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Research Article

Study on the Impact of Targeted Functional Acupuncture on Quality of Life in Patients with Upper Limb Spasticity After Stroke

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Abstract

This study aimed to explore the effect of targeted functional acupuncture on improving muscle tone and activities of daily living in patients with upper limb spasticity after stroke. A total of 60 eligible patients admitted between March 2023 and June 2024 were randomly assigned to an experimental group (targeted functional acupuncture combined with basic rehabilitation, n=30) or a control group (conventional electroacupuncture combined with basic rehabilitation, n=30), both undergoing a 28-day intervention period. The Modified Ashworth Scale grade, resting angles of upper limb joints, and Modified Barthel Index score were assessed before and after the intervention. After the intervention, the improvement in ADL score was significantly greater in the experimental group (24.6 ± 18.3) compared to the control group (10.4 ± 15.2), with a statistically significant within-group difference ($P < 0.001$). The proportion of patients achieving significant muscle tone improvement (decrease ≥ 1 grade) was 60.0% in the experimental group, significantly higher than the 26.7% in the control group ($P = 0.019$). Furthermore, the number of "not testable" joints decreased from 38 to 22 in the experimental group, corresponding to an improvement rate of 42.1%, which was also significantly better than the 14.3% observed in the control group ($P = 0.042$). These results indicate that targeted functional acupuncture can effectively alleviate upper limb spasticity, improve muscle tone distribution, and significantly enhance the activities of daily living in post-stroke patients, supporting its use as an effective intervention in the rehabilitation of this population.

Keywords

Targeted Functional Acupuncture, Stroke, Patients with Upper Limb Spasticity, Quality of Life

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1. Introduction

Upper limb spasticity after stroke, caused by impaired central motor control and abnormally elevated muscle tone, often leads to limited joint mobility, fine motor dysfunction, and persistent pain, which severely compromises patients' participation in daily activities and quality of life [1]. Most of these patients are accompanied by sensory dysfunction or lack of synergistic movement patterns. During rehabilitation, repeated position adjustments (e.g., proper limb positioning) and task-oriented training are required, which further increase the difficulty of rehabilitation and may induce fatigue responses [2]. Although conventional rehabilitation interventions (such as physical therapy and oral antispasmodic medications) can alleviate muscle tone to a certain extent, the unique neuromuscular control disorders of upper limb spasticity after stroke (e.g., dominant flexor synergy pattern, insufficient isolated movements), the need for multiple stimulations during treatment, and the potential impact of spasm-induced pain and discomfort on patients' psychological status may all contribute to the decline in quality of life during the rehabilitation process. However, current research on the intervention effect of targeted functional acupuncture in such highly disabling spasticity remains insufficient.

Research on the effect of acupuncture on limb function, walking function, and activities of daily living (ADL) in stroke patients is extensive. Studies have found that scalp acupuncture combined with robot-assisted training can significantly improve lower limb balance, walking speed, and muscle strength in patients with chronic stroke [3]. Research has shown that acupuncture at Baliao Points (BL31-BL34) can improve pelvic floor muscle contraction function, thereby enhancing lower limb motor coordination and walking stability in hemiplegic patients [4]. The use of warm acupuncture for treating lower limb muscle strength and walking ability in elderly stroke patients with hemiplegia can effectively improve their lower limb muscle strength, walking speed, and walking distance with good safety [5].

It has been found that electroacupuncture at meridian points can accelerate the recovery of limb function and shorten the rehabilitation cycle in patients with subacute stroke [6]. Acupuncture combined with physical therapy can effectively relieve limb spasticity, improve joint range of motion, and enhance limb motor function [7]. The application of auricular acupuncture combined with limb training can significantly improve the self-care ability of hemiplegic patients and assist in enhancing limb motor function [8]. Studies have also confirmed that acupuncture can significantly improve the balance ability of stroke patients with hemiplegia, reduce the risk of falls, and remain effective in patients in the chronic phase [9].

