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EFFECTIVENESS OF FUNCTIONAL MAGNETIC STIMULATION VERSUS CONVENTIONAL PHYSIOTHERAPY IN MYOFASCIAL PAIN SYNDROME OF UPPER TRAPEZIUS: A MATHEMATICAL MODELLING WITH RANDOMIZED CONTROLLED TRIAL

Physiotherapy

Dr. Shreya Mishra* Assistant Professor, Department of Physiotherapy, School of Liberal Arts and Sciences, Mody University of Science and Technology, Laxmangarh-332311, Sikar, Rajasthan, India *Corresponding Author

Shilpa Jain Former Professor and Principal, College of Physiotherapy and Rehabilitation, Maharishi Markandeshwar University, Sadopur, Ambala

Jitendra Binwal Professor& Dean, Department of Mathematics, School of Liberal Arts and Sciences, Mody University of Science and Technology, Laxmangarh-332311, Sikar, Rajasthan, India

ABSTRACT

Background: Myofascial pain syndrome (MPS) is a common musculoskeletal disorder that is often linked to active myofascial trigger points (MTrPs) in the upper trapezius. This condition causes pain, disability, and a lower quality of life. Functional magnetic stimulation (FMS) is a new, non-invasive way to treat deep tissue without touching the skin, unlike traditional physiotherapy.**Objective:** To evaluate the effectiveness of FMS compared with conventional physiotherapy in reducing pain, improving cervical range of motion (ROM), and lowering disability in patients with MPS of the upper trapezius.**Methods:** In this parallel-group randomized controlled trial, 54 participants aged 18–45 years with active myofascial trigger points in the upper trapezius were assigned to two groups. Group A (n = 27) underwent FMS therapy for three weeks, attending three sessions per week. Group B (n = 27) underwent standard physiotherapy. Pain (VAS), cervical range of motion (goniometry), and the Neck Disability Index (NDI) were evaluated at baseline and after three weeks.**Results:** Group A demonstrated significantly greater improvements across all outcomes compared to Group B, including reductions in pain intensity and improvements in Neck mobility and NDI.**Conclusion:** FMS is a safer and more effective treatment for upper trapezius MPS patients than traditional physiotherapy for reducing pain, increasing neck mobility, and lowering disability. More extensive and prolonged trials are necessary.

KEYWORDS

Functional Magnetic Stimulation, Myofascial Pain Syndrome, Trigger Points, Upper Trapezius, Randomized Controlled Trial

INTRODUCTION

Musculoskeletal diseases (MSDs) are one of the main causes of pain and disability in the world. They have a big impact on quality of life, healthcare costs, and productivity. According to the Global Burden of Disease study, MSDs are the second biggest cause of years lived with disability around the world [1,2]. Neck pain has become more common, especially among young people and office workers, because of long hours spent on the computer, sitting still, and always having their heads forward [3,4].

Myofascial pain syndrome (MPS), a chronic pain disorder characterized by the formation of myofascial trigger points (MTrPs) in tense muscular bands, is a major contributor to neck pain. There are two kinds of MTrPs: latent, which only hurt when touched, and active, which hurt both on their own and when they are touched. Active MTrPs are most common in the upper trapezius muscle and can cause stiffness, pain, limited neck movement, and problems with daily activities [5,6]. MPS has a complex pathophysiology that includes peripheral and central sensitization, prolonged sarcomere contraction, local ischemia, increased metabolic demand, and the release of chemicals that increase sensitivity, such as bradykinin, prostaglandins, and substance P. For MPS, common treatments include pharmacotherapy, manual therapy, dry needling, stretching, ultrasound therapy, thermotherapy, and exercise. The fact that traditional treatments often provide only temporary relief and may be invasive or difficult for some patients to tolerate underscores the importance of finding new, non-invasive, and effective therapies [7,8]. Functional Magnetic Stimulation (FMS) is a new way to treat people that uses high-intensity, pulsed electromagnetic fields to depolarize peripheral nerves, which causes painless, repeated muscle contractions. These contractions enhance local blood circulation, interrupt the harmful cycle of prolonged sarcomere contraction, and reduce metabolic stress at the myofascial trigger point [11,12]. FMS has been examined in numerous neurological and musculoskeletal disorders; however, its use in MPS, particularly in the upper trapezius, remains underinvestigated.

