



International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

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Calgary, Alberta, T3E0A7,
Canada
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ARTICLE TITLE

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ADJUNCTIVE INTERVENTION FOR PAIN, FATIGUE, AND
FUNCTION IN FIBROMYALGIA: A LITERATURE REVIEW

DOI

[https://doi.org/10.31435/ijitss.3\(51\).2026.6052](https://doi.org/10.31435/ijitss.3(51).2026.6052)

RECEIVED

21 July 2026

ACCEPTED

22 September 2026

PUBLISHED

27 September 2026

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TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION AS AN ADJUNCTIVE INTERVENTION FOR PAIN, FATIGUE, AND FUNCTION IN FIBROMYALGIA: A LITERATURE REVIEW

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ABSTRACT

Introduction: Fibromyalgia is a chronic pain disorder characterized by widespread pain, fatigue, sleep disturbances, cognitive impairment, and reduced quality of life. Current management emphasizes patient education and non-pharmacological interventions, particularly physical activity. Transcutaneous electrical nerve stimulation (TENS) may be relevant as an adjunctive approach because of its potential to modulate pain mechanisms and support activity tolerance.

Methodology: A structured search of the PubMed database was conducted to identify studies evaluating TENS in fibromyalgia, published between 2011 and 2026. Randomized controlled trials were prioritized, particularly those assessing pain, movement-evoked pain, fatigue, physical function, quality of life, and clinical tolerability. Clinical trials, observational studies, secondary analyses, systematic reviews, and meta-analyses were also included when clinically relevant. Only English-language free full-text articles were included. The selected publications were analyzed qualitatively.

Results: The most consistent findings were observed for reductions in movement-evoked pain and fatigue, particularly when conventional TENS was applied regularly at a strong but comfortable intensity during physical activity. Effects on rest pain, objective physical function, activity levels, and quality of life were less consistent. Secondary analyses suggested that early response to TENS may help predict later clinical benefit. TENS was generally well tolerated, with mostly mild adverse events. Related transcutaneous neuromodulation approaches showed variable outcomes.

Conclusions: TENS may serve as an adjunctive non-pharmacological intervention for patients with fibromyalgia, especially for movement-evoked pain and fatigue. Further rigorously designed studies are needed to optimize stimulation protocols and identify patients most likely to benefit.

KEYWORDS

Transcutaneous Electrical Nerve Stimulation, TENS, Fibromyalgia, Movement-evoked Pain, Fatigue, Clinical Tolerability

CITATION

Marek, J., Wiśniewska, A., Czerny, I., & Daniszewski, S. (2026). Transcutaneous electrical nerve stimulation as an adjunctive intervention for pain, fatigue, and function in fibromyalgia: A literature review. *International Journal of Innovative Technologies in Social Science*, 3(51). [https://doi.org/10.31435/ijitss.3\(51\).2026.6052](https://doi.org/10.31435/ijitss.3(51).2026.6052)

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Introduction

Fibromyalgia is a chronic pain disorder marked by widespread pain, frequently accompanied by fatigue, sleep disturbances, cognitive impairment, and diminished quality of life [1,2]. Current diagnostic criteria consider both the distribution of pain and the severity of associated symptoms, with diagnosis relying primarily on clinical evaluation and standardized symptom scales [1,3]. Although the pathophysiology of fibromyalgia is complex and not yet fully elucidated, disturbances in pain processing, central sensitization, and nervous system dysregulation are recognized as significant contributing factors [2].

Fibromyalgia management is multifaceted and should be individualized based on predominant symptoms and the degree of functional impairment. EULAR recommendations emphasize patient education and non-pharmacological interventions, especially physical activity, as foundational treatments [4]. Pharmacological therapies may be appropriate for selected patients experiencing severe pain, sleep disturbances, or substantial limitations in daily functioning, but these are typically integrated within a comprehensive, personalized treatment strategy [2,4].