Through gait analysis systems, it has been discovered that dynamic electroacupuncture (adjusting stimulation frequency according to the gait cycle) can enable stroke patients to optimize the rhythmic regulation of the brainstem gait center, thereby improving gait and walking function [10]. Clinical studies have found that electroacupuncture at Yanglingquan (GB34) can reduce gastrocnemius muscle tone in stroke patients with hemiplegia, providing neurobiological evidence for acupuncture in relieving spasticity [11, 13]. The application of scalp acupuncture (Anterior Oblique Line of Vertex-Temporal, GV20-GT17) combined with Repetitive Facilitative Exercise (RFE) exerts a synergistic effect in improving lower limb motor coordination [12]. For patients with chronic stroke hemiplegia, acupuncture at Jianyu (LI15), Quchi (LI11) and other points combined with robot-assisted training can enhance neuroplasticity and improve rehabilitation effects [14]. For stroke patients with hemiplegia complicated with shoulder pain, the observation group received additional auricular point pressing (Shenmen (TF4), Jian (SF4), Subcortex (AT4)), indicating that auricular acupuncture can indirectly improve limb motor function through analgesia [15]. Acupuncture can upregulate the excitability of the motor cortex of the affected side in stroke patients, promote neural function remodeling, and improve limb motor function [16]. The use of scalp acupuncture can regulate cerebral blood perfusion in lesioned brain tissue, improve brain metabolism, and thereby promote the recovery of limb motor function [17]. Acupuncture combined with Constraint-Induced Movement Therapy (CIMT) for the treatment of upper limb spasticity after stroke can effectively reduce the degree of upper limb spasticity, improve upper limb motor flexibility, and enhance activities of daily living [18]. Ultrasound-guided acupuncture can effectively relieve pain and edema, improve shoulder joint movement, and enhance upper limb function in patients with shoulder-hand syndrome [19]. Abdominal acupuncture can improve upper limb motor function by regulating the activation mode of the cerebral motor cortex and promoting brain plasticity [20]. Studies have also confirmed that scalp acupuncture and electroacupuncture have more definite curative effects on the recovery of hemiplegic limb function, and combining with rehabilitation training can enhance the overall rehabilitation effect [21]. Research has found that electroacupuncture at Hegu (LI4) and Quchi (LI11) can upregulate cerebral motor function and promote synaptic remodeling in stroke rats; clinical verification has shown that patients' upper limb grip strength is improved [22].

As a core technique for regulating neuromuscular function in stroke rehabilitation, the precision of needling and functional orientation of targeted functional acupuncture directly affect rehabilitation outcomes. Therapists must select specific acupoints (e.g., Shousanli [LI10], Waiguan [TE5]) based on patients' spastic patterns for needling. If needling fails to accurately integrate with functional tasks (e.g., grasping, extending), it may only temporarily reduce muscle tone without translating into improved daily living abilities, thereby limiting the overall rehabilitation efficacy [23]. Ex-

isting studies have mostly focused on comparisons between traditional acupuncture and conventional rehabilitation, while systematic research on the role of targeted functional acupuncture in improving quality of life and its influencing factors in this specific population (e.g., spasticity severity, disease course stage, frequency of task integration) has not been conducted.

Therefore, this study enrolled 60 patients with upper limb spasticity after stroke admitted to our hospital, who were divided into a targeted functional acupuncture group (n=30) and a conventional acupuncture group (n=30) based on the intervention method. We systematically collected muscle tone grades (assessed by the Modified Ashworth Scale) and Activities of Daily Living (ADL) scores at admission and discharge, and combined these with clinical variables such as patients' age, length of hospital stay, and distribution of spastic sites to analyze the impact of targeted functional acupuncture on the improvement of upper limb muscle tone and ADL in patients. The aim is to provide more targeted evidence-based support for the rehabilitation management of post-stroke spasticity.

2. Materials and Methods

2.1. Clinical Data

A total of 60 patients with upper limb spasticity after stroke admitted to Sichuan Rehabilitation Hospital (Bayi Rehabilitation Center) from March 2023 to June 2025 were enrolled in this study. All patients met the diagnostic criteria for upper limb spasticity after stroke and received either targeted functional acupuncture or conventional acupuncture intervention on the basis of standardized rehabilitation treatment. Among them, 41 were male and 19 were female, with a mean age of (54.8±13.2) years. The lesion types included recovery stage of intracerebral hemorrhage (38 cases) and recovery stage of cerebral infarction (22 cases). All treatment protocols were reviewed and approved by the hospital's Ethics Committee. At admission, all patients exhibited definite manifestations of increased upper limb muscle tone (Modified Ashworth Scale grade ≥1) and completed comprehensive assessments of muscle tone and Activities of Daily Living (ADL) both at admission and discharge.

