Original article

Direct myofascial release reduces shoulder muscle spasticity after stroke: a quasi-experimental study

A liberação miofascial direta reduz a espasticidade muscular do ombro após acidente vascular cerebral: um estudo quase experimental

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ABSTRACT | INTRODUCTION: Stroke, a complication that affects motor function and reduces quality of life, can lead to spasticity. Myofascial release (MFR) is a protected low load stretch technique used to reduce muscle spasticity and tightness. **OBJECTIVE:** The objective of this study is to evaluate the efficacy of the direct myofascial release (MFR) technique on spasticity of shoulder muscle, sensorimotor functions and quality of life in patients with chronic stroke (≥6 months). **METHODS AND MATERIALS:** This quasi-experimental one-group pre-test post-test study involved 14 chronic stroke patients who had shoulder muscle spasticity. Participants underwent direct MFR applied to the subscapularis, pectoralis major, teres major, and latissimus dorsi, with sessions lasting 30-35 minutes, 3 times a week for 2 weeks. Pre- and post-assessments were done by using the Modified Ashworth Scale (MAS) for spasticity, Fugl-Meyer Upper Extremity (FMA-UE) for motor function, and Indian Stroke Scale (ISS) for quality of life. **RESULTS:** The mean age of participants was 49.9 ± 7.96, with mean time since stroke of 24.93 ± 29.11 months. The Wilcoxon signed-rank test indicated statistically significant improvements across all outcome measures: MAS (p = 0.001), FMA-UE (p = 0.001), and ISS (p = 0.001). Correspondingly, effect size analysis using Cohen's d demonstrated clinically meaningful changes, with large effect sizes observed for MAS (d = 1.4), FMA-UE (d = 1.86), and ISS (d = 1.07). **CONCLUSION:** Our results demonstrated that two-weeks direct myofascial release therapy is efficacious for reducing spasticity and improving motor function, and quality of life in chronic stroke participants. However, the small sample size and lack of a control group interpretation should be done carefully. Further randomized controlled trials are needed.

KEYWORDS: Stroke. Myofascial Release Therapy. Muscle Spasticity. Quality of Life.

RESUMO | INTRODUÇÃO: O AVC, uma complicação que afeta a função motora e reduz a qualidade de vida, pode levar à espasticidade. A liberação miofascial (LMF) é uma técnica de alongamento protegida com baixa carga, utilizada para reduzir a espasticidade e a tensão muscular. **OBJETIVO:** O objetivo deste estudo é avaliar a eficácia da técnica de liberação miofascial direta (RMF) na espasticidade muscular do ombro, nas funções sensório-motoras e na qualidade de vida em pacientes com AVC crônico (≥6 meses). **MÉTODOS E MATERIAIS:** Este estudo quase experimental, pré-teste e pós-teste unigrupo, envolveu 14 pacientes com AVC crônico que apresentavam espasticidade muscular do ombro. Os participantes foram submetidos a RMF direta aplicada ao subescapular, peitoral maior, redondo maior e grande dorsal, com sessões com duração de 30 a 35 minutos, 3 vezes por semana, durante 2 semanas. As avaliações pré e pós foram realizadas através da Escala de Ashworth Modificada (MAS) para a espasticidade, da Escala de Fugl-Meyer para a Extremidade Superior (FMA-UE) para a função motora e da Escala Indiana de AVC (ISS) para a qualidade de vida. **RESULTADOS:** A idade média dos participantes foi de 49,9 ± 7,96 anos, com um tempo médio desde o AVC de 24,93 ± 29,11 meses. O teste de Wilcoxon indicou melhorias estatisticamente significativas em todas as medidas de resultados: MAS (p = 0,001), FMA-UE (p = 0,001) e ISS (p = 0,001). Correspondentemente, a análise do tamanho do efeito utilizando o d de Cohen demonstrou alterações clinicamente significativas, tendo sido observados grandes tamanhos de efeito para MAS (d = 1,4), FMA-UE (d = 1,86) e ISS (d = 1,07). **CONCLUSÃO:** Os nossos resultados demonstraram que a terapia de liberação miofascial direta durante duas semanas é eficaz na redução da espasticidade e na melhoria da função motora e da qualidade de vida em participantes com AVC crônico. No entanto, o pequeno tamanho da amostra e a ausência de um grupo de controle devem ser interpretados com cautela. Mais ensaios clínicos randomizados são necessários.

