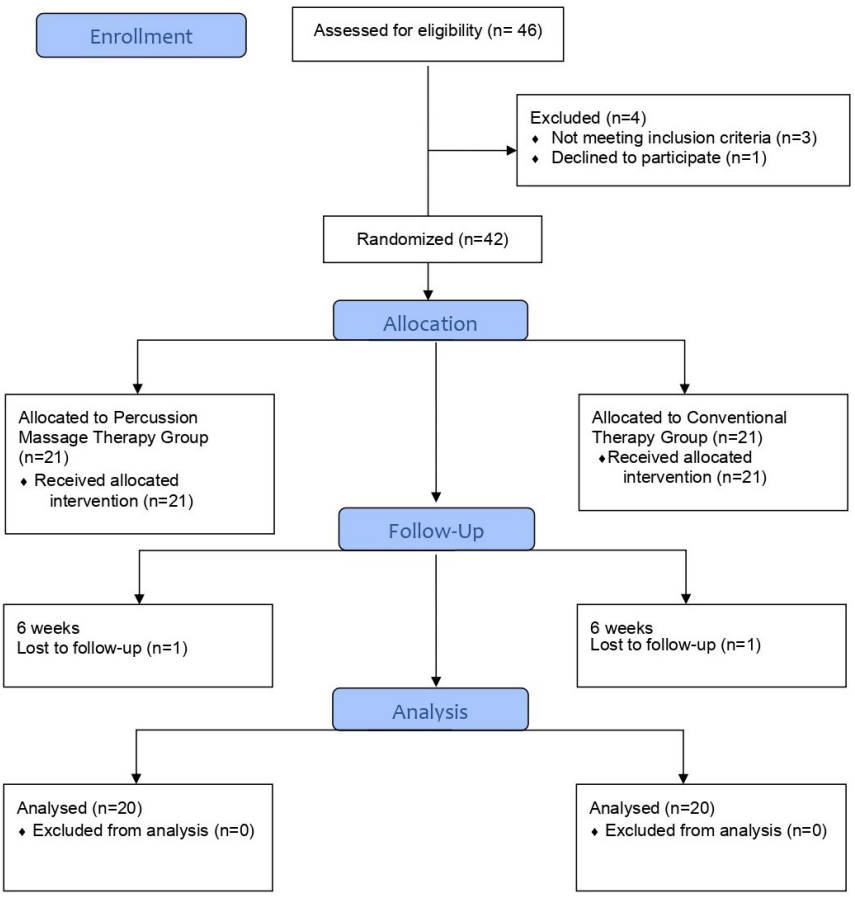

Figure 1. Design and flow chart of the study.

Figure 2. Percussion massage therapy.

Flexibility

The Sit-and-Reach Test was used to assess flexibility. Participants sat on the floor with their feet flat against a testing bench and reached forward as far as possible while keeping their knees extended. The distance reached beyond the edge of the bench was recorded in centimeters (positive values for distances beyond the bench, negative values for distances short of the bench). The highest of two attempts was recorded [19,20] (Figure 3).

Kinesiophobia

Kinesiophobia was assessed using the TSK, a 17-item questionnaire designed to evaluate fear of movement in individuals with chronic musculoskeletal pain. Responses are scored on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree), with a total score ranging from 17 to 68. Higher scores indicate greater kinesiophobia [21,22].

Figure 3. Sit and reach test.

Quality of life

The SF-36, a widely used health survey, was used to assess overall health status and quality of life. This tool evaluates eight health domains: physical functioning, social functioning, role limitations (physical and emotional), mental health, vitality, pain, and general health perception. Each domain is scored from 0 to 100, with higher scores indicating better health and functional capacity [23,24].

Statistical analysis

This study hypothesized that adding percussion massage therapy (PMT) to a conventional exercise program would be more effective than conventional therapy alone in managing non-specific low back pain (NSLBP) by improving pain, flexibility, kinesiophobia, functionality, and quality of life. Using G*Power, a sample size of 36 participants was estimated to achieve 80% power with an effect size of 0.25 ($\alpha = 0.05$, 1-$\beta = 0.80$) [25]. To account for potential dropout, the study was initiated with 42 participants (21 per group). Data were analyzed using IBM SPSS Statistics 26.0 (IBM Corp., Armonk, NY, USA). Skewness and kurtosis values were within the acceptable range for normal distribution (±2.0 for skewness, <7.0 for kurtosis), thus parametric tests were used [26]. Categorical characteristics were compared using chi-square tests (Pearson chi-square/Fisher's exact test). Independent samples t-tests were used to compare baseline characteristics and post-treatment outcomes between groups. Paired samples t-tests were used for within-group comparisons. Statistical significance was set at $p<0.05$.