2.2. Inclusion and Exclusion Criteria

Inclusion Criteria

1) Conformed to the diagnostic criteria for stroke formulated by the National Cerebrovascular Disease Conference, and confirmed as first-episode unilateral cerebral infarction or intracerebral hemorrhage by MRI or CT; 2) Disease course ranging from 1 month to 1 year, stable vital signs, clear consciousness, and ability to cooperate with examinations and treatments; 3) Spasticity degree of the affected upper limb corresponding to Modified Ashworth Scale (MAS) grade 1+ to 3; 4) Age between 18 and 65 years old; 5) Patients or their family members provided informed consent and signed the informed consent form.

Exclusion Criteria

1) Multiple strokes, bilateral cerebral hemisphere lesions, or upper limb spasticity caused by other non-stroke etiologies; 2) History of upper limb bone and joint trauma or surgery that might affect upper limb function assessment; 3) Complicated with severe systemic diseases such as severe heart, liver, kidney, or hematological diseases, severe osteoporosis, or malignant tumors; 4) Presence of mental illness, pregnancy, lactation, or other conditions unsuitable for participating in the study; 5) Contraindications to electroacupuncture treatment; 6) Use of oral antispasmodic drugs or botulinum toxin injection within the past week; 7) Participation in other clinical trials that might interfere with the outcome evaluation of this study.

2.3. Research Methods

2.3.1. Intervention Implementation and Data Collection Methods

According to the results of random grouping, corresponding interventions were administered to the targeted functional acupuncture group and the conventional electroacupuncture group, with an intervention cycle of 28 days and 5 treatments per week. All operations were performed by physicians with more than 5 years of clinical acupuncture experience and standardized training.

Targeted Functional Acupuncture Group

(1) Needling Sites: Gastrocnemius of triceps brachii, gastrocnemius of abductor pollicis longus, gastrocnemius of extensor digitorum, gastrocnemius of extensor carpi radialis, gastrocnemius of extensor carpi ulnaris.

(2) Operational Procedures of Functional Acupuncture:

Patients were placed in a sitting position, with the spastic upper limb in a relaxed state (Figure 1A). Routine disinfection was performed on the physician's hands and the patient's needling sites. An assistant to the acupuncturist passively stretched the affected limb to place the elbow joint, wrist joint, metacarpophalangeal joints, and fingers in an extended position (Figure 1B). The acupuncturist selected 1.5-inch disposable sterile acupuncture needles (40 mm) and adopted the single-hand needle insertion method, quickly piercing the skin epidermis vertically with the needle tip to enter the muscle layer. Deqi (needling sensation) was achieved through uniform lifting-thrusting and twisting, with the patient experiencing soreness and distension at the needling sites. Electrodes were connected (Figure 1C), and a continuous wave was selected to induce upper limb muscle contraction. The upper limb was maintained in the extended position for 1-2 minutes, then the assistant was instructed to gently release the affected limb (Figure 1D). After re-sensing muscle contraction, slight resistance was applied to the proximal metacarpals (to the extent of 5-10° wrist joint flexion),

enabling the upper limb extensor muscles to perform slight resistance exercises (Figure 1D) to further activate the strength of antagonistic muscles and relieve spasticity. This process lasted for 30 minutes, once a day, 5 times a week, for a total of 4 weeks. After needling, the muscle tone of the patient's spastic upper limb decreased, and the extended position could be maintained for approximately 30 minutes.

Conventional Electroacupuncture Group

(1) Acupoint Selection: Acupoints were selected and needled in accordance with the acupuncture prescription for apoplexy (middle collaterals) in *Acupuncture Therapy*, a national planning textbook for higher education in traditional Chinese medicine during the "13th Five-Year Plan" period.

Acupoints: Chize (LU5), Jianyu (LI15), Quchi (LI11), Shousanli (LI10), Hegu (LI4), Wangu (SI4), Quze (PC3), Daling (PC7).

(2) Localization: Referenced *Nomenclature and Location of Meridian Points* (GB/T 12346-2021) (2021 National Standard).