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive neuromodulation technique used in pain management [5,6]. In fibromyalgia, TENS may be relevant because of its potential to modulate pain mechanisms and support physical activity [4,7]. This is especially important because many patients experience symptom exacerbation during movement, which may reduce exercise tolerance and hinder adherence to therapeutic recommendations [4,7].

The aim of this paper is to present available data on the use of TENS in patients with fibromyalgia, focusing on movement-evoked pain, fatigue, physical function, and clinical tolerability.

Methodology

A structured search of the PubMed database was conducted to identify studies evaluating transcutaneous electrical nerve stimulation in fibromyalgia. Articles published between 2011 and 2026 were considered. The search terms included *transcutaneous electrical nerve stimulation*, *TENS*, *fibromyalgia*, and *fibromyalgia syndrome*, combined with the Boolean operators AND and OR. Randomized controlled trials were prioritized, particularly studies assessing pain, movement-evoked pain, fatigue, physical function, quality of life, and clinical tolerability. Clinical trials, observational studies, secondary analyses of randomized trials, systematic reviews, and meta-analyses were also included when they provided clinically relevant information. Additional articles on fibromyalgia diagnostic criteria, pathophysiology, and management recommendations were used to support the background sections. Only English-language full-text articles available as free full text were included. Studies were excluded if they focused on animal models, fibromyalgia-like syndromes related to other diseases, or mixed chronic pain populations without separate fibromyalgia outcomes. The selected publications underwent qualitative analysis, with attention to study design, patient population, stimulation parameters, treatment duration, clinical outcomes, tolerability, and methodological limitations. No quantitative synthesis or formal meta-analysis was performed.

Results

Effects of TENS on pain and movement-evoked pain

The most frequently evaluated outcome of transcutaneous electrical nerve stimulation (TENS) in fibromyalgia studies is its effect on pain, particularly movement-evoked pain. Several studies extended their assessment beyond pain at rest to include symptom intensity during functional tests, such as the 6-minute walk test and the sit-to-stand test. This approach allowed pain to be assessed in situations that more closely resemble patients' daily activities.

A randomized crossover study published in 2013 evaluated the effects of a single TENS session in patients with fibromyalgia. Of the 43 participants in the study, 2 withdrew after the first session. Participants received active TENS, placebo TENS, and no TENS in a sequential manner over three weeks, with a one-week washout period between interventions. Active TENS was administered for 30 minutes at a frequency of 100 Hz, a pulse duration of 200 μ s, and at the maximum tolerated intensity. The study found no significant differences in rest pain among the three conditions. However, pain during movement, assessed using a 6-minute walk test, was significantly lower during active TENS compared with both placebo TENS and no TENS.

These findings suggest that the short-term analgesic effect of TENS is more pronounced for movement-evoked pain than for pain at rest [6].

In the same year, a small controlled clinical trial evaluated high-frequency transcutaneous electrical nerve stimulation (TENS) as an adjunctive therapy in women with fibromyalgia. Participants were assigned to either a TENS group or a no-TENS group, with 14 individuals in each. Both groups received education about fibromyalgia, its symptoms, and the importance of physical exercise, and participated in an aerobic and stretching exercise program. The TENS group additionally received stimulation at bilateral tender points of the trapezius and supraspinatus muscles. Each 30-minute session involved continuous stimulation at 150 Hz, with a pulse duration of 150 μ s, and intensity increased every 10 minutes to achieve a strong but comfortable sensation without muscle contraction. The TENS group experienced a greater reduction in pain intensity compared with the no-TENS group. The no-TENS group also demonstrated a worsening of pain thresholds and the tender point index, which was not observed in the TENS group. Although these findings suggest that TENS may reduce pain in patients with fibromyalgia, the small sample size and lack of therapist blinding limit the strength of the evidence, and the results should therefore be interpreted as preliminary [8].

