

Original Paper

Clinical Efficacy and Mechanism of Micro-needle Pulsed Combined with new Bobath Technique in the Treatment of Shoulder Subluxation after Stroke

Zailin Yang¹, Feng Zhang² & Congan Wang^{3*}

^{1,2,3} Pain of Neck, Shoulder, Lumbar and Leg Hospital, Shandong First Medical University, Shandong, China

* Corresponding Author

Received: September 6, 2026 Accepted: September 28, 2026 Online Published: October 11, 2026

doi:10.22158/rhs.v11n4p14

URL: <http://dx.doi.org/10.22158/rhs.v11n4p14>

Abstract

Post-stroke shoulder subluxation is a relatively common secondary complication of stroke that can seriously impair the recovery of upper-limb motor function, reduce quality of life, and adversely affect long-term rehabilitation outcomes. Traditional single-modality rehabilitation interventions have limited effectiveness because they address only one pathway of action. The Microneedle Tongmai Method is a traditional Chinese medicine physical therapy technique that acts on the superficial meridians and myofascia of the shoulder joint to promote qi-blood circulation and reduce local muscle tension. The new Bobath technique, a contemporary neurorehabilitation approach, corrects abnormal postural patterns and rebuilds normal motor control through neurodevelopmental intervention. Together, the two treatments exert a synergistic effect that helps stroke patients improve mobility and regain functional independence. This paper systematically discusses the application principles, clinical significance, and internal action mechanisms of the combined therapy for post-stroke shoulder subluxation, clarifying the synergistic advantages of the Microneedle Tongmai Method and the new Bobath technique in alleviating glenohumeral subluxation, repairing neurological damage, and reconstructing motor function. To objectively evaluate the contribution of the Microneedle Tongmai Method within this combined regimen, a prospective randomized controlled clinical comparison was conducted in which both the experimental group and the control group received identical new Bobath rehabilitation training and differed only in the traditional Chinese medicine intervention. The between-group data demonstrate that, when combined with the new Bobath technique, the Microneedle Tongmai Method is superior to conventional acupuncture with routine acupoint selection in correcting shoulder subluxation, reducing pain, and

restoring upper-limb motor function and activities of daily living.

Keywords

Microneedle Tongmai Method, New Bobath technique, Shoulder subluxation, Stroke, Motor function, Neuroplasticity

Introduction

Shoulder subluxation is a movement disorder that frequently occurs after stroke, mainly caused by a loss of neuromuscular control, relaxation of the joint capsule and periarticular ligaments, and an imbalance in the tension of shoulder-stabilizing muscles. This complication leads to local pain and restricted shoulder motion, provokes abnormal compensatory movement patterns of the affected limb, worsens upper-limb motor deficits, and contributes to long-term physical and psychological disability. A recent network meta-analysis comparing treatments for shoulder subluxation after stroke confirmed that no single intervention is uniformly superior, and combined approaches tend to yield better outcomes [1]. Active shoulder exercise delivered through sling suspension has been investigated in patients with subacute stroke [2]. A Lycra arm sleeve has also been studied for glenohumeral subluxation in people with sub-acute stroke [3]. Repetitive peripheral magnetic stimulation has been evaluated as a preventive intervention [4]. The search for more effective integrated regimens nevertheless continues. Currently, rehabilitation methods for post-stroke shoulder subluxation in China include physical factor therapy, exercise rehabilitation, and traditional Chinese medicine therapy; although these approaches help improve neuromuscular coordination and address the consequences of subluxation, they have limitations in achieving fundamental correction. The Microneedle Tongmai Method addresses meridian stasis and muscle dystonia of the affected shoulder, while the new Bobath technique targets the neuroplasticity of the central nervous system and the reconstruction of normal motor patterns. The integration of these two modalities offers a promising pathway for more comprehensive and effective rehabilitation.

1Clinical efficacy and mechanism principle of micro-needle pulse-dredging combined with new Bobath technique in the treatment of shoulder subluxation after stroke

1.1 Theoretical Basis of Microneedle Tongmai Method for Rehabilitation of Post-stroke Shoulder Subluxation

Microneedle Tongmai Method is based on the traditional Chinese medicine meridian theory and fascia therapy, with the main idea being to "dredge meridians, regulate qi and blood, relax tendons and relieve spasm" in the treatment of post-stroke shoulder subluxation. In terms of traditional Chinese medicine, post-stroke shoulder subluxation falls under the category of "apoplexy sequelae" and "tendon bi", and its main pathological mechanism is the obstruction of shoulder meridians, deficiency of qi and blood nourishment, and dystrophy of tendon and ligament tissues; thus, there is an imbalance in muscle tension and abnormal joint displacement. A microneedle device can lightly puncture and separate the adherent fascial tissue at the surface of the shoulder joint, meridian points and muscle attachment areas to relieve the blockage of meridian channels and promote the free flow of local qi and blood. This kind of therapy

does not cause serious harm to the body; it can be done minimally invasively to boost the body's own regulatory function, increase the supply of nutrients to the capsule of the shoulder joint, ligaments and muscles, reduce muscle spasm and flaccid paralysis in the affected limb, and offer a basis for correcting subluxation of the shoulder joint. Microneedle Tongmai Method is different from traditional acupuncture and moxibustion in that it aims to improve the general circulation of the local area and the fascia system, and thus can address the specific pathological changes in the shoulder joint caused by stroke, regulating soft tissue lesions that lead to joint dislocation. Recent clinical evidence in post-stroke shoulder-hand syndrome indicates that acupuncture combined with rehabilitation can improve shoulder-related outcomes [5]. A recent meta-analysis likewise supports acupuncture or moxibustion combined with rehabilitation therapy for post-stroke shoulder-hand syndrome [6].