Common treatments for myofascial pain syndrome (MPS) include thermotherapy, stretching, ultrasound therapy, manual trigger-point release, dry needling, and medication. Even though these treatments might help with symptoms, they have a lot of problems, like causing pain, making the problem worse, and being invasive [9,10]. Consequently, there is increasing demand for alternative, non-invasive therapeutic strategies that can effectively address the fundamental pathophysiology of myofascial trigger points (MTrPs) while enhancing patient adherence.Various treatments for upper trapezius MPS have been investigated, including shockwave therapy and ultrasound, as well as complementary methods such as acupuncture and photobiomodulation [13–15]. Prior research indicates that the integration of extracorporeal shockwave therapy with ultrasound-guided lidocaine trigger point injection yields superior reductions in pain and muscle elasticity relative to shockwave therapy administered in isolation. Comparative studies of kinesio taping, dry needling, and lidocaine injection have shown that each method can effectively reduce MPS symptoms, but none has been shown to be better than the others [16]. Additionally, the combination of photobiomodulation therapy and exercise has been shown to reduce pain and increase the pressure pain threshold, while ultrasound-based therapies provide immediate pain relief and improved function [17]. Instrument-assisted soft tissue mobilization and myofascial release are two types of manual therapy that have been shown to improve range of motion and reduce pain. Moreover, treatments like acupuncture, integrated neuromuscular inhibition techniques, and TECAR therapy have shown promising results in lowering symptom severity and enhancing functional outcomes in patients with upper trapezius myofascial pain syndrome [18].

There are several similar studies; for instance, one study compared Instrument-Assisted Soft Tissue Mobilization (IASTM) and Manual Myofascial Release (MFR) for treating myofascial pain syndrome in the upper trapezius. In a single-blind, randomized controlled trial, 31 participants received either IASTM or manual MFR, along with conventional therapy, for 1 week. Both treatments significantly reduced pain and improved pain pressure threshold, cervical range of motion, and neck function. Although IASTM showed slightly greater pain reduction, overall improvements were similar, indicating that both techniques are effective treatment options [14]. In another study, Taheri et al. performed a randomized clinical trial to evaluate the effectiveness of transfer energy capacitive and resistive (TECAR) therapy for treating myofascial pain syndrome in the upper trapezius. Fifty patients were randomly assigned to either TECAR therapy with conventional treatment or conventional treatment alone. Outcomes were assessed using the Numeric Pain Scale, Neck Disability Index, and Shoulder Pain and Disability Index before treatment, after

treatment, and one month later. The study aimed to determine whether adding TECAR therapy improves pain and functional outcomes compared to conventional therapy alone [19]. Chen et al. (2025) performed a randomized controlled trial comparing the ultrasound-guided myofascial hydrodissection technique (UMHT) with lidocaine trigger point injection (TPI) for treating myofascial pain syndrome of the upper trapezius. Forty-two patients were randomly assigned to either the UMHT or TPI group. Pain intensity was measured using the Visual Analog Scale, while the SF-MPQ and Neck Disability Index assessed pain characteristics and disability. The study was conducted at West China Hospital under ultrasound guidance and in accordance with CONSORT ethical guidelines [15].

Several limitations are associated with these studies. First, most studies had relatively small sample sizes (31–50 participants), which may limit the statistical power and generalizability of the findings. Second, the short duration of treatment and follow-up periods (e.g., one week or one month) makes it difficult to determine the long-term effectiveness and sustainability of the therapeutic outcomes. Third, some studies used single-blinded or partially blinded designs, which may introduce performance or assessment bias. In addition, the use of adjunct conventional therapies (such as stretching exercises, medication, or other physiotherapy modalities) makes it challenging to isolate the independent effect of the specific intervention being studied. Finally, most trials focused only on upper trapezius MPS, limiting the applicability of the results to myofascial pain in other muscle groups.

The objective of this study was to compare the effectiveness of Functional Magnetic Stimulation (FMS) and Conventional Physiotherapy (CP) in managing Myofascial Pain Syndrome (MPS), with particular emphasis on pain reduction, improvements in functional ability, and enhanced quality of life among affected individuals.