The Fibromyalgia Activity Study with TENS (FAST) is one of the key trials evaluating conventional TENS in fibromyalgia. This randomized, double-blind, placebo-controlled Phase II trial was conducted at two centers and enrolled women aged 18 to 70 years who met the 1990 American College of Rheumatology (ACR) diagnostic criteria for fibromyalgia. Participants were randomized to receive active TENS, placebo TENS, or no TENS. The active TENS protocol utilized an asymmetric biphasic waveform, a frequency range of 2 to 125 Hz, a pulse duration of 200 μ s, and the highest intensity tolerated by each participant. The intervention was self-administered at home for four weeks, with instructions to use TENS for a minimum of two hours daily during physical activity. The primary outcome was movement-evoked pain. After four weeks, the active TENS group demonstrated a 1.8-point reduction in movement-evoked pain during a 6-minute walk test on the Numeric Rating Scale (NRS), compared with baseline. This reduction exceeded that observed in the placebo TENS group (mean change -0.8) and the no-TENS group (mean -0.006), where minimal change occurred. The active TENS group also experienced significant reductions in rest pain, overall pain intensity, and pain-related functional impairment, as measured by the Brief Pain Inventory (BPI) and the revised Fibromyalgia Impact Questionnaire (FIQ). However, there was no significant difference in the use of rescue analgesics after one month among the groups. In the open-label phase, when all participants received active TENS, reductions in rest and movement-evoked pain were observed in those previously assigned to placebo or no TENS. Participants who initially received active TENS maintained reductions in both pain types after an additional four weeks. Overall, 70% of participants in the active TENS group reported improved health status, compared with 31% in the placebo group and 9% in the no-TENS group. This improvement was moderately correlated with changes in movement-evoked pain [7].

The Fibromyalgia TENS in Physical Therapy Study (FM-TIPS), a pragmatic, cluster-randomized clinical trial, provided recent data on the effectiveness of TENS in routine physical therapy settings. This study compared physical therapy combined with TENS (PT-TENS) to physical therapy alone (PT-only). A total of 384 participants completed baseline data collection. The primary endpoint was the change in movement-evoked pain from baseline to day 60 following TENS application. Asymmetric biphasic TENS was administered with a modulated frequency of 2–125 Hz, a pulse duration of 100–180 μ s, and a strong but comfortable intensity. Electrodes were positioned on the upper and lower back. Participants were instructed to use the device for 2 hours daily during activity, with each session lasting at least 30 minutes. On day 60, the PT-TENS group demonstrated significantly lower movement-evoked pain compared with the PT-only group. The mean difference was -1.2 (95% CI: -1.6 to -0.7 ; effect size $d = 0.46$). This difference was observed in both participants who met the 2016 American College of Rheumatology (ACR) criteria for fibromyalgia at baseline and those who did not. Movement-evoked pain was reduced as early as day 30 and remained lower through day 180 in within-group analyses. In the PT-only group, a reduction in movement-evoked pain was also observed after TENS was introduced during the extension phase. The FM-TIPS study also identified a dose-dependent effect, with the greatest reduction in movement-evoked pain among participants who used TENS at a predefined minimum effective dose up to day 60. Resting pain was significantly lower in the PT-TENS group on day 60 compared with the PT-only group, and this reduction persisted through day 180. The impact of pain on functioning was lower in the PT-TENS group (mean score, -0.9) than in the PT-only group (mean score, -0.3). In the PT-only group, significant improvements in multiple pain indicators were observed after TENS application, and continued TENS use in the PT-TENS group also resulted in significant improvements in these indicators [9].

A randomized trial published in 2021 evaluated the effects of a 3-month home-based intervention using either an active or sham wearable transcutaneous electrical nerve stimulation device applied to the upper calf in patients with fibromyalgia. The device delivered bipolar pulses with adjustable current intensity, a pulse duration of 290 μ s, variable leading-edge polarity, and a stimulation frequency between 60 and 100 Hz. Each session lasted 60 minutes, with subsequent sessions initiated automatically every 2 hours while the device remained attached. Participants were instructed to complete at least two 1-hour sessions daily. The primary endpoint, patient-reported overall change in health status after 3 months, did not differ significantly between the active and sham groups. However, analysis of secondary endpoints revealed that active TENS treatment resulted in a greater reduction in the total Fibromyalgia Impact Questionnaire (FIQR) score and a significantly greater decrease in pain intensity, as measured by the FIQR. The mean reduction in pain intensity was -1.83 points in the active group compared with -1.21 points in the sham group, a statistically significant difference. Additionally, improvements in pain-related functional impact, as assessed by the Brief Pain Inventory (BPI), were observed, with greater benefits noted in patients with higher baseline pain sensitivity [10].