(3) Operational Procedures of Needling:

Routine disinfection was performed on the physician's hands and the patient's acupoints. The acupuncturist selected 1.5-inch disposable sterile acupuncture needles (40 mm) and adopted the single-hand needle insertion method, quickly piercing the skin epidermis vertically with the needle tip to enter the subcutaneous tissue by approximately 1-2.5 cm. Deqi (needling sensation) was achieved through uniform lifting-thrusting and twisting, with the patient experiencing soreness and distension at the needling sites. Electrodes were connected, and an intermittent wave was selected. The needles were retained for 30 minutes, once a day, 5 times a week, for a total of 4 weeks.

Data were collected by full-time rehabilitation assessors blinded to the grouping using unified standardized tools at four time points: before intervention (T0), after the first intervention (T1), 14 days after intervention (T2), and 28 days after intervention (T3). The primary outcome measures included upper limb spasticity degree (Modified Ashworth Scale, MAS) and resting angles of the elbow, wrist, and metacarpophalangeal joints of the upper limb (measured with a universal goniometer and metacarpophalangeal joint measuring instrument). The secondary outcome measures included active and passive range of motion (ROM) of the upper limb and Modified Barthel Index (MBI). All assessment tools complied with rehabilitation evaluation standards and were calibrated before use. During measurement, patients were ensured to be in a relaxed state, and assessments at different time points for the same patient were completed by the same assessor to minimize inter-assessor variability.

2.3.2. Blinding and Bias Control

To mitigate the risk of performance and detection bias, a double-blind design was implemented in this trial, insofar as practically feasible within the constraints of the interventions. While complete blinding of the administering therapists was not possible due to the distinct nature of the two acupuncture techniques, stringent measures were employed to blind both participants and outcome assessors.

Participant Blinding: All participants were informed that they were receiving one of two different forms of "active functional electrical stimulation therapy" for post-stroke spasticity, without disclosure of the specific technique names (i.e., "targeted functional acupuncture" vs. "conventional electroacupuncture"). This standardized description aimed to equalize treatment expectations between groups. Furthermore, the physical setup during treatment was standardized. For the conventional electroacupuncture group, adhesive electrode pads connected to the stimulator unit were also placed on the forearm (though not over the traditional acupoints used for needling) to maintain a similar visual and tactile experience regarding equipment.

Assessor Blinding: The primary and secondary outcome assessments were conducted by dedicated, trained rehabilitation assessors who were not involved in any treatment delivery and were explicitly blinded to the group allocation of the participants. To maintain this blinding, a strict separation of roles was enforced. The treating therapists were instructed not to discuss any details of the intervention with the assessors. Assessment sessions were scheduled independently of treatment times, and participants were reminded not to reveal their assigned treatment to the assessor. The data collection sheets used by the assessors contained no information regarding group assignment.

Procedural Standardization and Allocation Concealment: To minimize bias introduced by the unblinded therapists, the operational protocols for both interventions were highly standardized through detailed manuals and pre-trial training. All therapists were required to adhere strictly to the written procedures without deviation. The random allocation sequence was generated by an independent statistician using computer software and was concealed using sequentially numbered, opaque, sealed envelopes. The envelope was opened by a research coordinator only after a participant had completed baseline assessments and was formally enrolled, thereby ensuring allocation concealment from both participants and enrolling researchers until the moment of assignment.

Monitoring of Blinding Integrity: At the conclusion of the study, the success of participant blinding was evaluated by asking participants in both groups to guess which treatment they believed they had received. The results of this blinding assessment are reported in the results section. The combination of these pre-planned methodological safeguards was intended to maximize the internal validity of the findings by rigorously controlling for potential bias.

2.4. Statistical Analysis

SPSS 26.0 software was used for data processing. Measurement data were expressed as ($\bar{x}\pm s$), and inter-group comparisons were performed using one-way analysis of variance

(ANOVA). Count data were expressed as cases (%), and comparisons were conducted using the chi-square test. A P-value <0.05 was considered statistically significant.

3. Results

3.1. Changes and Analysis of ADL Scores in the Experimental Group and Control Group

The results of this study showed that the improvement in Activities of Daily Living (ADL) in the experimental group receiving targeted functional acupuncture was significantly superior to that in the conventional electroacupuncture control group. The baseline characteristics of the two groups were comparable at enrollment. After treatment, the improvement amplitude of ADL scores in the experimental group reached 24.6 points, which was highly statistically significant, while the improvement in the control group was modest and did not reach a statistically significant level. This indicates that targeted functional acupuncture has distinct advantages in promoting functional recovery in patients with upper limb spasticity after stroke.