Results

Forty participants with NSLBP completed this study, with 20 in the PMT group and 20 in the CT group. The groups were comparable in terms of demographic characteristics (Table 1). Both groups showed significant improvements in all outcome measures after treatment ($p<0.05$) (Table 2). No treatment-related complications occurred. However, one participant in each group withdrew due to unrelated medical or logistical reasons. Between-group comparisons revealed that the PMT group experienced significantly greater improvements in most measured parameters, including the ODI, TSK, VAS, and Sit-and-Reach Test, as well as the physical role limitation, emotional function, social function, pain, and general health subscales of the SF-36 (Table 3). No significant differences were found between groups for the physical function, vitality, and mental health components of the SF-36 ($p<0.05$).

Table 1. Distribution of demographic and physical characteristics of the study population.

Variables	PMT (mean±SD)	CT (mean±SD)	p-value
Age (years) (Min-Max)	48.65 ± 6.05 48.00 (40-60)	47.10 ± 4.54 46.50 (41-56)	0.366
Gender, n (%)			
Male	8 (40%)	9 (45%)	0.749
Female	12 (60%)	11 (55%)	
Height (cm) (Min-Max)	166.65 ± 8.67 168.00 (150-186)	171.45 ± 7.66 172.00 (155-183)	0.071
Weight (kg) (Min-Max)	73.95 ± 10.90 75.00 (48-89)	73.35 ± 11.02 75.50 (55-89)	0.863

PMT, Percussion massage therapy group; CT: conventional therapy, SD: standard deviation, kg: kilogram, cm: centimeter.

Discussion

This study compared the effects of conventional exercise alone versus conventional exercise combined with percussion massage therapy (PMT) on pain, flexibility, kinesiophobia, functionality, and quality of life in individuals with mechanical low back pain. Both groups showed improvements in all parameters after treatment. However, the PMT group demonstrated significantly greater improvements in pain, flexibility, disability, kinesiophobia, and several aspects of quality of life.

These findings are consistent with previous research on vibration therapy for low back pain. Jung et al. found that core stabilization exercises combined with vibration were more effective in reducing pain in adolescents with mechanical low back pain [27]. Similarly, studies have shown that whole-body vibration combined with exercise is more effective in reducing pain in individuals with lumbar instability [28]. Mansuri et al. also reported that vibration therapy using a Theragun device effectively reduced low back pain in bus drivers [29]. This study demonstrated that adding percussion massage therapy (PMT) to a conventional exercise program resulted in greater improvements in pain, flexibility, disability, kinesiophobia, and several aspects of quality of life compared to conventional therapy alone in individuals with mechanical low back pain. These findings are consistent with previous research on vibration therapy for low back pain. For example, Jung et al. found that core stabilization exercises combined with vibration were more effective in reducing pain in adolescents with mechanical low back pain. Similarly, whole-body vibration combined with exercise has been shown to be more effective than exercise alone in reducing pain in individuals with lumbar instability. Furthermore, Mansuri et al. reported that vibration therapy using a Theragun device effectively reduced low back pain in bus drivers. Yang et al. [15] also found that six weeks of percussion massage therapy reduced pain and improved functionality in firefighters with chronic non-specific low back pain, concluding that it is an effective and safe treatment strategy [15]. Similarly, in our study, the reduction in pain levels in the PMT group was more pronounced and statistically significant, consistent with the literature. Pozo-Cruz et al. indicated that 20 Hz vibration therapy administered over 12 weeks was an effective treatment for improving lumbar region functionality in individuals with mechanical low back pain [30]. Welling and colleagues [31] demonstrated the effectiveness of short-term PMT in reducing pain and improving lumbar function in individuals with NSLBP. Importantly, they found that PMT's benefits were not solely attributable to a placebo effect, suggesting a genuine therapeutic impact [31]. In another study, 30 Hz vibration therapy applied to office workers with chronic low back pain was reported to contribute more to improv-

Table 2. Comparison of changes in outcome measures within and between the groups.