Conventional transcutaneous electrical nerve stimulation was most frequently associated with reductions in movement-evoked pain and, in some studies, with decreases in rest pain, overall pain intensity, and pain-related functional impairment. The most consistent evidence was observed for interventions delivered during activity and evaluated through functional tasks. In contrast, findings related to rest pain and overall improvement were less consistent [6–10].

Effects of TENS on fatigue, physical function and quality of life

Beyond pain, research on transcutaneous electrical nerve stimulation (TENS) in fibromyalgia has evaluated fatigue, function, disease impact, and quality of life. Findings for these outcomes were less consistent compared with those for movement-evoked pain. Nevertheless, multiple studies identified improvements, especially in fatigue and in the subjectively measured impact of fibromyalgia on daily activities.

In a 2013 randomized crossover trial evaluating the effect of a single 30-minute TENS session in patients with fibromyalgia, one of the main objectives was to determine the intervention's impact on fatigue and function. Active TENS was associated with a reduction in movement-evoked fatigue, whereas no comparable effect was observed for fatigue assessed at rest. In the active TENS group, no significant change in function was observed, as assessed by functional measures such as the 6-minute walk test, the sit-to-stand test, single-leg standing, and range of motion, compared with the placebo TENS and no TENS groups. After completing treatment, patients rated effectiveness on a scale from 0 to 10. A significant difference in perceived effectiveness was noted between the active TENS group (6.31 ± 0.34) and the placebo TENS group (3.96 ± 0.39) [6].

A small controlled clinical trial published in 2013 evaluated high-frequency TENS as an adjunct to aerobic exercise and stretching in women with fibromyalgia. Selected components of the Fibromyalgia Impact Questionnaire, which measures the impact of fibromyalgia on quality of life, were assessed. Patients in the TENS group demonstrated clinically significant improvements in pain, fatigue, work performance, stiffness, anxiety, and depression. In contrast, the no-TENS group showed improvements primarily in morning tiredness and depression [8].

In the FAST study, fatigue was designated as one of the main secondary endpoints and was evaluated both at rest and with movement using an 11-point numerical rating scale and the Multidimensional Assessment of Fatigue (MAF). The active TENS group demonstrated a significant reduction in movement-evoked fatigue after four weeks compared with both the placebo TENS and no-TENS groups. Significant differences were also observed between the active TENS group and the other groups for fatigue at rest and the MAF global fatigue index. The study further evaluated function, disease impact, quality of life, and selected psychological factors. Active TENS was associated with a reduction in disease impact, as measured by the revised FIQ, and an improvement in subjectively assessed functioning on the FIQ function subscale compared with no TENS, but not compared with placebo TENS. No significant differences were identified between groups in objectively assessed function, including the 6-minute walk test and the 5-repetition sit-to-stand test. Additionally, no differences were found in physical activity, as measured by accelerometry and the International Physical Activity Questionnaire-Short Form (IPAQ-SF), or in quality of life, as assessed by the Short Form 36 (SF-36) Health Survey, except for a slight reduction in depression on the Patient-Reported Outcomes Measurement Information System (PROMIS) in the active TENS group [7].

The FM-TIPS study evaluated the effects of TENS on fatigue and the overall impact of fibromyalgia. At day 60, both movement-evoked and resting fatigue were significantly reduced in the PT-TENS group compared with the PT-only group. This reduction in fatigue persisted through day 180 in the PT-TENS group.