Method

This randomised controlled experiment was undertaken to evaluate the efficacy of Functional Magnetic Stimulation (FMS) combined with Conventional Physiotherapy (CP) in patients with myofascial pain syndrome (MPS) of the upper trapezius. The research complied with the Declaration of Helsinki (2013 revision) and received ethical approval from the Institutional Ethics Committee before participant recruitment. Written informed consent was obtained from all participants before enrolment. 54 Participants aged 18 to 45 years, clinically diagnosed with upper trapezius myofascial pain syndrome according to established diagnostic criteria of presence of Myofascial Trigger Points (MTrPs) as per Travell and Simons'Criteria (presence of palpable taut band, hypersensitive trigger point, and referral pain pattern with restricted ROM, and reproduction of pain on palpation), were enlisted for the study with duration of pain more than 3 months scoring between 3 and 10 and Neck Disability Index (NDI) score between 20 to 35. Exclusion criteria included cervical trauma or surgery, radiculopathy, neurological or psychiatric disorders, malignancy, recent injections/dry needling, systemic illness, anticoagulant use, pregnancy, or intolerance to magnetic/electrotherapy.

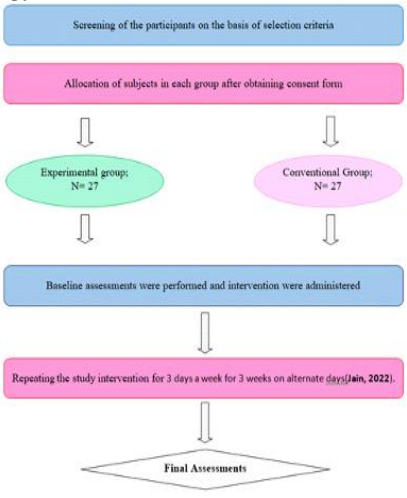

Fig 1. Procedure followed for the study

The study was prospectively registered with the Clinical Trials Registry India, National Institute of Medical Statistics (Indian Council of Medical Research), with registration number CTRI/2024/05/067997.

54 Eligible participants were randomly allocated in a 1:1 ratio to either Group A (FMS) or Group B (CP). Randomisation was performed using a computer-generated sequence devised by an independent researcher uninvolved in participant evaluation or treatment. Allocation secrecy was maintained by using sealed opaque envelopes, which the treating therapist unsealed at the onset of the initial intervention. Participant and therapist blinding was impracticable due to the nature of the interventions (Figure 1).

Interventions

Functional Magnetic Stimulation (Group A)

The experimental group underwent therapy via the BTL-6000 Super Inductive System. Patients were positioned prone on a plinth, with arms at rest, and the stimulation coil was placed directly over the upper trapezius myofascial trigger point. The intensity was established at 30–40% of predetermined values, modified according to patient tolerance, while the frequency was set for neuromuscular activation – There were 9 sessions, each lasting ten minutes and happening three times a week for three weeks. The aim was to get painless, repetitive contractions that would improve blood flow, reduce sarcomere contracture, and lower metabolic stress at the myofascial trigger point (MTrP). Safety precautions were strictly followed, including the removal of metallic equipment and the avoidance of hazardous situations.

Conventional Physiotherapy Treatment (Group B)

The control group got a systemic multimodal physiotherapy program. For 20 minutes, hot fomentation was used to relax the trapezius and improve circulation. After that, gentle trapezius stretching was done within pain-free limits to improve flexibility. Continuous-mode ultrasound therapy (frequency: 1 MHz, intensity: 1 W/cm²) was administered for 5 minutes immediately over the myofascial trigger point (MTrP). Each session lasted roughly 30 minutes and was conducted three times weekly for three weeks.

Outcome measures

Evaluations were performed at baseline (pre-intervention) and after three weeks (post-intervention). Pain severity was assessed with the Visual Analogue Scale (VAS). Cervical/Neck range of motion (ROM) in flexion, extension, lateral flexion (left/right), and rotation (left/right) was evaluated with a universal goniometer in accordance with standardized protocols. The Neck Disability Index (NDI) was employed to assess functional impairment associated with neck pain (Table 1). All outcome measures were documented by a blinded, trained assessor.