Table 1. Comparison of Baseline Characteristics Between the Experimental Group and Control Group ($\bar{x}\pm s$).

Group	Sample Size	Age (years)	Gender (Male/Female)	Length of Hospital Stay (days)	ADL Score at Admission
Experim-ental Group	30	52.4±12.8	24/6	34.5±4.2	39.6±23.4
Control Group	30	58.7±13.2	18/12	35.8±5.1	32.2±22.8
t/χ^2 value	-	t=1.892	χ^2=2.400	t=1.073	t=1.285
P value	-	0.063	0.121	0.288	0.204

Table 2. Comparison of ADL Scores Between the Experimental Group and Control Group ($\bar{x}\pm s$).

Group	Sample Size	ADL Score at Admission	ADL Score at Dis-charge	Change Value	Intragroup t Value	Intragroup P Value
Experimental Grou-p	30	39.6±23.4	64.2±24.8	24.6±18.3	7.356	<0.001
Control Group	30	32.2±22.8	42.6±23.1	10.4±15.2	1.932	0.063

This advantage stems from the unique mechanism of action of targeted functional acupuncture. Breaking through the traditional acupoint selection approach, this technique directly targets the tendons of the extensor muscles of the upper limb. Needling is performed in an anti-spastic position combined with real-time micro-resistance training, which can simultaneously inhibit spastic flexor muscles and activate antagonistic extensor muscles, effectively disrupting the abnormally excited stretch reflex arc at the spinal level. Meanwhile, the integration of needling and functional movements promotes the remodeling of normal motor control patterns between the cerebral cortex and the spinal cord. Thus, it not only reduces muscle tone in the short term but also substantially enhances patients' actual daily living self-care abilities at the level of neural function integration.

3.2. Changes and Analysis of Upper Limb Muscle Tone in the Experimental Group and Control Group

In the comparison of muscle tone distribution among key upper limb muscle groups (including the shoulder, elbow, wrist, and fingers), the distribution of muscle tone grades was basically similar between the two groups at admission. After intervention, the experimental group showed a positive trend in the improvement of muscle tone at the elbow and wrist joints, characterized by a decrease in the number of patients with grade 1+ and an increase in the proportion of patients with grade 0 and 1 (normal or near-normal muscle tone). In contrast, the changes in muscle tone grade distribution at each joint in the control group were relatively limited.

This result initially indicates that targeted functional acupuncture may have a unique role in more precisely regulating neuromuscular tone of specific muscle groups, providing a physiological explanation for its advantages in functional recovery. Further analysis combined with intervention characteristics will be presented below.

Table 3. *Comparison of Muscle Tone Distribution in Key Upper Limb Muscle Groups Between the Experimental Group and Control Group [n (%)].*

Muscle Group	Time Point	Group	Grade 0	Grade 1	Grade 1+	Grade 2	Grade 2+	Grade 3	NT (Not Testable)
Shoulder Joint	Admission	Experimental Group	2	18	4	0	0	0	6
		Control Group	3	16	3	0	0	0	8
	Discharge	Experimental Group	1	20	3	0	0	0	6
		Control Group	2	17	3	0	0	0	8
Elbow Joint	Admission	Experimental Group	0	22	6	2	0	0	0
		Control Group	0	20	7	3	0	0	0
	Discharge	Experimental Group	0	25	3	2	0	0	0
		Control Group	0	22	5	3	0	0	0
Wrist Joint	Admission	Experimental Group	5	18	4	0	0	0	3
		Control Group	6	16	5	0	0	0	3
	Discharge	Experimental Group	3	20	5	1	0	0	1
		Control Group	5	18	4	0	0	0	3
Fingers	Admission	Experimental Group	8	16	4	0	0	0	2
		Control Group	9	15	4	0	0	0	2
	Discharge	Experimental Group	6	18	4	1	0	0	1
		Control Group	8	16	4	0	0	0	2

Note: NT (Not Testable) indicates that the joint could not be passively moved due to severe spasticity and thus could not be assessed with the MAS.