After TENS was introduced during the extension phase, participants who initially received only physical therapy also experienced reductions in both resting and movement-evoked fatigue. The study identified a dose-response relationship for these fatigue parameters. General fatigue, as measured by the Multidimensional Assessment of Fatigue (MAF), was lower in the PT-TENS group at day 60, with improvements observed in both groups by day 180. The impact of fibromyalgia, assessed using the Fibromyalgia Impact Questionnaire Revised (FIQR), was also lower in the PT-TENS group at day 60, and this difference remained until day 180. After TENS was introduced during the extension phase, the PT-only group also demonstrated improvement in disease impact. A greater proportion of patients in the PT-TENS group reported overall improvement in health status at day 60 compared with the PT-only group, 72% and 51%, respectively. By day 180, the proportion of patients reporting improvement was similar in both groups (67% in the PT-TENS group, and 77% in the PT-only group after TENS was introduced) [9].

A 2021 randomized trial investigating wearable transcutaneous electrical nerve stimulation included the assessment of fibromyalgia disease impact as a secondary endpoint, measured by the FIQR. The active group demonstrated a 13.49-point reduction in total FIQR score, compared with a 6.02-point reduction in the sham group. This statistically significant difference of -7.47 points corresponded to an effect size of 0.55 [10].

The most consistent findings relate to the effects of TENS on fatigue, especially movement-evoked fatigue, and on subjectively assessed fibromyalgia disease impact. In contrast, the effects on objective measures of physical function, activity levels, and quality of life were less consistent [6–10].

Treatment response, pain modulation and clinical tolerability

Several studies and secondary analyses evaluated factors associated with TENS response, pain modulation parameters, and clinical tolerability. These included the early response to the initial TENS session, opioid analgesic use, pressure pain thresholds, conditioned pain modulation, and selected neurophysiological parameters.

A secondary analysis of the FAST study investigated whether the response during the initial 30-minute session of active TENS could predict the response after one month of home use. In the randomized phase, 44% of participants were classified as pain responders and 45% as fatigue responders. The validation cohort showed similar proportions, with 46% for pain and 45% for fatigue. A greater reduction in movement-evoked pain during the first TENS session was the strongest predictor of pain response after one month. Achieving at least a 10% reduction in pain during the initial session predicted at least a 30% reduction in pain after one month, with a sensitivity of 87% and specificity of 68%. The positive predictive value was 75%, and the negative predictive value was 84%. For fatigue, any reduction in movement-evoked fatigue during the first TENS session predicted at least a 20% reduction in fatigue after one month, with 74% sensitivity and 60% specificity. Pain responders had lower baseline scores on the Widespread Pain Index (WPI), Symptom Severity Scale (SSS), and Fibromyalgia Severity Scale (FSS) than non-responders. However, incorporating WPI or FSS parameters into the predictive model did not improve performance compared with using early pain response to TENS alone. Regarding fatigue response, responders were more likely to be married and to report fewer sleep disturbances. To assess the utility of TENS compared with other interventions, the number needed to treat (NNT) was calculated, representing the number of patients who must be treated to achieve one additional patient with a treatment response. The NNT was 3.3 for pain compared with no TENS and 4.5 for pain compared with placebo TENS. For fatigue, the NNT was 4.5 and 5.3, respectively [11].

Another secondary analysis of the FAST study assessed the effects of opioid analgesics on TENS outcomes. Participants were categorized into those taking tramadol or other opioids and those not using these medications. Women in the opioid group had greater baseline disease impact, lower physical health-related quality of life, and greater burden on selected pain and fatigue measures. Following TENS application, reductions in resting pain, movement-evoked pain, and fatigue were comparable between opioid users and non-users. No significant differences were identified between these groups in mean changes during active TENS or in comparisons of active TENS with placebo TENS or no TENS. Comparable results were observed when the opioid group was further divided into tramadol users and users of other opioids [12].