Table 1 Comparison of all the interventions on all the neck range of motion, VAS, and neck disability index.

GROUP	Experimental Group (A)	Conventional Group (B)
	(N=27)	(N=27)
Variable	Mean(SD)	Mean(SD)
Cervical Flexion Baseline	29.7(4.28)	29.07(3.33)
Cervical Flexion- After 3 weeks	37.33(3.05)	30.67(3.27)
Cervical Extension Baseline	17.3(3.24)	17.33(2.91)
Cervical Extension- After 3 weeks	21.52(2.61)	17.93(2.99)
Cervical Lateral Flexion (Left) Baseline	15.93(1.27)	16.26(1.29)
Cervical Lateral Flexion (Left)- After 3 weeks	18.89(1.60)	16.63(1.18)
Cervical Lateral Flexion (Right) Baseline	21.37(4.00)	21.81(2.71)
Cervical Lateral Flexion (Right)- After 3 weeks	29.41(4.64)	22.56(2.76)
Cervical Rotation (Right) Baseline	22.15(2.27)	22.44(1.95)
Cervical Rotation (Right)- After 3 weeks	28.56(2.28)	22.93(1.80)
Cervical Rotation (Left) Baseline	21.56 (2.39)	21.19(2.34)
Cervical Rotation (Left)- After 3 weeks	27.48(2.33)	21.78(2.01)

Visual Analog Scale Baseline	7.04(0.90)	7.11(0.89)
Visual Analog Scale- After 3 weeks	3.63(1.15)	6.48(0.75)
Neck Disability Index Baseline	28.78(3.23)	29.89(2.42)
Neck Disability Index- After 3 weeks	14.96(3.62)	28.22(3.11)

RESULTS

Of the 67 screened participants, 54 met the inclusion criteria and were randomized into two groups of 27 each. Both groups were found to be good post-intervention. Intervention by FMS exhibited better results than conventional physiotherapy treatment in different outcomes.

Effect on Pain Intensity

Group A exhibited a considerable improvement on VAS 7.04 (0.9) to 3.63 (1.15), $p < 0.001$, but Group B had a minor reduction in pain intensity 7.11(0.89) to 6.48 (0.75), $p = 0.04$. The comparison between groups supported FMS ($p < 0.001$).

Effect on Neck Disability Index

The Neck Disability Index indicated a significant decrease in Group A (28.78 (3.27) to 14.96 to(3.62), $p < 0.001$). Group B had negligible alteration (29.89 (2.42) to 28.22 (3.11), $p = 0.12$). The difference between groups was substantial ($p < 0.001$).

Effect on Neck Range of Motion

The experimental group (Group A) consistently showed greater improvements in cervical range of motion than the conventional group (Group B) over three weeks. Group A had significant improvements in cervical flexion and extension, while Group B displayed only negligible alterations. Enhancements were also apparent in lateral flexion (left and right) and rotation (left and right), with Group A exhibiting much greater gains than Group B. Cervical right lateral flexion showed the greatest improvement, underscoring the efficacy of the experimental intervention across multiple movement planes (Table 1).

DISCUSSION

The current investigation examined the impacts of the FMS and traditional physiotherapeutic interventions on patients diagnosed with myofascial pain syndrome localized in the upper trapezius region. The findings indicated that FMS yielded markedly greater improvements in pain relief, cervical range of motion, and the Neck Disability Index (NDI) than conventional therapeutic approaches, thereby corroborating our initial hypothesis.

According to VAS scores, it decreased significantly in both groups, but even more in the FMS group. This suggests that magnetic stimulation may be more effective than superficial methods such as ultrasound and heat for pain relief. FMS causes repetitive, painless muscle contractions that enhance blood flow, reduce local ischemia, and eliminate the agents that trigger nociception . Prior research has demonstrated similar benefits of FMS in musculoskeletal pain disorders, validating our findings ' .

Neck flexion, extension, lateral flexion, and rotation showed greater improvement in the FMS group compared to the control group. Restoring range of motion is crucial for clinical reasons because limited mobility signals MPS and directly impacts functional independence. The improved outcomes may be attributed to FMS's ability to reduce muscular stiffness and break the chronic contracture cycle at the MTrP. Conversely, traditional physiotherapy, although helpful, primarily provides temporary relaxation and minimal pain relief, which may not be sufficient to produce significant biomechanical improvements.