PALAVRAS-CHAVE: AVC. Terapia de Liberação Miofascial. Espasticidade Muscular. Qualidade de Vida.

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1. Introduction

Stroke occurs when cerebral blood flow is interrupted, leading to brain tissue damage and long-term neurological deficits. Globally, stroke ranks as the second most common cause of mortality and the third leading contributor to long-term disability, with 12.2 million new cases in 2019, 6.55 million deaths, and 143 million disability-adjusted life years (DALYs)[1]. Among the sequelae, spasticity is one of the most disabling consequences, substantially affecting recovery and quality of life[2].

Spasticity is typically defined as a velocity-dependent increase in muscle tone with exaggerated tendon reflexes due to hyperexcitability of the stretch reflex[3]. However, current agreement highlights the need to differentiate between spasticity and hypertonia, noting that spasticity is specifically linked to altered stretch reflex responses, whereas hypertonia is a broader concept encompassing increased resistance to passive movement[4]. The estimated prevalence is reported to vary between 4% and 43%, while the incidence of disability ranges from 2% to 13%[5]. Spasticity arises from altered synaptic and motoneuron properties, leading to increased muscle tone and hyperreflexia. Spasticity and disability in upper motor neuron lesions result from reduced homosynaptic depression, motoneuron property changes, and altered muscle properties, leading to increased muscle tone and hyperreflexia at rest[6]. The prevalence of spasticity has been reported to reach 43% in six months and 38% in one year following a stroke. Incidence rates are estimated at 27% after one month, 28% at three months, between 23% and 43% at six months, and 34% at 18 months after stroke[7]. In the upper limb, spasticity generally affects shoulder muscles particularly the subscapularis, pectoralis major, teres major, and latissimus dorsi leading to abnormal postural patterns of internal rotation and adduction. These muscle imbalances contribute to pain, contractures, reduced range of motion, and impaired participation in rehabilitation[8]. Therefore, it is essential to treat spasticity in these particular muscles in order to restore effective upper limb usage.

Treatments include medications (e.g., baclofen, botulinum toxin), physical therapy (stretching, ROM exercises), and advanced methods like Neuromuscular Electrical Stimulation (NMES), Transcranial Magnetic Stimulation (TMS), orthotics, and cryotherapy. However, pharmacological treatments often have side effects, and invasive options may not be accessible in low-resource settings. Consequently, manual therapy approaches such as myofascial release therapy (MFR), are gaining attention for spasticity management[9].

Myofascial Release (MFR) is a therapeutic technique involving low load stretching, aimed at reducing muscle tightness and spasticity, applied manually (Direct MFR) or with tools (Indirect MFR)[10]. Its proposed mechanisms include decreasing excitability of motor neurons through stimulation of Golgi tendon organs, reducing fascial adhesions, enhancing blood flow, and normalizing myofascial chain mechanics[11]. Evidence supports role of MFR in reducing spasticity and improving motor function in conditions like cerebral palsy and chronic stroke[12,13]. Most stroke-related MFR studies have focused on the lower limb or indirect methods (e.g., tennis ball release). Evidence regarding direct MFR applied to the shoulder muscles in chronic stroke remains scarce, particularly for its effects on spasticity, motor recovery, and quality of life. Most research focuses on lower limb spasticity, leaving a gap in upper limb studies.

Therefore, this study aimed to assess direct MFR effects on shoulder muscle spasticity, upper extremity sensorimotor function, and quality of life (QOL) in patients with chronic stroke.