1.2 Technical Principles of New Bobath Technique for Post-stroke Shoulder Subluxation Rehabilitation

Based on the traditional Bobath neurorehabilitation theory, the new Bobath technique has been updated and optimised; it is based on the concept of central nervous system neuroplasticity to correct abnormal postural reflexes and motor patterns and restore the normal motor control function of the shoulder joint. Stroke can harm the cerebral motor cortex and its connecting pathways; thus, there is a loss of voluntary control over the muscle group of the shoulder girdle, an increase in primitive reflexes, and the formation of abnormal compensatory movement patterns, all of which are underlying neurological reasons for post-stroke shoulder subluxation. The new Bobath method is not a single kind of passive exercise as in the old method, but rather a combination of all kinds of active-passive interventions, such as postural control, key-point compression, anti-spasm mode correction and limb weight-bearing exercises. It can reduce the abnormal muscle tension in the shoulder and upper limb, activate the weakened muscle groups, balance the tension of the internal and external muscle groups of the shoulder joint, and restore the normal mechanical balance of the shoulder joint. The purpose of the above rehabilitation intervention for shoulder subluxation is to help patients learn a proper sense of the position of the shoulder joint, correct abnormal movement compensation habits that have developed after stroke, and promote the restructuring of the motor function of the central nerves; thus, it can improve the neuromuscular control of the shoulder joint at its root and achieve the goals of correcting subluxation and preventing recurrence. A recent scoping review consolidates contemporary Bobath theoretical and clinical principles in adult neurorehabilitation [7]. In a 2024 randomized trial of post-stroke upper-limb rehabilitation, a Bobath group served as an active comparator to exoskeleton-assisted training [8]. Sensory training combined with trunk-centered Bobath exercises has also been evaluated in stroke rehabilitation [9].

2. Clinical Effect and Mechanism Significance of Micro-needle Pulse-dredging Combined with New Bobath Technique in the Treatment of Shoulder Subluxation after Stroke

2.1 Clinical Application Value of Combined Therapy in Optimizing Post-stroke Rehabilitation Effect

although there will be a temporary decrease in soft tissue symptoms, the basic problem of abnormal neural control and subluxation will not be solved. On the other hand, a single New Bobath technique can

regulate nerve motor control and retrain the brain's signalling pathway to restore normal muscle activation, but it is slow to improve local fascia adhesion, meridian stasis and muscle dystonia of the shoulder joint. Most stubborn soft tissue abnormalities need more direct physical intervention for correction, and Bobath alone is not very effective in this regard. Together, the two therapies can reduce the damage at the site of injury and restore central function; thus, the repair of the periphery can also support the organisation of the central nervous system. The Microneedle Tongmai Method can improve the local microenvironment of the shoulder joint, increase blood flow and reduce inflammation, alleviate the pathological state of soft tissues (such as fascia tightness and trigger points), and thus create a good physical condition for Bobath rehabilitation training. Reducing the soft tissue barrier will help the patient do the movement rehabilitation exercise more easily and effectively. The new Bobath technique will further stabilize the joints and improve the motor control ability that has been enhanced by microneedle intervention; extend the new range of motion and alignment; prevent the recurrence of subluxation due to abnormal motor patterns (such as improper muscle compensation or poor posture); and build an uninterrupted and systematic rehabilitation intervention process to address both the local and central problems of the disease. The two aims above can improve the clinical rehabilitation effect of post-stroke shoulder subluxation and boost the recovery efficiency of upper limb motor function in patients, helping them regain functional independence more quickly and achieve better long-term results. Recent randomized evidence shows that focused scapulo-humeral training can improve upper-extremity performance and shoulder-related measures after stroke [10]. High-intensity laser and ultrasound therapies have also been evaluated for hemiplegic shoulder pain [11]. A separate randomized trial reported benefits of high-intensity laser therapy for hemiplegic shoulder dysfunction [12].

2.2 Theoretical Research Significance of Combined Therapy in Establishing the Stroke Rehabilitation System

Combined therapy is based on the dual theoretical support of meridian theory in traditional Chinese medicine and the theory of neuroplasticity in modern science; therefore, we have systematically clarified the internal correlation between local soft tissue dredging and central nerve function reconstruction in the treatment of shoulder subluxation and constructed a new rehabilitation theoretical model of "local lesion repair - central function remodeling - motor pattern normalization". Further investigation into the reasons for this will help correct the existing theoretical deficiencies in the current study on integrated Chinese and Western rehabilitation for post-stroke complications, provide new theoretical support for the innovative development of the discipline of stroke rehabilitation, and promote the standardisation and systemisation of comprehensive rehabilitation therapy for stroke sequelae.

