



Clinical Observation and Mechanism Study on the Treatment of Hemiplegic Patients with Foot Drop and Inversion Using the Six Step of Neurological Training Method of Daoyin Technique in Chinese Medicine

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ABSTRACT

Objective: To verify the clinical effect of the innovative six step Daoyin technique method of neurological training in Chinese medicine for the rehabilitation of hemiplegic patients with foot drop and inversion, and explore its mechanism. **Method:** 64 patients with stroke hemiplegia accompanied by foot drop and inversion during the recovery period were randomly divided into a six-step method group and a control group, with 32 cases in each group, according to the order of hospitalization. The six-step method group adopts of six step Daoyin technique method of the neurological training in Chinese medicine, while the control group adopts the Brunnstrom method and receives rehabilitation training for 4 weeks. Before and after training, Fugl-Meyer score, Lovett muscle strength assessment of tibialis anterior and fibular long and short muscles, as well as joint range of motion assessment of active dorsiflexion and eversion of the foot were conducted, and the data were statistically analyzed. **Result:** There was no significant difference in various indicators between the two groups before training ($P>0.05$), and there was a very significant difference in various indicators between the six-step method group after training and before training ($P<0.001$). There was no significant difference in various indicators between the control group before and after training ($P>0.05$). There was a significant difference in various indicators between the two groups after training, with $P<0.001$. The therapeutic effect of the six-step method group was significantly better than that of the control group ($P<0.001$). **Conclusion:** The six step Daoyin technique of the neurological training in Chinese medicine is an effective training method for the rehabilitation of stroke hemiplegic foot drop and foot inversion. Its mechanism of action is to use the "motor sensory information motor function coupling" mechanism and "target-dynamics" mechanism formed by the induction of resistance active movement through Daoyin technique to gradually enhance motor sensory information, and feedback this information to the motor center of the cerebral cortex, promoting its synergistic effect, gradually increasing the number and function of activated reserve brain cells, so as to restore lost muscle strength on the basis of restoring brain function, as well as the motor function of dorsiflexion and eversion of the foot, final improving the patient's walking ability.

Keywords: rehabilitation methods, Daoyin technique, foot drop and inversion, effect, mechanism.

INTRODUCTION

The focus of rehabilitation for the motor function of limbs lost after brain injury such as cerebral infarction and traumatic brain injury must also be on the recovery of brain function. Therefore, it is necessary to develop the potential of the central nervous system (CNS) through resistance active exercise training methods in order to activate spare brain cells to replace the function of damaged brain cells. However, neurodevelopmental rehabilitation methods that have been applied for over a century, such as Bobath, Wood, Brunnstrom and PNF etc.), due to their reliance on passive movement, primitive reflexes, and input stimuli, lack the effects of training and self exercise, have resulted in suboptimal clinical efficacy [1] and their theories have been denied [2]. There are reports suggesting that these methods cannot bring better results to patients than conventional treatment methods (such as surgery and medication) [4] and should be abandoned [5], especially for patients in the recovery period more than six months after brain injury [6]. Hemiplegic lower limb foot droop and inversion are the main influencing factors of abnormal gait in the lower limbs. Correcting the droop and inversion of the affected

foot is necessary to reconstruct the normal movement pattern of hemiplegic lower limb walking.

Originating from the Spring and Autumn period and the Warring States period (5000 years ago), traditional Chinese medicine Daoyin techniques encourage patients to engage in active resistance movements of their limbs to develop their brain potential and promote the recovery of limb movements and other functions after brain function reorganization, based on guiding patients to regulate their minds and breath. However, due to the influence of medical knowledge at that time, the techniques of guidance surgery were mostly based on overall movements, lacking the principle of gradual rehabilitation training from easy to difficult, which affected the clinical application of this technology. On the basis of inheriting the basic methods of ancient guidance techniques and combining with modern medical theory [7], we have improved it into the "Six Step Daoyin Technique in Chinese Medicine of the Neurological training", which can adapt to rehabilitation training for one joint movement and one piece of muscle contraction, and thus achieve precise rehabilitation training. Good results have been achieved through clinical verification, and the mechanism of this method has been analyzed and discussed.