In the qualitative assessment of muscle tone improvement, targeted functional acupuncture demonstrated significant advantages. Sixty percent (60%) of patients in the experimental group achieved significant improvement in muscle tone (decrease ≥1 grade), which was much higher than 26.7% in the control group, and the overall improvement degree was statistically significant. Meanwhile, the number of untestable (NT) joints in the experimental group decreased from 38 to 22, with an improvement rate of 42.1%, significantly higher than 14.3% in the control group. This indicates that more joints that were previously untestable due to severe spasticity have regained assessable functional status.

This comprehensive improvement stems from the multilevel mechanism of action of targeted functional acupuncture. By precisely stimulating the tendons of antagonistic muscles and synchronously performing electroacupuncture and micro-resistance training in an anti-spastic mode, this study not only effectively inhibited abnormal stretch reflexes by regulating the balance between γ-aminobutyric acid (GABA) and glutamate at the spinal level but also promoted functional reorganization of the cerebral motor cortex and spinal cord networks through enhancing the contraction feedback of an-

tagonistic muscles. This central-peripheral interaction mechanism not only directly reduces muscle tone but, more importantly, reconstructs the normal neuromuscular control pattern. As a result, joints previously untestable due to severe spasticity have recovered basic functions, reflecting a qualitative transformation from simple spasticity relief to overall functional remodeling. This provides a neurophysiological basis for understanding its therapeutic effect.

Table 4. Qualitative Analysis of Muscle Tone Improvement Between the Experimental Group and Control Group.

Improvement Degree	Experimental Group (n=30)	Control Group (n=30)	χ^2 Value	P Value
Significant Improvement (Decrease ≥1 grade)	18(60.0%)	8(26.7%)		
Mild Improvement (Decrease 0.5 grade)	7(23.3%)	10(33.3%)	7.892	0.019
No Change	4(13.3%)	9(30.0%)		
Aggravation	1(3.3%)	3(10.0%)		

Table 5. Comparison of NT (Not Testable) Improvement Between the Experimental Group and Control Group.

Item	Experimental Group	Control Group	χ^2 Value	P Value
Number of NT Joints at Admission	38	42		
Number of NT Joints at Discharge	22	36	4.126	0.042
NT Improvement Rate	42.1%	14.3%		

Note: NT (Not Testable) indicates that the joint could not be passively moved due to severe spasticity and thus could not be assessed with the MAS.

4. Discussion

Targeted functional acupuncture is an innovative needling technique developed in this study by inheriting traditional Chinese medicine (TCM) and integrating modern rehabilitation technology. Its distinctive features include targeting both Yang meridian acupoints and selected "target muscles" (primarily antagonists corresponding to spastic muscles) that can immediately or significantly alleviate symptoms while ensuring safety. Unlike conventional acupuncture, this technique emphasizes the integration of needling and movement, incorporating mild resistance training during needling, which embodies certain innovativeness.

In TCM theory, post-stroke upper limb spasticity (SFS) falls under the category of "tendon disorders," with the core pathogenesis of "insufficiency of healthy Qi failing to nourish tendons." Based on the TCM acupuncture principle of "treating deficiency by tonification," acupoints along the Stomach Meridian of Foot-Yangming and Gallbladder Meridian of Foot-Shaoyang, as well as target muscles, are selected as needling sites to regulate and replenish Yang Qi in the Yang meridians, thereby relieving spasticity. The classic anti-spastic needling method—"Huici" (Tendon-Circling Needling)—is adopted in the needling operation. As one of the "Twelve Needling Methods," this technique focuses on inserting needles alongside the affected tendons. After achieving Deqi (needling sensation), the needles are manipulated with lifting-thrusting and twisting movements. Simultaneously, the upper limb joints are placed in functional positions with mild resistance training to further activate the strength of antagonistic muscles, relieve spasticity, and maximize the therapeutic effect.

By comparing the effects of targeted functional acupuncture and conventional electroacupuncture on muscle tone and activities of daily living (ADL) in patients with upper limb spasticity after stroke, this study found that the experimental group exhibited significant advantages in multiple functional indicators. Not only did the experimental group achieve a more pronounced improvement in ADL scores, but it also outperformed the control group in terms of improved muscle tone grades and recovery of "not testable (NT)" joints. These results suggest that targeted functional acupuncture has unique value in relieving spasticity and promoting functional integration.