2.3 Social Application Significance of Combined Therapy in Improving Patients' Rehabilitation Prognosis

If the dislocation is not corrected in time, there will be long-term problems in the shoulder joint, and people will be unable to do daily activities such as working and taking care of themselves. Therefore, both the families of the patients and society have been under considerable financial and emotional

pressure and require continuous attention and large-scale allocation of medical resources. At the same time, the joint rehabilitation plan can effectively enhance the function of the shoulder joint and the motor ability of the upper limb in stroke patients, helping them regain basic daily living skills such as dressing, eating and personal hygiene. Reduce the reliance of older adults on family care so as to lessen the burden on family members and lower the total amount of social medical and nursing expenses. Microneedle therapy is also relatively small in size, safe and effective, and when combined with the scientific and targeted advantages of new Bobath rehabilitation training, it is expected to have good results in clinical practice. It can offer high-quality rehabilitation services for a larger number of stroke patients and help them improve their physical and mental health and social integration. It can be expected that it will help to raise the overall rehabilitation level of people with strokes in society and promote the improvement of public health and social stability.

3. Clinical Efficacy and Mechanism of Micro-needle Pulse-dredging Combined with New Bobath Technique in the Treatment of Shoulder Subluxation after Stroke

3.1 Clinical Efficacy of Combined Therapy in Correcting Shoulder Subluxation and Improving Joint Function

A combination of the microneedle Tongmai method and the new Bobath technique has been applied to improve the correction of post-stroke shoulder subluxation and restore shoulder joint function. On the one hand, microneedle Tongmai can directly treat fascia and meridian lesions in the shoulder joint to address the particular pathological sites of soft tissue abnormalities. Directly address the spasm and adhesion of the muscle groups in the shoulder girdle to reduce tension on the joint and correct the joint misalignment. It can also help relax the shoulder joint capsule and ligaments to improve their function of support and stability. Strengthen the elasticity and toughness of the soft tissues in the area to help them better withstand mechanical injury. Together, the above effects can reduce the main reason for shoulder joint displacement due to soft tissue dystrophy by correcting the underlying structural problems in the joint that are likely to cause subluxation. At the same time, according to the new Bobath technique, one can regularise the posture and movement patterns of the shoulder joint and limbs by using specific neurorehabilitation exercises and guidance to correct abnormal movement. This exercise will help you regulate the pull of the front and back, inside and out, of the muscles around your shoulder joint to prevent any one area from pulling too hard and causing problems for the joint. Restore the mechanical stability of the shoulder joint to accurately correct the subluxation, and then move the humeral head back to the correct position in the glenoid cavity. At the same time, the two treatments are also complementary and can be used together in the clinic. The improvement of the local soft tissue in the area after microneedle therapy can help sustain the rehabilitation training; that is to say, a reduction in spasm and an increase in tissue compliance will make it easier for patients to perform the prescribed exercises. At the same time, the neuro-motor regulation of the Bobath technique can keep correcting the position of the shoulder joint and prevent subluxation at this time after training. Based on the above combined method, various parts

of the range of motion, stability and function of the damaged shoulder joint can be improved to correct the disorder caused by stroke, thereby enabling patients to operate their upper limbs normally once more. Contralaterally controlled functional electrical stimulation has been evaluated for shoulder pain and subluxation in subacute stroke [13]. Neuromuscular joint facilitation has also shown short-term effects in stroke patients with shoulder subluxation [14]. Ultrasound-based methods have been examined for reliable assessment of shoulder subluxation after stroke [15].

3.2 Local Soft Tissue Regulatory Mechanism of Combined Therapy in the Affected Shoulder Joint

Together, the two treatments can address various problems in the soft tissues of the injured area of a dislocated shoulder joint, and working together, they will create a good microenvironment for repairing damage caused by stroke in the shoulder. First, the microneedle Tongmai method is used to apply a small amount of physical stimulation to the superficial tissues of the shoulder joint to effectively dilate the local microvessels, improve blood and lymph circulation, and increase the general metabolic level of the soft tissues in the shoulder joint. The increased metabolic activity will help to raise the concentration of local inflammatory substances and thus promote the organised repair of damaged fascia and muscle tissue to restore the structure of the soft tissue. Therefore, we can adjust the excitability of the local peripheral nerves more accurately, reduce the abnormal pain and numbness in the shoulder joint caused by nerve compression and blood stasis, and gradually restore the normal sensory function of the local tissues in the shoulder joint to improve the patient's subjective feeling of comfort. At the same time, the new Bobath technique can reduce the stress on the shoulder joint capsule and ligaments by combining passive and active limb positioning with specific muscle training; thus, it can prevent soft tissue atrophy and contracture caused by prolonged abnormal joint positions and actively stimulate the vitality of dormant muscle cells in the shoulder girdle to restore muscular support. The joint operation of the two complementary ways can fully repair the damage to the soft tissues in the shoulder joint, distribute the mechanical stress of the soft tissue structure properly, build a stable and flexible system of soft tissue support for the shoulder joint; thus, the local pathological factors causing recurrent subluxation will be completely eliminated, and long-term therapeutic stability will be achieved.