The NDI scores decreased significantly in the FMS group, showing they were able to do more and experienced less impairment. Since the NDI is a patient-reported measure, our results emphasize both physiological improvements and an increased perceived quality of life in the experimental group.

The current randomized controlled trial showed that FMS produced significantly greater improvements in pain relief, cervical range of motion, and neck disability compared to traditional physiotherapy in patients with upper trapezius myofascial pain syndrome. After three weeks of treatment, participants receiving FMS experienced a significant decrease in VAS scores (from 7.04 to 3.63) and a notable reduction in Neck Disability Index scores (from 28.78 to 14.96), along with substantial improvements in cervical mobility across all movement planes. These results align with the study by Lee and Kim (2025), which reported that magnetic field therapy significantly enhanced muscle tone, posture, and scapular alignment in individuals with upper trapezius myofascial pain syndrome. Their findings also indicated that magnetic stimulation decreases muscle tension and enhances tissue elasticity, supporting the mechanism proposed in the present study for the superior outcomes observed with FMS [20].

Similarly, Patil et al. (2025) reported that IASTM produced greater reductions in pain and improvements in cervical range of motion compared with conventional physiotherapy alone. Although their intervention relied on mechanical stimulation of soft tissues, the improvements in mobility and pain relief are comparable to those observed with FMS in the current study, suggesting that targeted stimulation of affected tissues plays a key role in managing myofascial trigger points [5].

In addition, the study by Khalid et al. (2025) found that cervical spine manipulation significantly improved cervical range of motion and pressure pain threshold in patients with upper trapezius trigger points [21]. Likewise, Morsi et al. (2025) demonstrated that Muscle Energy Technique (MET) and Strain Counterstrain (SCS), when combined with physiotherapy, resulted in greater reductions in pain intensity and disability compared with physiotherapy alone. These findings align with the present results, as both manual and neuromuscular techniques appear effective in improving functional outcomes in myofascial pain syndrome [22].

In addition, several studies have been conducted on the MPS of the upper Trapezius, either alone or in combination with other methods, and these are briefly summarized in Table 2 below.

Table 2: Techniques used for treatment of myofascial pain syndrome of the upper trapezius

Technique used	Combined with methods	Outcome of the study	References
MET	Ischemic Compression and Ultrasound	Significant improvement in pain and ROM after one week.	[23]
MFR	None	Effective in reducing neck pain and improving functional motion.	[24]
Pulsed Nd: YAG Laser	Progressive Pressure Release Technique (PPRT) and Exercises	Significant improvement in cervical range of motion (CROM), pressure pain threshold (PPT), and pain reduction on VAS. More effective than a placebo laser with PPRT.	[25]
MFR	Hold Relax Technique	Significant reduction in pain for garment workers with upper trapezius MPS.	[26]
MFR	Isometrics	Slightly more effective in pain alleviation and ROM improvement compared to isolated MFR. Both interventions were effective.	[27]
Neuromuscular taping	Contract relax stretching (CRS)	Significant reduction in neck pain.	[28]
Infrared (IR) and Ultrasound (US)	MFR and CRS	Reduction in pain, muscle spasm, improvement in ROM and muscle strength.	[29]

ASTM	Conventional Treatment	More effective than manual MFR in reducing pain. Both methods improved PPT, ROM, and function equally.	[14]
Dry Needling	Laser therapy	Both methods effective in reducing pain and improving cervical range of motion and quality of life	[30]
MFR Therapy	Positional release therapy	Effective in improving pain, neck impairment, and quality of life	[31]
Algometric Pressure Release (APR)	Conventional physical therapy	More effective than post-isometric relaxation in decreasing pain and improving neck function	[32]
UMHT	None	Significant reduction in pain (VAS), improved function (NDI), comparable to lidocaine injection	[15]
Dry needling	Balneotherapy	Improved pain, mood, anxiety, kinesiophobia, disability, and quality of life; the combination increased treatment success	[33]
Effleurage and petrissage	Combined Manual Pressure Release	Effective in improving the range of motion, decreasing pain, and releasing trigger points	[34]
Cervical spine manipulation	Conventional Physical Therapy	Increased cervical range of motion and pressure pain threshold	[21]
MFR	None	More effective in reducing pain compared to cervical isometric exercises	[37]
MET	Physiotherapy	Significant improvement in pain intensity, pressure pain threshold, and cervical range of motion	[22]
Dry needling	Strain Counterstrain	Effective in reducing trigger points, improving pain, and enhancing range of motion	[36]
Phonophoresis with Succinylcholine	None	Effective in reducing pain intensity significantly	[38]