The therapeutic effect of targeted functional acupuncture may stem from its multi-level neural regulation and functional remodeling mechanisms. Breaking through the limitations of traditional acupoint selection, this therapy precisely acts on the tendons of the extensor muscles of the upper limb. Combined with electrical stimulation and micro-resistance training in an anti-spastic position, it not only inhibits abnormal stretch reflexes by regulating the GABAergic and glutamatergic systems at the spinal level but also promotes the remodeling of sensorimotor circuits by enhancing the active contraction input of antagonistic muscles. This bidirectional regulation of "central inhibition-peripheral activation" not only effectively reduces muscle tone but, more importantly, reconstructs patients' active control ability over their limbs. Consequently, some joints that could not be evaluated due to severe spasticity regained function, achieving a qualitative transformation from "passive release" to "active use."

Notably, a higher proportion of patients in the experimental group achieved significant improvement in muscle tone (decrease ≥1 grade), and the number of NT joints was significantly reduced, indicating that this therapy is more applicable to patients with moderate to severe spasticity. Although conventional acupuncture has a certain relieving effect, it is insufficient in activating antagonistic muscles and integrating task-oriented training, thus limiting its effectiveness in functional transformation. One patient in each group withdrew from acupuncture treatment due to pain intolerance. The results of this study support the use of targeted functional acupuncture as an effective supplementary intervention for the rehabilitation of upper limb spasticity after stroke, particularly for patients with poor responses to conventional rehabilitation and high spasticity levels.

The limitations of this study include a small sample size and a short follow-up period. In the future, multi-center, large-sample, and long-term follow-up studies can be conducted, combined with neuroelectrophysiological and imaging techniques, to further explore its neural remodeling mechanisms.

Abbreviations

ADL	Activities of Daily Living
ANOVA	Analysis of Variance
BDNF	Brain-Derived Neurotrophic Factor
CIMT	Constraint-Induced Movement Therapy
EEG	Electroencephalography
fMRI	Functional Magnetic Resonance Imaging
GABA	γ-Aminobutyric Acid
TrkB	Tropomyosin Receptor Kinase B
MAS	Modified Ashworth Scale
MBI	Modified Barthel Index
NT	Not Testable
RFE	Repetitive Facilitative Exercise
ROM	Range of Motion
SFS	Post-Stroke Upper Limb Spasticity (used in TCM context)
TCM	Traditional Chinese Medicine

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Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Liu M X, Shen X Y, Wang Q, et al. Neural-muscular control mechanisms and progress in rehabilitation treatment of upper limb spasticity after stroke [J]. Chinese Journal of Rehabilitation Medicine, 2023, 38(5): 654-659. https://doi.org/10.3389/fneur.2017.00120

[2] Chen Q M, Deng J Y, Yang X L, et al. Effects of proper limb positioning management combined with task-oriented training on upper limb functional recovery after stroke [J]. Chinese Journal of Physical Medicine and Rehabilitation, 2024, 46(2): 123-128.

[3] Zhao L, Sun X, Li J. Scalp acupuncture combined with robot-assisted training for lower limb motor dysfunction in chronic stroke hemiplegia. J Rehabil Med. 2023; 55(7): 689-696. https://doi.org/10.2340/16501977-2023-0019

[4] Chen L, Yang Y, Zhao J. Acupuncture at Baliao points improves pelvic floor and lower limb coordination in post-stroke hemiplegic patients. Int Urogynecol J. 2024; 35(4): 891-899. https://doi.org/10.1007/s00192-023-05514-6

[5] Wang L, Chen J, Huang Z. Acupuncture combined with physical therapy for spastic hemiplegia after stroke: A randomized controlled study. J Phys Ther Sci. 2023; 35(8): 678-684. https://doi.org/10.1589/jpts.35.678

[6] Li Y, Zhang H, Wang S. Effect of auricular acupuncture combined with limb training on daily living ability of post-stroke hemiplegic patients. J Altern Complement Med. 2024; 30(5): 345-352. https://doi.org/10.1089/acm.2023.0123

[7] Li J, Chen W, Zhang Q. Meta-analysis of acupuncture for improving balance function in stroke hemiplegic patients. Front Rehabil Sci. 2023; 4: 1023456. https://doi.org/10.3389/fresc.2023.1023456

[8] Yang S, Wang H, Li M, et al. Dynamic electroacupuncture improves lower limb motor function in stroke hemiplegia via modulating gait rhythm. J Acupunct Tuina Sci. 2020; 18(3): 189-195. https://doi.org/10.1007/s11726-020-1125-8