3.3 Central Neuroplasticity Remodeling Mechanism of Combined Therapy on Stroke Injury

The main reason that the microneedle Tongmai Method combined with the new Bobath technique helps reduce post-stroke shoulder subluxation is that it can promote changes in the central nervous system and rebuild a normal nerve-muscle regulation pathway. Damage to the central nerves in the brain due to stroke interrupts motor nerve conduction, so there is a loss of active regulation function for the shoulder muscles and thus an occurrence of shoulder subluxation. At the base of the new Bobath method is neuroplasticity, and by means of repeatedly practising standardised postural exercises and correcting motor patterns precisely, one can promote the compensatory regeneration of cerebral nerve cells. This way will help to repair the damaged motor nerve conduction pathway, re-establish the central nerve's main control over the muscle groups in the shoulder girdle, and restore the normal neural command chain from the brain to the shoulder muscles. At the same time, the microneedle Tongmai method can also

transmit local somatic sensory stimulation of the shoulder joint to the central nervous system by way of peripheral nerve conduction and increase the sensory feedback in the affected limb. The increased sense of touch can activate the dormant nerve function area in the brain and promote the reconstruction of central nerve motor function to improve the therapeutic effect of the Bobath method. The two kinds of stimulation for peripheral somatic sensation and central motor training form a whole and cooperative closed-loop regulation mechanism of "peripheral stimulation - central response - functional reconstruction". In this way, we can address the problem of neuromuscular control disorders after stroke and reduce post-stroke shoulder subluxation significantly at the level of central nerve function to achieve effective and lasting treatment. Transcutaneous electrical nerve stimulation has been studied as an adjunct to post-stroke upper-limb rehabilitation [16]. Transcranial direct current stimulation combined with constraint-induced movement therapy has also demonstrated effects on upper-limb impairment after stroke [17]. Early interventions targeting post-stroke spasticity, including electrical stimulation, may reduce abnormal muscle tone [18].

3.4 Controlled Clinical Comparison: Microneedle Tongmai Method versus Conventional Acupuncture Under the Same New Bobath Regimen

3.4.1 Study Design, Subjects, and Grouping

To verify whether the Microneedle Tongmai Method offers a genuine advantage over conventional acupuncture when both are combined with the new Bobath technique, a prospective randomized controlled clinical study was conducted in patients with post-stroke shoulder subluxation. A total of 60 eligible patients were enrolled according to the diagnostic criteria for stroke and shoulder subluxation. All patients had a first-ever unilateral stroke confirmed by cranial CT or MRI, presented with shoulder subluxation of the affected side, and had stable vital signs without severe consciousness, cognitive, or psychiatric disorders that would prevent cooperation. Patients were randomly assigned in a 1:1 ratio to two groups of 30 cases each. The control group (conventional acupuncture group) comprised 16 males and 14 females, aged 52 to 76 years (mean 64.2 ± 7.0 years), with a disease duration of 25 to 74 days (mean 47.7 ± 12.3 days) and 16 left-sided and 14 right-sided lesions. The experimental group (Microneedle Tongmai group) comprised 17 males and 13 females, aged 45 to 74 years (mean 61.0 ± 7.5 years), with a disease duration of 29 to 65 days (mean 46.5 ± 9.6 days) and 17 left-sided and 13 right-sided lesions. There were no statistically significant differences between the two groups in sex, age, disease duration, affected side, or baseline outcome scores (all $p > .05$), indicating that the two groups were comparable at baseline.

To clarify the experimental-control comparison, both groups were managed under the same new Bobath rehabilitation framework and the same 8-week treatment schedule, while the traditional Chinese medicine intervention differed between groups. The control group represented the conventional acupuncture approach with routine acupoint selection for post-stroke shoulder dysfunction, whereas the experimental group represented the Microneedle Tongmai approach, which focused on the meridian routes, fascial planes, trigger points, and muscle attachment areas around the affected shoulder. Thus, the

comparison was not between Bobath and non-Bobath rehabilitation, but between two acupuncture-related interventions delivered on the same Bobath background. This grouping framework allows the additional therapeutic contribution of the Microneedle Tongmai Method, relative to conventional acupuncture point selection, to be examined while the principal rehabilitation program remains consistent.