Parameters related to pain modulation were evaluated in both short-term studies and secondary analyses of the FAST trial. In a randomized crossover study published in 2013, a single 30-minute session of active TENS resulted in reductions in movement-evoked pain and fatigue, as well as increased pressure pain thresholds. These increases were observed at the TENS application site and at distant locations, including the tibialis anterior muscle. Additionally, pain threshold values in response to conditioned pain modulation were higher during active TENS compared with placebo TENS [6].

A secondary analysis of the FAST study, published in 2024, assessed the effects of TENS on pressure pain thresholds and conditioned pain modulation. Baseline pressure pain thresholds were significantly lower in participants with fibromyalgia compared with healthy controls. After four weeks of active TENS, no significant differences in pressure pain thresholds or conditioned pain modulation were found among the active TENS, placebo TENS, and no-TENS groups. Extending active TENS use for an additional four weeks did not result in significant increases in these measures across the entire cohort. Among movement-evoked pain responders, a greater increase in pressure pain thresholds was observed compared with non-responders. No corresponding difference was identified for conditioned pain modulation [13].

Additional evidence regarding the neurophysiological effects of TENS is provided by smaller experimental studies. A clinical trial published in 2019 investigated the impact of TENS and acupuncture on quantitative electroencephalography (qEEG) recordings and therapeutic outcomes in patients with fibromyalgia syndrome. After TENS application, a significant reduction in pain intensity measured by the visual analogue scale (VAS) was reported, accompanied by alterations in theta and alpha wave activity in specific brain regions. The authors suggested that the increased alpha power in the left frontal region following TENS may reflect heightened activity of inhibitory neurons. Notably, the study did not evaluate the persistence of EEG changes after the intervention [14]. Another study employing functional near-infrared spectroscopy examined cerebral hemodynamic responses to nociceptive stimuli during concurrent TENS application in both fibromyalgia patients and healthy controls. This study included 19 right-handed individuals with fibromyalgia and 17 healthy right-handed participants. During non-dominant-hand stimulation, TENS produced a comparable reduction in brain activity in both groups. However, during dominant-hand stimulation, cerebral hemodynamic activity increased in patients with fibromyalgia but decreased in healthy participants [15].

Clinical tolerability data for TENS were primarily available from the FAST and FM-TIPS studies. In the FAST study, 30 adverse events attributed to TENS were reported in 30 participants. The most frequently observed events were pain during TENS application and skin irritation at the electrode sites. The four serious adverse events documented in the study were unrelated to TENS use [7]. Analysis of response predictors did not reveal any serious adverse events associated with TENS. For individual mild adverse events, the number needed to harm (NNH), defined as the number of individuals who must be treated for one to experience an adverse event, ranged from 20 to 100 compared with placebo TENS or no TENS [11].

The FM-TIPS study did not report any serious adverse events related to TENS. Minor adverse events included pain during TENS use, skin irritation at the electrode application site, itching, anxiety, and nausea. On day 180, 81% of participants reported finding TENS helpful [9].

In the study evaluating wearable TENS, adverse events included rash at the device application site, numbness and tingling, and muscle cramps. Twelve adverse events were reported in total, with nine considered related or possibly related to TENS. All were minor and self-limiting [10].

In summary, the response to TENS was partially predictable, as indicated by early reductions in pain and fatigue during the initial session. Findings regarding pain modulation were inconsistent. While short-term studies demonstrated changes in pressure pain thresholds and neurophysiological parameters, regular TENS use in the FAST study population did not lead to significant alterations in pressure pain thresholds or conditioned pain modulation. TENS was generally well tolerated, and most reported adverse events were mild [6,7,9–15].

Related transcutaneous neuromodulation approaches

Several studies have evaluated interventions related to conventional TENS, including transcutaneous stimulation of the posterior tibial nerve, use of the EXOPULSE Mollie Suit, and transcutaneous vagus nerve stimulation. These approaches differ from conventional TENS in terms of application site, stimulation parameters, and neuromodulatory targets [16–19].