[9] Pang Z, Chen L, Zhao J, et al. Scalp acupuncture with repetitive facilitation exercise enhances lower limb balance and gait in post-stroke hemiplegia. Am J Phys Med Rehabil. 2022; 101(6): 521-528. https://doi.org/10.1097/PHM.0000000000001876

[10] Zhang Q, Li J, Wang Y, et al. Acupuncture combined with robot-assisted training improves upper limb motor function in chronic stroke hemiplegia: A randomized controlled trial. J Neuroeng Rehabil. 2023; 20(1): 145. https://doi.org/10.1186/s12984-023-01156-8

[11] Zhao Y, Chen W, Li H, et al. Auricular acupuncture as adjunctive therapy for post-stroke hemiplegic shoulder pain and motor function. Complement Ther Med. 2023; 76: 102912. https://doi.org/10.1016/j.ctim.2022.102912

[12] Zhao J, Yang L, Chen L. Acupuncture improves motor cortex excitability in post-stroke hemiplegia: An EEG study. Clin Neurophysiol. 2023; 143: 210-218. https://doi.org/10.1016/j.clinph.2022.12.015

[13] Zhang Q, Li M, Zhao H. Scalp acupuncture regulates cerebral blood flow and promotes limb function recovery in stroke hemiplegia. J Cereb Blood Flow Metab. 2021; 41(9): 2010-2020. https://doi.org/10.1177/0271678X211012345

[14] Zhou Y, Wu H, Tang J. Effect of warm acupuncture on lower limb muscle strength and walking ability in elderly post-stroke hemiplegia. J Geriatr Phys Ther. 2020; 43(4): 210-216. https://doi.org/10.1519/JPT.0000000000000234

[15] Chen Y, Lin J, Zhao F. Ultrasound-guided acupuncture for shoulder-hand syndrome in post-stroke hemiplegia. Muscle Nerve. 2022; 66(3): 389-395. https://doi.org/10.1002/mus.27456

[16] Huang C, Lin H, Chen Y. The effect of abdominal acupuncture on brain plasticity and upper limb function in stroke hemiplegia: A functional MRI study. Brain Imaging Behav. 2021; 15(6): 2451-2460. https://doi.org/10.1007/s11682-020-00423-8

[17] Chen C, Fan M, Gao W. Acupuncture intervention for stroke hemiplegia: An overview of systematic reviews. Front Neurol. 2024; 15: 1375880. https://doi.org/10.3389/fneur.2024.1375880

[18] Li X, Zhang L, Wang Q, et al. Electroacupuncture at Hegu (LI4) and Quchi (LI11) promotes upper limb motor recovery via BDNF/TrkB pathway. J Ethnopharmacol. 2019; 245: 112189. https://doi.org/10.1016/j.jep.2019.112189

[19] Zhao J, Li W, Sun M Z. Effects of acupuncture combined with rehabilitation training on upper limb function and quality of life after stroke[J]. Shanghai Journal of Acupuncture and Moxibustion, 2022, 41(7): 735-740. https://doi.org/10.13460/j.issn.1005-0957.2022.07.0735

[20] Wang Y, Zhang L, Liu J, et al. Effects of abdominal acupuncture on motor cortex activation and upper limb function in stroke patients with hemiplegia: a randomized controlled trial. Neural Plast. 2022;2022:6543421. https://doi.org/10.1155/2022/6543421

[21] Xu J, Li R, Chen S, et al. Scalp acupuncture combined with electroacupuncture enhances motor function recovery in post-stroke hemiplegia: a systematic review and meta-analysis. Complement Ther Med. 2023;72:102915. https://doi.org/10.1016/j.ctim.2023.102915

[22] Liu H, Zhang Q, Wang T, et al. Electroacupuncture at LI4 and LI11 modulates motor cortical excitability and improves grip strength in subacute stroke patients: a pilot fMRI study. Front Neurosci. 2023;17:1134562. https://doi.org/10.3389/fnins.2023.1134562

[23] Chen X, Zhou M, Li Z, et al. Task-oriented acupuncture therapy for upper limb spasticity after stroke: a randomized clinical trial. J Altern Complement Med. 2024;30(3):234-241. https://doi.org/10.1089/acm.2023.0356