2. Materials and methods

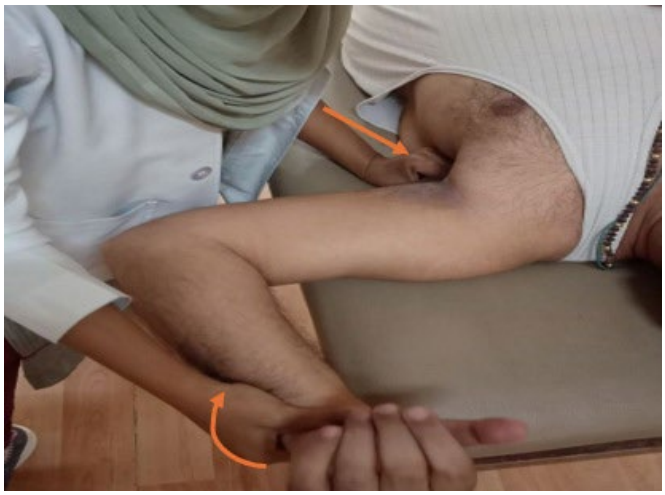
The approval for conducting the study has been received by the Institutional Ethics Committee of Chhatrapati Shahu Ji Maharaj University, Kanpur (I.E.C.M.03/2022/06/P05) and was also registered under the Clinical Trial Registry in a publicly accessible clinical trial registry (CTRI; ctri.nic.in) under the registration number CTRI/2022/11/047344. The study employed a quasi-experimental one-group pre-test post-test design and utilized purposive sampling for participant selection. The sample size was determined using G* Power software, version 3.1.9.7. Sample size was calculated using MAS scale, so results reported by Park et al.[13] were used in the sample size estimation. Power was set as 0.95 with an alpha of 0.85, estimated effect size of 1.45, considering 30% dropouts, resulting total number of sample size[14].

The study included men and women (40–65 years) with first-ever unilateral stroke (≥6 months post-stroke) and shoulder spasticity (≥1+ on the Modified Ashworth Scale, ≥Stage 2 on Brunnstrom Stages). Exclusion criteria included acute or recurrent stroke, severe neurological deficit (NIHSS > 15) or cognitive deficits (MMSE <24), musculoskeletal shoulder pain, or recent shoulder surgery/trauma. Participants were recruited from the Physiotherapy OPD, provided informed consent, and underwent assessments. Dropout criteria included failure to complete the study, missing six myofascial release sessions over two weeks, or not attending the final assessment. Reliable measures included the Modified Ashworth Scale (MAS) for spasticity (primary outcome)[14], Fugl-Meyer Upper Extremity (FMA-UE) for sensorimotor function[15], and the Indian Stroke Scale (ISS) for QOL[16]. Assessments were performed by an independent physiotherapist blinded to the intervention. Post-intervention assessment was conducted immediately after the 2-week program.

2.1 Procedure

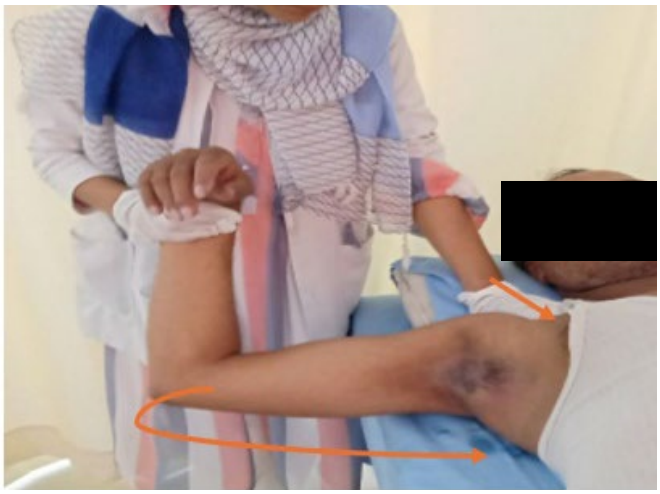
Direct myofascial release (MFR) was delivered by a qualified physiotherapist with certified expertise in MFR techniques. Four muscles (subscapularis, pectoralis major, teres major, latissimus dorsi) were targeted due to their involvement in common post-stroke postural patterns (adduction, internal rotation, and restricted abduction). Each muscle received 90 seconds of sustained pressure/stretch repeated 5 times. Sessions lasted 30–35 minutes, 3 times per week for 2 weeks. No modifications in touch intensity or movement range were required. The therapist positioned themselves beside the affected shoulder while the patient lay either supine or prone, depending on the targeted muscle. For the subscapularis (Figure 1), one hand was placed above the lateral border of the scapula in the axillary region, while the other stabilized the arm in horizontal abduction and facilitated external rotation. In the case of the pectoralis major (Figure 2), one hand was placed over its tendon while the other held the arm in horizontal abduction and assisted in abduction movement. For the teres major (Figure 3), the therapist applied pressure with their hand over the muscle at the lateral border of the scapula while supporting the arm to facilitate abduction and flexion. Finally, for the latissimus dorsi (Figure 4), the therapist placed their forearm over the muscle and moved their hand from insertion to origin while assisting with shoulder abduction and lateral rotation.