3.4.2 Intervention Protocols

Both groups received identical standardized new Bobath neurorehabilitation training, including postural control, key-point compression, anti-spastic pattern correction, scapulothoracic mobilization, and progressive weight-bearing exercises of the affected upper limb, for 40 minutes per session, once daily, 5 days per week, over 8 weeks. On this common basis, the two groups differed only in the traditional Chinese medicine intervention. The control group received conventional body acupuncture with routine acupoint selection for post-stroke shoulder dysfunction; the selected points included Jianyu (LI15), Jianliao (TE14), Jianzhen (SI9), Binao (LI14), Quchi (LI11), Shousanli (LI10), Hegu (LI4), and Waiguan (TE5), with standard needle insertion, 25-minute retention, and uniform reinforcing-reducing manipulation. These shoulder-related acupoints reflect a conventional acupuncture framework for post-stroke shoulder dysfunction. The experimental group received the Microneedle Tongmai Method, in which a microneedle device was used to perform light puncturing and superficial separation along the meridians, fascial planes, trigger points, and muscle attachment areas around the affected shoulder (the deltoid, supraspinatus, upper trapezius, and bicipital groove regions), aiming to dredge meridians, regulate qi and blood, release fascial adhesion, and relax tendons to relieve spasm. This treatment was administered once daily, 5 days per week for 8 weeks, consistent with the control group. Apart from the difference between the two Chinese medicine interventions, the Bobath protocol, treatment duration, frequency, and rehabilitation guidance were identical, so that any difference in efficacy could be attributed to the Chinese medicine technique itself.

3.4.3 Outcome Measures and Statistical Analysis

The therapeutic effects of the two groups were evaluated before and after the 8-week treatment using the following measures: (a) the Fugl-Meyer Assessment for the upper extremity (FMA-UE), with a higher score indicating better upper-limb motor function; (b) the Visual Analogue Scale (VAS) for shoulder pain, with a lower score indicating less pain; (c) the acromiohumeral interval (AHI), i.e., the subluxation distance measured on an anteroposterior shoulder radiograph, with a smaller value indicating better reduction; (d) the Barthel Index (BI) for activities of daily living, with a higher score indicating greater independence; and (e) the overall clinical effective rate, classified as markedly effective, effective, or ineffective according to the improvement in shoulder alignment, pain, and motor function. Data were processed using SPSS; measurement data were expressed as mean $\pm$ standard deviation and compared using the within-group paired t test and the between-group independent-samples t test, while count data were compared by the chi-square test, with $p < .05$ considered statistically significant.

3.4.4 Results

Within-group changes. After 8 weeks of treatment, both groups showed significant improvements in all

four quantitative outcome measures compared with their respective baselines. In the experimental group, the FMA-UE score increased from 24.7 ± 4.7 to 45.4 ± 5.4 , the VAS score decreased from 5.3 ± 1.0 to 1.6 ± 1.1 , the AHI decreased from 16.1 ± 2.3 mm to 8.7 ± 2.4 mm, and the BI score increased from 39.3 ± 10.0 to 70.5 ± 11.5 (all $p < .001$). In the control group, the FMA-UE score increased from 27.0 ± 5.4 to 38.9 ± 6.3 , the VAS score decreased from 5.8 ± 1.1 to 3.3 ± 1.3 , the AHI decreased from 15.2 ± 2.3 mm to 11.0 ± 2.8 mm, and the BI score increased from 41.9 ± 8.4 to 58.2 ± 10.2 (all $p < .001$). These results indicate that both treatment regimens—conventional acupuncture plus new Bobath and Microneedle Tongmai plus new Bobath—were effective in improving shoulder subluxation and related functional deficits.

Between-group comparisons at post-treatment. Although both groups improved, the experimental group achieved significantly better outcomes than the control group across all measures at the 8-week endpoint. As shown in Table 1, the post-treatment FMA-UE score was significantly higher in the experimental group than in the control group (45.4 ± 5.4 vs. 38.9 ± 6.3 , $t = 4.27$, $p < .001$), representing a between-group mean difference of 6.5 points. The VAS score was significantly lower in the experimental group (1.6 ± 1.1 vs. 3.3 ± 1.3 , $t = 5.51$, $p < .001$). The AHI was significantly smaller in the experimental group (8.7 ± 2.4 mm vs. 11.0 ± 2.8 mm, $t = 3.48$, $p = .001$), indicating greater reduction of the subluxation distance. The BI score was significantly higher in the experimental group (70.5 ± 11.5 vs. 58.2 ± 10.2 , $t = 4.38$, $p < .001$). Because baseline outcome scores did not differ significantly between groups, these endpoint differences were interpreted together with the change-from-baseline analysis as evidence of an additional benefit associated with the Microneedle Tongmai Method on the shared new Bobath background.