The findings of the present study are consistent with previous research investigating therapeutic interventions for upper trapezius myofascial pain syndrome (MPS). Lee and Kim (2025) reported that magnetic field therapy improved muscle tone, posture, and scapular alignment while reducing muscle tension, supporting the mechanism underlying the superior outcomes observed with FMS in the present study [20]. Similarly, Patil et al. (2025) found that IASTM produced greater reductions in pain and improvements in cervical range of motion compared with conventional physiotherapy [5]. Comparable improvements have also been reported with manual therapy approaches, such as cervical spine manipulation [27] and the Muscle Energy Technique combined with physiotherapy [22]. Overall, previous studies summarized in Table 5 demonstrate that various therapeutic techniques, including laser therapy, myofascial release, dry needling, and neuromuscular taping, can effectively reduce pain and improve cervical function in individuals with upper trapezius MPS, findings that align with the present study.

Clinical implications

The results show that FMS is a safe, non-invasive, and effective alternative to traditional physiotherapy for managing MPS. Unlike invasive methods such as dry needling or injections, FMS prioritizes patient comfort and compliance, making it a valuable clinical option. Additionally, its short duration (10 minutes per session) makes it practical in busy outpatient settings.

Our findings align with previous studies that highlight the benefits of neuromuscular stimulation methods for reducing myofascial pain. Research on transcutaneous electrical nerve stimulation (TENS) and extracorporeal shockwave therapy (ESWT) has shown similar pain-relief effects; however, FMS seems to be more effective because of its deeper penetration and capacity to cause muscular contractions without discomfort. Still, few studies have explored FMS, especially for trapezius MPS, making our experiment one of the first controlled efforts in this field.

A key aspect of this study is its randomized controlled design with assessor blinding, which reduces bias. The use of validated outcome measures (VAS, ROM, NDI) increases the reliability of the results. However, the study has certain limitations: the follow-up period was only 3 weeks, and long-term outcomes were not assessed.

Limitations

The sample size, while statistically sufficient, was rather limited and sourced from a single centre, thereby constraining generalizability. The study excluded objective physiological methods, such as electromyography or Doppler ultrasound, for the direct assessment of muscle activity or circulatory alterations.

Future directions

Future research should concentrate on large, multicenter trials with longer follow-up periods to verify the lasting benefits of FMS in MPS. Comparing it with other proven therapies, such as dry needling, phonophoresis, or manual trigger point release, would improve understanding of its relative effectiveness. Including objective assessments of muscle physiology may reveal the specific mechanisms behind the therapeutic effects of FMS.

CONCLUSIONS

This randomized controlled trial assessed the effectiveness of Functional Magnetic Stimulation (FMS) versus conventional physiotherapy (CP) in patients with myofascial pain syndrome affecting the upper trapezius. The findings show that while both treatments led to improvements, FMS resulted in significantly greater reductions in pain intensity and neck disability, along with more marked improvements in cervical range of motion by the end of the three-week treatment period. These results suggest that FMS may provide superior therapeutic benefits by enabling painless neuromuscular activation, improving local circulation, and reducing muscle tension associated with trigger points. From a clinical perspective, FMS is a promising non-invasive, time-efficient treatment option for upper trapezius myofascial pain syndrome. Its ability to produce meaningful improvements in pain and function could facilitate its inclusion in physiotherapy rehabilitation programs. However, the current findings should be interpreted with caution, given the study's limited sample size and short follow-up period. Future multicenter studies with larger participant groups and longer follow-up are needed to better confirm the long-term effectiveness and clinical usefulness of FMS in treating myofascial pain syndrome.

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