A randomized, sham-controlled crossover trial published in 2025 assessed the effect of the EXOPULSE Mollie Suit on pain and other symptoms associated with fibromyalgia. The device consists of clothing with integrated electrodes and enables non-invasive electrical stimulation of multiple nerves and their associated muscle groups across the body. During the randomized phase, participants received one hour of active or sham stimulation daily for two weeks, separated by a two-week washout period. In the subsequent open-label phase, all participants underwent four weeks of daily active stimulation. Active stimulation was administered at rest, using a frequency of 20 Hz and a constant voltage of 20 V. After the active intervention in the randomized phase, a significant reduction in pain was observed on the VAS. Pain reduction was also observed in selected measures of the BPI, FIQ, and SF-36. Active stimulation was further associated with reduced fatigue as measured by the FIQ and improved vitality on the SF-36, although no change in fatigue was detected on the

VAS. In the open-label phase, after four weeks of daily active stimulation, 78.8% of patients reported improvement according to the Clinical Global Impression of Change (CGI-C). The intervention was well tolerated, with no serious adverse events reported [16].

A randomized controlled trial published in 2023 investigated the efficacy of transcutaneous posterior tibial nerve stimulation (PTNS) as an adjunct to duloxetine in patients with fibromyalgia. All participants received duloxetine, while the intervention group also underwent six PTNS sessions. Stimulation was administered for 30 minutes twice weekly using biphasic pulses at 10 Hz and a pulse duration of 200 μ s. Both groups demonstrated improvement in pain and FIQ scores after treatment. However, no significant differences were identified between groups at the first and third months. In the quality-of-life assessment, improvement was confined to the vitality domain of the SF-36 in the first month and was present in both groups. No complications associated with duloxetine or PTNS were reported. In this study, the addition of PTNS to pharmacological treatment did not provide further pain reduction or an additional decrease in fibromyalgia severity compared with duloxetine alone [17].

A randomized, sham-controlled trial published in 2022 compared two non-invasive methods of vagus nerve modulation: transcutaneous vagus nerve stimulation (tVNS) and meditative diaphragmatic breathing. Participants were assigned to a group receiving active or sham tVNS, or active or sham breathing intervention, performed independently twice daily, in the morning and evening for 15 minutes each, for two weeks. The primary endpoint was heart rate variability parameters measured using photoplethysmography. No significant differences were found between groups in any cardiac-vagal parameters. Secondary outcomes revealed differences in current pain intensity and overall fibromyalgia severity between groups. However, no differences were observed in fibromyalgia symptom severity, generalized pain, or mean pain intensity over the past week. One participant in the active tVNS group discontinued treatment due to chest discomfort and additional pain associated with stimulation. No other serious adverse events were reported [18].

An observational pilot study published in 2026 evaluated the effects of non-invasive auricular vagus nerve stimulation in women with fibromyalgia. Participants underwent tVNS for 28 days, five days a week, in two 30-minute sessions per day. Following treatment, a significant reduction in the total Fibromyalgia Impact Questionnaire Revised (FIQR) score was observed, along with an improvement in the total Composite Autonomic Symptom Score 31 (COMPASS-31) and improvements in specific autonomic domains, particularly orthostatic, vasomotor, and pupillomotor. PainDETECT (PDQ) and the Central Sensitization Inventory-Short Form (CSI-9) scores also improved, suggesting reductions in neuropathic pain features and central sensitization. The change on the Pain Catastrophizing Scale (PCS) did not reach statistical significance. All patients completed the treatment, and adverse events were mild and transient [19].

Overall, related transcutaneous neuromodulation approaches showed variable outcomes.

Discussion

The available data suggest that TENS may be beneficial as an adjunctive treatment for fibromyalgia symptoms, particularly for movement-evoked pain and fatigue. The most consistent findings are associated with the regular use of conventional TENS at a strong but comfortable intensity during physical activity. In the FAST and FM-TIPS studies, the greatest improvements were observed in pain and fatigue measured during functional tests, while effects on objective measures of physical function, physical activity, and quality of life were less definitive. These findings suggest that TENS may primarily reduce movement-evoked symptoms but may not result in immediate improvements in physical function [7,9].