Figure 1. Subscapularis Muscle



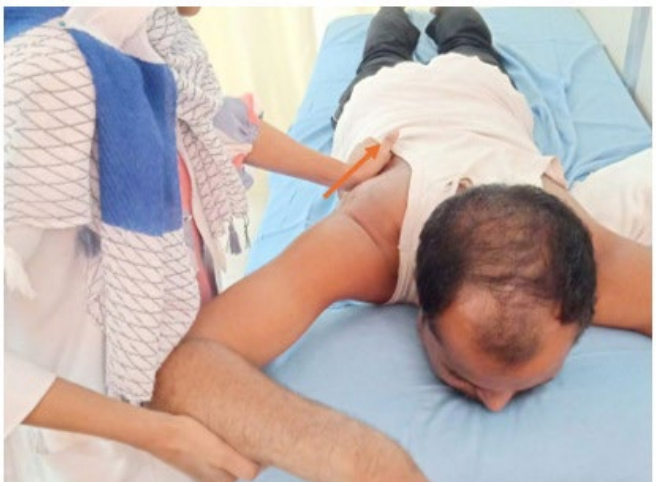
Source: the authors (2025).

Figure 2. Pectoralis Major



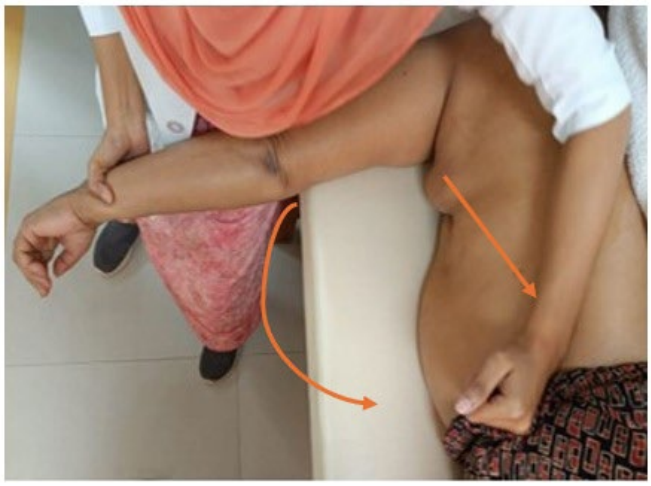
Source: the authors (2025).

Figure 3. Teres Major



Source: the authors (2025).

Figure 4. Lattisimus Dorsi



Source: the authors (2025).

2.2 Statistical analysis

Statistical analysis was performed using SPSS 25.0. All variables were evaluated at baseline and after a 2-week post-intervention period. Demographic features were reported in the median and quartiles. We performed a within-group analysis using the Wilcoxon Signed-rank test. In addition, the effect size was calculated using Cohen's *d* formula to study the variables. The level of significance was kept at $p<0.05$. Post hoc analysis was also performed to calculate the power of the study.

3. Results

A total of 19 subjects with chronic stroke and shoulder muscle spasticity were screened. Five participants did not complete the post intervention assessment and were excluded, leaving a final sample of 14 participants who completed all six intervention sessions. The demographic data of the subjects are summarized in table 1. Participants had a mean age of 49.9 ± 7.96 years. The mean time since stroke was 24.93 ± 29.11 months (range 6 - 104 months), confirming that all participants were in the chronic phase. The mean baseline FMA-UE motor score was 26.71 ± 12.04, indicating moderate to severe upper limb motor impairment. Regarding hemiparesis, 10 participants (71.4%) had left-sided involvement and 4 (28.6%) had right-sided involvement.

Table 1. Demographic characteristics of the study's participants

Characteristics (*n*=14)	Mean ± SD	(95% CI)	*p*-value
Age	49.9 ± 7.96	(45.3-54.5)	0.072
Height	165.9 ± 11.07	(159.6-172.3)	0.719
Weight	70.1 ± 13.46	(62.3-77.9)	0.138
BMI	25.5 ± 4.77	(22.8-28.3)	0.153
Gender	Male	71.43%	<0.001
	Female	28.57%	
Side of Hemiparesis Left 10 (71.4%) Right 4 (28.5%)	1.29 ± 0.46	(1.02-1.56)	<0.001

Source: the authors (2025).
SD - standard deviation, BMI - body mass index.