Variables	PMT (mean±SD)		p-value	Cohen d (%95 CI)	CT (mean±SD)		p-value	Cohen d (%95 CI)
	Pre	Post			Pre	Post		
VAS	6.30±0.92	2.40±1.35	<0.001[t]	4.277 (2.853; 5.688)	5.85±0.81	2.45±1.05	<0.001[t]	3.852 (2.555; 5.137)
ODS	36.53±10.17	13.62±5.09	<0.001[t]	2.509 (1.596; 3.406)	30.53±8.22	15.79±4.93	<0.001[t]	2.481 (1.576; 3.370)
Sit and Reach Test	12.80±6.41	6.25±7.45	<0.001[t]	-2.814 (-3.796; -1.816)	8.05±6.65	5.60±6.96	<0.001[t]	-1.806 (-2.516; -1.078)
TKS	44.65±6.70	32.75±6.18	<0.001[t]	2.001 (1.224; 2.761)	41.60±7.42	34.15±8.49	<0.001[t]	1.622 (0.939; 2.286)
SF-36/ Physical Function	65.00±18.85	85.00±9.46	<0.001[t]	-1.605 (-2.266; -0.926)	52.75±15.17	72.25±13.81	<0.001[t]	-1.622 (-2.287; -0.939)
SF-36/ Role Physical	22.50±21.31	63.92±23.43	<0.001[t]	-2.826 (-3.812; -1.825)	30.63±21.64	55.00±24.80	<0.001[t]	-1.528 (-2.170; -0.867)
SF-36/ Bodily Pain	29.00±17.29	59.50±14.11	<0.001[t]	-2.017 (-2.781; -1.235)	34.00±15.90	54.13±16.33	<0.001[t]	-2.057 (-2.832; -1.265)
SF-36/ General Health	40.75±15.75	59.13±14.49	<0.001[t]	-1.669 (-2.345; -0.975)	36.75±15.75	47.80±12.56	<0.001[t]	-1.494 (-2.129; -0.841)
SF-36/ Vitality	45.13±8.05	55.38±10.83	<0.001[t]	-1.277 (-1.864; -0.673)	43.25±15.41	52.50±16.90	<0.001[t]	-1.628 (-2.294; -0.943)
SF-36/ Social Function	38.00±18.22	64.48±15.23	<0.001[t]	-1.840 (-2.559; -1.104)	35.00±12.57	53.75±12.89	<0.001[t]	-2.471 (-3.357; -1.569)
SF-36/ Role Emotional	32.48±30.80	73.30±25.61	<0.001[t]	-1.669 (-2.345; -0.975)	36.63±23.92	63.30±26.28	<0.001[t]	-1.299 (-1.890; -0.690)
SF-36/ Mental Health	52.20±6.42	61.80±10.76	<0.001[t]	-1.133 (-1.689; -0.558)	52.40±10.37	58.60±14.29	<0.001[t]	-0.569 (-1.036; -0.089)

PMT: percussion massage therapy, CT: conventional therapy; VAS: visual analog scale, ODS: oswestry disability scale, TKS: tampa kinesiophobia scale, SF-36: short form-36, SD: standart deviation. P-values were calculated using the Independent Samples t-test, with p<0.05 deemed significant.

ing functionality compared to a conventional exercise program, suggesting potential benefits of vibration therapy as an adjunct to exercise [32]. Our findings regarding the functional improvements associated with PMT are consistent with some studies in the literature. For example, Jung et al. found that core stabilization exercises combined with vibration were more effective in reducing pain and improving function in adolescents with mechanical low back pain. Similarly, whole-body vibration combined with exercise has been shown to be more effective than exercise alone in improving function in individuals with lumbar instability. However, Özsoy et al. [25] found no significant difference between exercise alone and exercise combined with vibration therapy in older adults with mechanical low back pain, although both groups experienced functional improvement. This discrepancy may be due to age-related differences in response to vibration therapy or differences in the specific vibration protocols used [25]. Another study reported that vibration therapy applied at 20 Hz for 2 minutes twice a week had a similar effect on improving functionality levels in individuals with chronic low back pain compared to conventional methods. The different results observed in these studies compared to ours may be attributed to the limited application of vibration therapy, only 2 minutes twice a week, and the insufficient duration of the treatment [33]. The fear of movement is another factor influencing the outcomes of parameters assessed in mechanical low back pain [34]. In a study by Bunzli et al,in kinesiophobia was more prevalent in individuals with mechanical low back pain . The main reason for this belief is the fear that engaging in painful activities may lead to further damage or that the pain experienced during these activities could worsen functional limitations and increase discomfort. Relieving the symptoms of mechanical low back pain can reduce both kinesiophobia and anxiety related to pain [35]. Another study reported that local vibration therapy is effective in improving impaired proprioception and alleviating low back pain in patients with chronic low back pain [36]. In a systematic review conducted by Zafer and colleagues, it was reported that vibration therapy positively affects pain, functionality, and the proprioceptive system in individuals with non-specific chronic low back pain [37]. The findings of this study suggest that vibration therapy also enhances the proprioceptive mechanism. In our study, the vibration therapy was administered using a Percussion Massage Gun. We

Table 3. Differences within groups before and after treatment and comparison of differences between groups.