MATERIALS AND METHODS

General Situation

From June 2022 to August 2023, 64 patients with stroke hemiplegia accompanied by foot prolapse and inversion who were admitted to the Rehabilitation Medicine Department of Beihai North Medical Rehabilitation Hospital and had a medical history of 1-5 years will be randomly divided into a six-step method group and a control group, with 32 patients in each group, according to the order of hospitalization. Six step method group: 18 males and 14 females, with an age range of 35 to 76 years old and an average of 48.4 years old. The shortest medical history is 1 year and 7 months, the longest is 4 years and 11 months, with an average of 3 years and 4 months; Control group: 17 males and 15 females, aged between 34 and 71 years, with an average age of 47.8 years, the shortest medical history was 1 year, the longest was 5 years, and the average was 3 years and 6 months.

Clinical Data

Training method: Six step method group: Using six step Daoyin method to train patients who with foot dorsiflexion and foot eversion by active resist resistance, once a day for 45 minutes each time, for a total of 30 times. Control group: Training was conducted using the Brunnstrom dorsiflexion of foot promotion method [4], which included: ① Bechteev/Marie Foix reflex: the therapist pressed the affected foot's toe towards the plantar flexion to traction the muscle spindles of the dorsiflexion and eversion muscles, with the aim of inducing a reaction of dorsiflexion and eversion through this reflex for 15 minutes. Three treatments were shared for 45 minutes, once a day, for a total of 30 times. 2.1 Improvement of Daoyin technique in Chinese Medicine. Based on the development of human potential and the theory of traditional Chinese medicine meridians, the specific steps to improve the Daoyin technique in Chinese medicine into the six-step method Daoyin technique are as follows: ① Sports imagination and simulation: Firstly, explain to the patient that the brain controls the movement of limbs by emitting electrical signals. Then Daiyin the patient to actively move the joint of the hemiplegic limb in preparation for training. Then, let the patient engage in active movement of the same

joint of a healthy limb, allowing them to see differences and establish a training goal to catch up. ② "Energy mobilization": In a quiet room, by relaxing into stillness, the whole body's "energy" is mobilized to the injured side of the brain, Daoyin the patient into a state of "ready doing". ③ Identifying targets: Inform the patient of the target muscles for "energy" release (such as the tibialis anterior muscle during training for dorsiflexion). ④ Firing: After guiding the patient to inhale deeply, they suddenly release their "energy" to the target muscle. The contraction of the target muscle produces corresponding joint movements (like dorsiflexion and eversion of the foot), so that the energy can be highly concentrated on a group of muscles to achieve better results. ⑤ Persist: At this point, the therapist places the hand in the direction of joint movement (during dorsiflexion training, the hand is placed at the metatarsophalangeal joint on the dorsum of the foot (see Figure 1), and during eversion training, the hand is placed on the outer side of the dorsum of the foot (see Figure 2)).

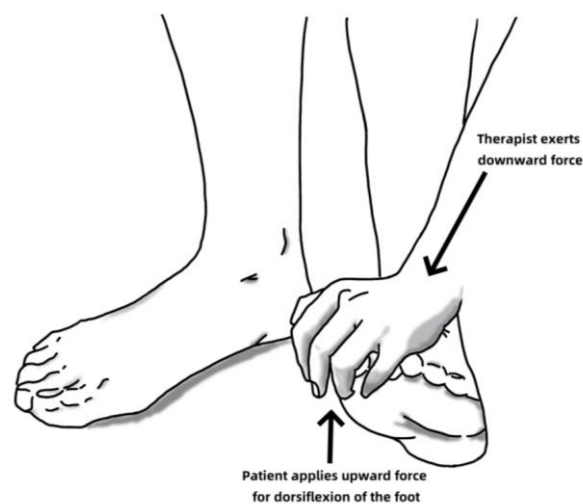


Figure 1: Training active resistance movement for foot dorsiflexion.

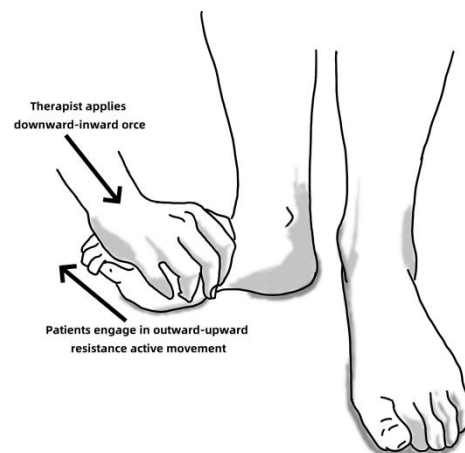


Figure 2: Training of induced resistance active movement with eversion of foot.