Table 1. Comparison of Outcome Measures Between the Experimental and Control Groups Before and After Treatment

Outcome measure	Group	n	Baseline	Post-treatment	Within-group p	Between-group post-treatment
FMA-UE (score)	Experimental	30	24.7 ± 4.7	45.4 ± 5.4	$< .001$	$t = 4.27$, $p < .001$
	Control	30	27.0 ± 5.4	38.9 ± 6.3	$< .001$	
VAS (score)	Experimental	30	5.3 ± 1.0	1.6 ± 1.1	$< .001$	$t = 5.51$, $p < .001$
	Control	30	5.8 ± 1.1	3.3 ± 1.3	$< .001$	
AHI (mm)	Experimental	30	16.1 ± 2.3	8.7 ± 2.4	$< .001$	$t = 3.48$, $p = .001$
	Control	30	15.2 ± 2.3	11.0 ± 2.8	$< .001$	
BI (score)	Experimental	30	39.3 ± 10.0	70.5 ± 11.5	$< .001$	$t = 4.38$, $p < .001$
	Control	30	41.9 ± 8.4	58.2 ± 10.2	$< .001$	

Note. FMA-UE = Fugl-Meyer Assessment for the upper extremity; VAS = Visual Analogue Scale; AHI = acromiohumeral interval; BI = Barthel Index. Within-group comparisons used the paired t test; between-group comparisons used the independent-samples t test.

Clinical effective rate. The overall clinical effective rate was 93.3% (28/30) in the experimental group, comprising 17 cases of markedly effective, 11 cases of effective, and 2 cases of ineffective. In the control group, the overall effective rate was 70.0% (21/30), comprising 9 cases of markedly effective, 12 cases of effective, and 9 cases of ineffective. The between-group difference in the overall effective rate was statistically significant ($\chi^2 = 5.45$, $p = .020$), as shown in Table 2.

Table 2. Comparison of Clinical Effective Rate Between the Two Groups

Group	n	Markedly effective	Effective	Ineffective	Total effective rate (%)	χ^2	p
Experimental	30	17	11	2	93.3	5.45	.020
Control	30	9	12	9	70.0		

Note. The overall effective rate = (markedly effective + effective) / total $\times$ 100%. Comparison by chi-square test.

A change-from-baseline comparison further clarifies the magnitude of improvement in the two groups. The FMA-UE score increased by 20.7 points in the experimental group (24.7 to 45.4) and by 11.9 points in the control group (27.0 to 38.9). The VAS score decreased by 3.7 points in the experimental group (5.3 to 1.6) and by 2.5 points in the control group (5.8 to 3.3). The AHI decreased by 7.4 mm in the experimental group (16.1 to 8.7 mm) and by 4.2 mm in the control group (15.2 to 11.0 mm), while the BI score increased by 31.2 points (39.3 to 70.5) and 16.3 points (41.9 to 58.2), respectively. Accordingly, the experimental group showed an 8.8-point greater FMA-UE gain, a 1.2-point greater VAS reduction, a 3.2-mm greater AHI reduction, and a 14.9-point greater BI gain than the control group. Together with the 23.3-percentage-point difference in overall clinical effective rate (93.3% vs. 70.0%), these directly derived changes provide additional quantitative support for the greater improvement observed with the Microneedle Tongmai Method when both groups received the same new Bobath rehabilitation program. No adverse events. No serious adverse events such as infection, hematoma, nerve injury, or allergic reactions were observed in either group during the 8-week treatment period, confirming the safety of both interventions.

3.4.5 Between-Group Data Analysis and Discussion

The controlled comparison yields several important findings. First, because both groups received identical new Bobath rehabilitation training and differed only in the traditional Chinese medicine component, the observed between-group differences can be attributed specifically to the superior efficacy of the Microneedle Tongmai Method over conventional acupuncture with routine acupoint selection. This design directly addresses the core question of whether the Microneedle Tongmai Method adds value beyond what new Bobath training alone—supplemented by standard acupuncture—can achieve.

Second, the magnitude of the between-group differences is clinically meaningful. At the 8-week endpoint, the experimental group had a 6.5-point higher FMA-UE score and a 2.3-mm smaller AHI than the control group, while its overall effective rate was 23.3 percentage points higher (93.3% vs. 70.0%). On the basis of the absolute difference in effective rate, the corresponding number needed to treat is approximately 5, indicating that the between-group advantage was not confined to a single outcome domain.

Third, the pattern of results is consistent with the proposed mechanistic synergy. The Microneedle Tongmai Method's focus on fascial release, meridian dredging, and local microcirculation improvement directly targets the soft tissue barriers—fascia adhesion, muscle spasm, and trigger points—that constrain the effectiveness of Bobath motor retraining. By reducing these peripheral obstacles, the Microneedle Tongmai Method creates a more permissive tissue environment in which the new Bobath technique can more effectively restore motor control and joint alignment. Conventional acupuncture, while beneficial, primarily stimulates fixed acupoints and may less comprehensively address the distributed fascial and muscular pathology characteristic of post-stroke shoulder subluxation. Recent randomized evidence indicates that peripheral needling can be paired with central neuromodulation: sinew acupuncture combined with low-frequency rTMS improved pain, upper-limb mobility, and activities of daily living in hemiplegic shoulder pain [19]. Separately, neuronavigated high-frequency rTMS has been evaluated in a double-blind randomized trial for post-stroke shoulder pain [20].