The Wilcoxon sign-rank test revealed statistically significant improvements ($p<0.05$) across all outcome measures after two weeks of direct MFR (Table 2). MAS scores decreased across all assessed muscle groups, indicating reduced spasticity. FMA-UE total scores increased significantly, reflecting improvements in motor function, sensation, and passive joint mobility.

Pain was only evaluated through the FMA-UE joint pain subdomain, and improvements were observed (median increase from 12 to 23.5, $p<0.001$). However, as no specific validated pain scale was used, these results should be interpreted with caution. ISS scores improved significantly (median increase from 42.5 to 57, $p = 0.001$), suggesting enhanced quality of life. Nonetheless, the limited psychometric validation of the ISS must be acknowledged, and its results should be considered exploratory.

Table 2. Pre- and post-test comparison of spasticity, motor functions and quality of life

Variable (*n*=14)	Median (IQR) Pre	Median (IQR) Post	*z*-value	*p*-value	Cohen's *d*	Power
MAS SF	2 (0.25)	1 (0.50)	-3.407	0.001*	2.23	1.00
MAS SE	1.5 (0.63)	0.5 (1)	-3.354	0.001*	2.70	1.00
MAS SAB	2 (1)	1.5 (.50)	-3.337	0.001*	2.04	1.00
MAS SADD	2 (0.50)	0.50 (1.50)	-3.321	0.001*	2.47	1.00
MAS SMR	2 (1.63)	1.25 (1.50)	-3.329	0.001*	1.48	0.99
MAS SLR	2 (1.50)	1(0.75)	-3.329	0.001*	1.42	0.99
FMA-UE Motor	26.5 (17)	45.0 (10.25)	-3.297	0.000*	1.45	0.99
FMA-UE Sensation	12 (2.50)	12 (.00)	-2.226	0.034*	0.63	0.70
FMA-UE Passive Joint Movement	11.5 (7.25)	18 (5.75)	-3.063	0.000*	1.17	0.99
FMA-UE Joint Pain	12 (8.25)	23.5 (4.50)	-3.301	0.000*	2.10	1.00
FMA-UE Total	57.50 (20.25)	96.50 (11)	-3.297	0.001*	1.86	0.99
ISS	42.50 (26.75)	57 (17.75)	-3.297	0.001*	1.07	0.97

Source: the authors (2025).
*$p<0.05$ considered statistically significant.
MAS - Modified Ashworth Scale, SF - Shoulder Flexors, SE - Shoulder Extensors, SAB - Shoulder Abductors, SADD - Shoulder Adductors, SMR - Shoulder medial rotators, SLR - Shoulder lateral rotators, FMA-UE - Fugl-Meyer Upper Extremity Scale, ISS - Indian Stroke Scale.

4. Discussion

This study demonstrated that direct MFR produced statistically and clinically significant improvements in muscle spasticity, sensorimotor function, and quality of life among chronic stroke patients. The results contribute to evidence supporting manual therapy interventions in stroke rehabilitation, particularly for upper extremity spasticity management.

Direct MFR significantly reduced muscle spasticity across assessed shoulder muscle groups, with large effect sizes ranging from 1.42 to 2.70. These results are consistent with previous research on MFR interventions in stroke populations. Parikh et al.[17] demonstrated that myofascial release performed with a tennis ball in conjunction with conventional physiotherapy has more beneficial effects on spasticity and motor functions of the upper extremity in patients with chronic stroke compared to conventional therapy alone. Similar benefits of fascial release in reducing tone and improving movement efficiency have been observed in spastic cerebral palsy populations[18]. The mechanisms likely involve sustained stretch and pressure influencing muscle spindle sensitivity, Golgi tendon organ activation, and fascial remodeling, leading to decreased motoneuron excitability[19].

Furthermore, by improving local blood flow and addressing fascial adhesions, the manual treatments may help restore normal myofascial chain mechanics. Recent advances in understanding spasticity biomarkers suggest that mechanical interventions like MFR may modulate the stretch reflex threshold and improve motor control patterns[11]. Mechanical therapies such as MFR may modify the stretch reflex threshold and enhance motor control patterns, according to recent developments in our understanding of spasticity biomarkers[20]. The subscapularis, pectoralis major, teres major, and latissimus dorsi were chosen as the target muscles because they are primarily involved in the typical post-stroke postural patterns that include shoulder adduction, internal rotation, and restricted abduction. These muscles usually become more toned after stroke, which can lead to pain and functional difficulties[8]. The 90- to 120-second sustained pressure recommended by recognized MFR standards for the best tissue response is consistent with our intervention procedure, which uses 90 seconds of sustained pressure five times per muscle[21].