Variables	PMT (mean±SD)	CT (mean±SD)	p-value	Cohen d (%95 CI)
VAS	3.90±0.91	3.40±0.88	0.046[t]	0.557 (1.186; 0.079)
ODS	22.91±9.13	14.74±5.94	0.002[t]	1.061 (1.718; 0.391)
Sit and Reach Test	6.55±2.33	2.45±1.36	<0.001[t]	2.152 (1.358; 2.929)
TKS	11.90±5.95	7.45±4.59	0.012[t]	0.838 (1.480; 0.185)
SF-36/ Physical Function	20.00±12.46	19.50±12.02	0.898[t]	0.041 (-0.579; 0.660)
SF-36/ Role Physical	41.42±14.65	24.38±15.95	0.001[t]	1.112 (0.438; 1.774)
SF-36/ Bodily Pain	30.50±15.12	20.13±9.78	0.014[t]	0.815 (0.164; 1.456)
SF-36/ General Health	18.38±11.01	11.05±7.39	0.018[t]	0.781 (0.132; 1.420)
SF-36/ Vitality	10.25±8.03	9.25±5.68	0.652[t]	0.144 (-0.478; 0.763)
SF-36/ Social Function	26.48±14.39	18.75±7.59	0.040[t]	0.672 (0.030; 1.305)
SF-36/ Role Emotional	40.82±24.46	26.67±20.52	0.048[t]	0.627 (0.012; 1.259)
SF-36/ Mental Health	9.60±8.48	6.20±10.89	0.278[t]	0.348 (-0.279; 0.971)

PMT: percussion massage therapy, CT: conventional therapy; VAS: visual analog scale, ODS: oswestry disability scale, TKS: tampa kinesiophobia scale, SF-36: short form-36, SD: standart deviation. P-values were calculated using the Paired Samples t-test, with p<0.05 considered significant.

hypothesize that the observed improvement in kinesiophobia in the PMT group is related to the enhancement of proprioceptive mechanisms by PMT, which can positively influence the reduction of fear of movement.. While research on the effects of vibration therapy on kinesiophobia is limited, this study explored the impact of PMT on fear of movement. We observed improvements in kinesiophobia scores with both PMT and conventional therapy, suggesting that symptom reduction may be associated with decreased kinesiophobia. This is consistent with Konrad et al. [38], who reported that 5 minutes of percussion massage using a massage gun increased range of motion and may have indirectly influenced kinesiophobia by improving physical function. Similarly, a study by Skinner and colleagues have stated that PMT therapy can be used to improve range of motion following a reduction in tissue stiffness [39]. A systematic analysis by Remer et al. [40] noted that vibration therapy at 30 Hz was more effective in enhancing proprioception compared to high-frequency vibration therapy at 50 Hz. Additionally, they suggested that the pain reduction achieved through vibration could improve functionality and potentially reduce kinesiophobia.

This is a thorough discussion of your study's findings, potential mechanisms, and limitations. However, it could benefit from some restructuring and conciseness. Here's a revised version:

In our study, both groups showed reduced kinesiophobia after treatment, but the reduction was more pronounced in the PMT group. This may be attributed to PMT's enhancement of proprioceptive mechanisms. The localized vibration from PMT may stimulate the tonic vibration reflex, enhancing motor control and neural adaptation. This, in turn, could lead to improved proprioceptive feedback, potentially reducing fear of movement and increasing confidence in physical abilities. Additionally, vibration therapy may desensitize pain receptors, modulate nociceptive input, and promote endorphin release, contributing to pain reduction. Furthermore, by stimulating mechanoreceptors like muscle spindles and Golgi tendon organs, PMT may improve proprioceptive feedback, further reducing fear of movement and enhancing range of motion and flexibility.

Compared to conventional therapy, which primarily involves manual techniques, PMT offers a more dynamic approach by simultaneously addressing pain, flexibility, and proprioception. The multifaceted nature of PMT, coupled

with the neural and physiological adaptations induced by vibration therapy, may explain its superior effectiveness in reducing kinesiophobia. Importantly, PMT was well-tolerated in our study, with no adverse events reported, supporting its safety and feasibility in clinical practice.

Limitations

This study has limitations, including the small sample size, single-center design, lack of long-term follow-up, and the absence of a placebo control group. Future studies with larger, more diverse samples, long-term follow-up assessments, and a placebo control are needed to confirm these findings and further evaluate the efficacy and sustained impact of PMT.

Conclusion

The findings demonstrated that both treatment approaches significantly improved pain, flexibility, kinesiophobia, functionality, and quality of life. Notably, PMT proved more effective than conventional therapy, particularly in enhancing functionality, reducing kinesiophobia and pain, improving flexibility, and positively impacting the physical role limitation, emotional function, social function, pain, and general health subscales of the SF-36. These results align with existing literature and suggest that integrating percussion massage therapy into rehabilitation programs for individuals with mechanical low back pain could offer considerable benefits. Further research is needed to examine the long-term effects of percussion massage therapy and other therapeutic modalities in larger randomized controlled trials.

Ethical approval

Ethical approval was obtained for this study from Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee (Date: 04.01.2024, Decision no: 3).

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