Fourth, the parallel improvement in pain (VAS), motor function (FMA-UE), anatomical reduction (AHI), and daily living independence (BI) in the experimental group suggests that the Microneedle Tongmai Method exerts a multi-domain effect rather than improving only one outcome. This multi-domain benefit is consistent with the theoretical model of “local lesion repair—central function remodeling—motor pattern normalization” proposed earlier in this paper: local soft tissue repair facilitates central motor relearning, which in turn consolidates functional gains and prevents recurrence.

Finally, the absence of adverse events in either group supports the safety profile of the Microneedle Tongmai Method when administered by trained practitioners. The minimally invasive nature of the technique, which involves superficial puncturing rather than deep needle insertion, likely contributes to its favorable tolerability.

Conclusion

The combination of the Microneedle Tongmai Method and the new Bobath technique constitutes an innovative integrated Chinese and Western rehabilitation system that has sound theoretical support and demonstrates favorable clinical results in the treatment of post-stroke shoulder subluxation. Grounded in the meridian dredging theory of traditional Chinese medicine and the neuroplasticity theory of modern medicine, the combined therapy leverages the Microneedle Tongmai Method's capacity for repairing local shoulder soft tissue lesions and the new Bobath technique's strength in reconstructing central nerve motor function, achieving a synergistic rehabilitation effect of local lesion repair and central function remodeling. The controlled clinical comparison confirms that, under identical new Bobath training

conditions, the Microneedle Tongmai Method is significantly superior to conventional acupuncture with routine acupoint selection in correcting shoulder subluxation, reducing pain, improving upper-limb motor function, and enhancing activities of daily living. Combined therapy possesses the attributes of safety, efficacy, and practicality; therefore, it is worthy of continued promotion in clinical practice. Further research should investigate the optimal treatment parameters, long-term follow-up outcomes, and neurophysiological mechanisms underlying the synergistic effect, in order to build a more scientific and standardized clinical rehabilitation scheme for post-stroke shoulder subluxation and to enrich the theoretical and practical system of integrated Chinese and Western rehabilitation for stroke sequelae.

References

- [1] Jong-Mi Park, Hee-Jae Park, Seo-Yeon Yoon, Yong-Wook Kim, Jae-Il Shin, & Sang-Chul Lee. (2025). Comparative Effectiveness of Treatments for Shoulder Subluxation After Stroke: A Systematic Review and Network Meta-Analysis. *Journal of Clinical Medicine*, 14(19), 6913. <https://doi.org/10.3390/jcm14196913>
- [2] Young-Jun Kim, Jungae An, & Byoung-Hee Lee. (2024). Effects of Sling-Suspension-Based Active Shoulder Joint Exercise on Shoulder Joint Subluxation, Pain, Muscle Strength, and Upper Limb Function in Patients with Subacute Stroke. *Medicina*, 60(8), 1350. <https://doi.org/10.3390/medicina60081350>
- [3] Robert Jones, Paul White, Rosemary Greenwood, & Praveen Kumar. (2025). The Lycra arm sleeve for treatment of glenohumeral subluxation in people with sub-acute stroke: a randomized controlled (RC) feasibility study. *Topics in Stroke Rehabilitation*, 32(4), 419-427. <https://doi.org/10.1080/10749357.2024.2403808>
- [4] Kenta Fujimura, Hitoshi Kagaya, Ryoka Itoh, Chiharu Endo, Hiroki Tanikawa, & Hirofumi Maeda. (2024). Repetitive peripheral magnetic stimulation for preventing shoulder subluxation after stroke: a randomized controlled trial. *European Journal of Physical and Rehabilitation Medicine*, 60(2), 216-224. <https://doi.org/10.23736/S1973-9087.24.08264-9>
- [5] Lin Li, Ju Li, & Mu He. (2024). Treatment outcomes in post-stroke shoulder-hand syndrome: The role of combined acupuncture, traditional Chinese herb hot compress and rehabilitation training. *Journal of Back and Musculoskeletal Rehabilitation*, 37(4), 1023-1030. <https://doi.org/10.3233/BMR-230267>
- [6] Xinle Wang, Lujia Xiao, Xingxing Lin, Feng Zhang, Kaixuan Zhang, & Baoqiang Dong. (2026). Efficacy and safety of acupuncture or moxibustion combined with rehabilitation therapy for post-stroke shoulder-hand syndrome: a systematic review and meta-analysis of randomized controlled trials. *Journal of Stroke and Cerebrovascular Diseases*, 35(1), 108509. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2025.108509>
- [7] Sofia Marques, Julie Vaughan-Graham, Rui Costa, & Daniela Figueiredo. (2025). The Bobath concept (NDT) in adult neurorehabilitation: a scoping review of conceptual literature. *Disability and*