The Fugl-Meyer Upper Extremity (FMA-UE) assessment showed significant improvements across multiple domains after direct MFR intervention. Motor function showed considerable improvement (p<0.001, d=1.86), indicating improved voluntary movement control, coordination, and upper limb function. These results are supported by recent systematic reviews highlighting the importance of addressing both motor and sensory components in stroke rehabilitation[22]. Sensory function improvements (p=0.034, d=0.63) showed a novel finding, as most previous MFR studies have focused primarily on motor outcomes. Improved sensation may result from enhanced mechanoreceptor function within fascial tissues and reduced abnormal muscle tension that can interfere with sensory processing[23]. The moderate effect size indicates that while improvement occurred, longer intervention times or a combination of approaches could be needed for sensory recovery.

Significant improvement was seen in passive joint mobility (p<0.001, d=1.17), which addressed a crucial aspect of upper limb function in stroke survivors. Stroke patients commonly experience reduced passive joint range of motion due to soft tissue stiffening, increased viscoelasticity, and secondary contracture development[21]. The observed improvement supports earlier studies that suggested MFR could change muscle characteristics and myofascial chains, resulting in increased range of motion[24,25]. Drawback is the reliance on the FMA-UE scale for range of motion assessment instead of a goniometer, which may affect result accuracy. Future studies should incorporate dedicated range of motion measures.

Additionally, shoulder pain, affecting 16%-72% of stroke patients, is linked to motor deficits, severity, and diabetes as a risk factor[26]. Pain reduction was observed in the FMA-UE pain subdomain, despite participants with primary musculoskeletal shoulder pain being excluded. However, these results should be interpreted with caution because no validated pain-specific instrument (such as the Visual Analogue instrument or Shoulder Pain and Disability Index) was used. While stroke-specific evidence is limited, systematic review by Ajimsha et al. highlights MFR's effectiveness in pain reduction[27]. The pain reduction observed may be secondary to decreased muscle spasticity and improved postural alignment following the intervention.

Quality of life improvements, as measured by the Indian Stroke Scale (ISS), showed significant enhancement (median increase from 42.5 to 57, p=0.001, d=1.07). Similar findings were reported by Ceca et al.[28] who demonstrated that self-myofascial release programs enhanced health-related quality of life in fibromyalgia patients. However, in contrast to commonly used measures like the Stroke-Specific Quality of Life Scale (SS-QOL), the ISS has limited psychometric validation. Therefore, to support these findings, future research should use more reliable and validated quality-of-life measures.

The observed quality of life improvements likely results from the combination of reduced spasticity, enhanced motor function, decreased pain, and improved functional capacity. In neurological rehabilitation, these interconnected factors contribute collectively to overall well-being and participation in daily activities.

4.1 Study limitation

Several limitations must be acknowledged: the quasi-experimental design without a control group limits causal inference; the small sample size (*n*=14) restricts generalizability; and the short intervention period (two weeks) with immediate assessment provides no information about long-term effects. The Modified Ashworth Scale has recognized psychometric limitations as reported by Gregson et al.[14], and the lack of validated pain assessment instruments represents a methodological constraint. The absence of a control group prevents definitive conclusions about MFR's specific contribution versus spontaneous recovery or placebo effects.

5. Conclusion

This quasi-experimental study suggests that direct MFR may reduce spasticity of shoulder muscles, improve sensorimotor function, and enhance quality of life in patients with chronic stroke. However, these results must be interpreted cautiously due to methodological limitations, including the small sample size, lack of control group, and short intervention period. Further randomized controlled trials are required to establish the efficacy and long-term effects of MFR in stroke rehabilitation.

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Authors' contributions

The authors declared that they have made substantial contributions to the work in terms of the conception or design of the research; the acquisition, analysis or interpretation of data for the work; and the writing or critical review for relevant intellectual content. All authors approved the final version to be published and agreed to take public responsibility for all aspects of the study.

Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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