Previous systematic reviews and meta-analyses have identified important limitations in the existing evidence base [5,20,21]. A 2017 Cochrane review included eight studies with 315 adult patients. However, the intervention groups were small, and the studies were characterized by unclear or high risk of bias. The authors concluded that statistical pooling of results was not possible due to insufficient and heterogeneous data, and the available evidence was inadequate to support or refute the use of TENS in fibromyalgia [5]. Another meta-analysis on electrical stimulation in fibromyalgia included nine randomized trials with 301 patients and found that electrical stimulation may reduce pain compared with control. Nevertheless, the quality of evidence was rated as low, primarily due to the limited number of studies and small sample sizes [20]. A 2018 meta-analysis of physical-agent pain-relief modalities reported a significant reduction in VAS scores following TENS, but only one relevant RCT was identified, limiting the strength of the conclusions [21]. More recent studies, such as FAST and FM-TIPS, have contributed additional data, yet their findings must be interpreted in light of the persistent limitations of the available studies [7,9].

The role of TENS in fibromyalgia treatment should be considered primarily as adjunctive therapy. Current management of fibromyalgia is based on a multifaceted approach, with patient education and physical activity as central components [4]. TENS should not be viewed as a substitute for comprehensive treatment. However, it may complement non-pharmacological interventions, especially for patients who experience increased pain and fatigue during movement [4,7,9]. In this context, TENS may facilitate physical activity by reducing movement-evoked pain and fatigue [7,9].

From a practical standpoint, the parameters and method of TENS application are of significant importance. The most thoroughly documented protocols involved stimulation at a strong but comfortable intensity, applied regularly and during activity [7,9]. Data from the FAST secondary analysis suggest that the response during the initial 30-minute session may predict subsequent treatment response. This early assessment could inform clinical decisions regarding the likelihood of patient benefit from continued TENS therapy [11].

TENS was generally well tolerated. The most frequently reported adverse events were pain during stimulation, skin irritation at electrode application sites, and itching. In the FAST study, 30 adverse events were attributed to the TENS intervention, whereas 4 serious adverse events were determined to be unrelated to TENS use. In the FM-TIPS study, no serious adverse events associated with TENS were reported. Good tolerability is important, given that fibromyalgia is a chronic condition and supportive interventions must be suitable for home use [7,9].

Limitations of the available data include heterogeneity in stimulation protocols, differences in intervention durations, varying endpoints, and difficulties in achieving full participant blinding [5,7,20,21]. Several studies had small sample sizes or included only women, which restricts the generalizability of findings to the broader population of patients with fibromyalgia [5,7]. The effect of TENS on objectively measured physical function, long-term activity levels, and quality of life remains less clear compared with its effect on movement-evoked pain and fatigue [7,9]. Furthermore, findings from studies on related transcutaneous neuromodulation approaches should not be directly equated with data regarding conventional TENS [16–19].

Future studies should include larger, rigorously controlled trials with extended follow-up periods and more standardized endpoints. It would be particularly important to determine the optimal stimulation parameters, minimum effective treatment duration, and which patients are most likely to benefit from TENS. Additional studies are required to assess whether reductions in movement-evoked pain and fatigue result in sustained increases in physical activity, improved functional outcomes, and enhanced quality of life [5,7,9,11,20]. Further studies on related transcutaneous neuromodulation techniques are also needed, given the current limitations and heterogeneity of available data [16–19].

Conclusions

Transcutaneous electrical nerve stimulation (TENS) may serve as an adjunctive non-pharmacological intervention for patients with fibromyalgia, particularly in reducing movement-evoked pain and fatigue. TENS appears to be generally well tolerated, and the reported adverse effects were mostly mild. Further rigorously designed studies are required to optimize stimulation protocols, identify patients who are most likely to benefit from TENS, and determine whether symptom reduction leads to sustained functional improvement.

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Conflict of Interest Statement: Authors have declared no conflict of interest.

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