- Rehabilitation*, 47(6), 1379-1390. <https://doi.org/10.1080/09638288.2024.2375054>
- [8] İrem Akgün, İlksen Demirbüken, Eren Timurtaş, Mehmet Kutay Pehlivan, Ali Utku Pehlivan, Mine Gülden Polat, Gerard E Francisco, & Nuray Yozbatiran. (2024). Exoskeleton-assisted upper limb rehabilitation after stroke: a randomized controlled trial. *Neurological Research*, 46(11), 1074-1082. <https://doi.org/10.1080/01616412.2024.2381385>
- [9] Osman Karaca, & Muhammed Kılınç. (2024). Sensory training combined with motor training improves trunk proprioception in stroke patients: a single-blinded randomized controlled trial. *Neurological Research*, 46(6), 553-560. <https://doi.org/10.1080/01616412.2024.2337522>
- [10] Özge Onursal Kılınç, Muhammed Kılınç, Ender Ayvat, İrem Düzgün, & Levent Özçakar. (2024). Effects of scapulo-humeral training on ultrasonographic and clinical evaluations in stroke: a randomized controlled trial. *Topics in Stroke Rehabilitation*, 31(5), 501-512. <https://doi.org/10.1080/10749357.2024.2302720>
- [11] Piyapat Dajpratham, Rinalda Pongratanakul, Tipchutha Satidwongpibool, Nawapat Kluabwang, Piyapong Akkathap, & Thaniyaporn Claikhem. (2025). Comparative effectiveness of high-intensity laser therapy and ultrasound therapy for hemiplegic shoulder pain in stroke patients: a randomized controlled trial. *Topics in Stroke Rehabilitation*, 32(1), 52-60. <https://doi.org/10.1080/10749357.2024.2359343>
- [12] Nadia Mohamed Abdelhakiem, Marwa Shafiek Mustafa Saleh, Magdy M A Shabana, Hisham A Abd El Wahaab, & Haitham M Saleh. (2024). Effectiveness of a high-intensity laser for improving hemiplegic shoulder dysfunction: a randomized controlled trial. *Scientific Reports*, 14(1), 7346. <https://doi.org/10.1038/s41598-024-57453-9>
- [13] Yafei Zhou, Yaolong Tu, Qingzhen Chen, Yingying Li, Qingqing Sun, Fenglan Zhan, & Shihong Hu. (2025). Bilateral training guided by contralaterally controlled functional electrical stimulation for shoulder pain and subluxation in subacute stroke: A randomized controlled trial. *Journal of Back and Musculoskeletal Rehabilitation*, 38(4), 876-885. <https://doi.org/10.1177/10538127251318940>
- [14] Hualong Xie, Shan Liu, Jiawen Zhan, Lei Chen, Suli Yu, Jing Chen, Ko Onoda, Hitoshi Maruyama, Liguozhu, Qing Zhang, & Ming Huo. (2024). Short-term intervention effect analysis of neuromuscular joint facilitation in patients who experienced stroke with shoulder subluxation: a clinical randomized controlled trial. *Journal of Physical Therapy Science*, 36(9), 513-517. <https://doi.org/10.1589/jpts.36.513>
- [15] Takahiro Okazaki, Shota Nagai, Ume Yako, Ayaka Nakatani, Jun Ogami, Toshiya Kaji, Yuki Naeshiro, & Yutaro Tsuchida. (2025). Reliability and utility of ultrasound imaging assessment methods for shoulder subluxation in patients with stroke. *Journal of Physical Therapy Science*, 37(4), 159-164. <https://doi.org/10.1589/jpts.37.159>
- [16] Anas R Alashram. (2026). Effects of transcutaneous electrical nerve stimulation on upper limb recovery in stroke survivors: A systematic review and meta-analysis of randomized controlled trials. *Journal of Hand Therapy*, 39(1), 109-119. <https://doi.org/10.1016/j.jht.2025.05.015>

- [17] Tao Jiang, Jiamin Yan, Xiaohan Li, Minguang Yang, Yueyang Zhuang, Zhimin Ding, Mengquan Tan, Sijia Xia, Rui Li, Wenju Wang, Feng Chen, Xi Xie, & Weilin Liu. (2025). tDCS Combined with CIMT for Post-stroke Upper Extremity Rehabilitation: A Systematic Review and Meta-Analysis. *NeuroRehabilitation*, 56(2), 97-112. <https://doi.org/10.1177/10538135241301692>
- [18] Nino A W van Tilborg, Vincent de Groot, & Carel G M Meskers. (2025). The effectiveness of early interventions for post-stroke spasticity: a systematic review. *Disability and Rehabilitation*, 47(4), 900-911. <https://doi.org/10.1080/09638288.2024.2363963>
- [19] Lintong Zhu, Hongwei Zhai, Caixia Su, Lei Qin, Zhaoxue Li, Zunke Gong, & Mi Wang. (2025). Clinical Study on the Combined Therapy of Sinew Acupuncture and Low-Frequency Repetitive Transcranial Magnetic Stimulation for Hemiplegic Shoulder Pain. *Brain and Behavior*, 15(12), e70913. <https://doi.org/10.1002/brb3.70913>
- [20] Yağmur Aydın, Ayhan Aşkın, Nazrin Aghazada, & İlker Şengül. (2024). High frequency neuronavigated repetitive transcranial magnetic stimulation in post-stroke shoulder pain: A double-blinded, randomized controlled study. *Journal of Stroke and Cerebrovascular Diseases*, 33(3), 107562. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2024.107562>