When the muscle strength is zero, resistance training is also performed to make it easier for the patient's brain to find the direction and target of signal transmission. When reaching the highest point of joint activity, encourage the patient to hold on for a few seconds using counting

methods, such as shouting 1, 2, 3... 6, etc. During this period, use language to create a “crisis state”, such as “hold on, otherwise you will fall!” “lift up, otherwise you will touch!”, to promote the development of the patient’s brain potential. ⑥ Relaxation: After the movement is completed, guide the patient to inhale deeply and exhale slowly (inhalation time: exhalation time=1:2), and try to relax the whole body and mind as much as possible to play the role of promoting meridians and eliminating fatigue. After completing one training session, the therapist performs passive joint activity and muscle massage for the patient to release joint adhesions and promote muscle blood circulation, followed by a second training session.

FUNCTIONAL EVALUATION

Using Lovett MMT (Including: tibialis anterior muscle (TAM)anterior and fibular long and short muscles (FLSM), ankle autonomous range of motion (AROM), Fugl-Meyer foot dorsiflexion (FD) and foot eversion (FE) function evaluation method is used to evaluate the function of the tibialis anterior muscle and fibular long and short muscles before and after treatment. (Fugl-Meyer evaluation criteria: 0 points: unable to actively bend backwards; 1 point: able to partially bend backwards; 2 points: able to fully bend backwards).

STATISTICAL ANALYSIS

After the experiment, use Epidata3.02 software to establish a database and perform dual entry of the data. Using SPSS 18.0 statistical software: ① Compare the functional score data of each group before and after treatment; ② Perform intergroup t-test analysis on the data of the six-step method group and the control group after treatment.

RESULTS

The statistical analysis of the three-evaluation data showed that there was a very significant difference ($P<0.01$) between the six-step method group after treatment and before treatment, while there was no significant difference ($P>0.05$) between the control group after treatment and before treatment (See Table 1).

Table 1: Statistical analysis of functional evaluation data before and after treatment in each group $\bar{X} \pm SD$

Group	pre-training	post-training	intra group p-values	inter group p-values
MMT				
Six step method group				
TAM	1.27±0.36	3.68±1.24	<0.01	<0.01
PLSM	1.32±0.65	2.62±1.21	<0.01	<0.01
Control group				
TAM	1.27±0.36	1.68±0.74	>0.05	<0.01
PLSM	1.32±0.65	1.62±1.21	>0.05	<0.01
AROM				
Six step method group				
FD	3.380±2.36	12.80±3.68	<0.01	<0.01
FE	2.380±2.36	9.60±3.68	<0.05	<0.01

Control group					
	FD	2.33 ± 0.502	2.51 ± 2.30	>0.01	<0.01
	FE	1.21 ± 0.361	1.80 ± 1.68	>0.05	<0.01
Fugl-meyer					
Six step method group					
	FD	0.43 ± 0.502	3.26 ± 1.30	<0.01	<0.01
	FE	0.21 ± 0.361	3.80 ± 1.18	<0.01	<0.01
Control group					
	FD	0.43 ± 0.502	0.75 ± 2.30	>0.05	<0.01
	FE	0.21 ± 0.361	0.61 ± 2.68	>0.05	<0.01

DISCUSSION

The treatment focus for limb motor dysfunction caused by central nervous system (CNS) cell damage must also first restore the function of the CNS. Due to the lack of regenerative ability of CNS cells, the lost function after injury relies on training the backup normal cells around the injury area to replace the damaged cells, which is the development and utilization of CNS potential. The human CNS, organs, and organs all contain enormous potential, which comes from a large amount of cellular reserves and is the foundation for restoring motor control and other functions after central nervous system injury. However, the development and utilization of this potential must be achieved through special training, such as the training of induced resistance active movements.

The potential of CNS is the result of plasticity changes and functional reorganization in CNS, which is based on the principle of "skillful use dependence" [8,9], that is, only when the brain actively controls limb movement can plasticity changes in the cortical motor area of the brain be caused, and then the motor function of the limbs can be restored.

The fundamental reason for the unsatisfactory effectiveness of neurodevelopmental rehabilitation methods [10] that mainly rely on passive movement, primitive reflexes, and input stimuli is that they do not conform to the mechanism of "skillful use-dependence" to promote the functional reorganization of the central nervous system. For example, foot drop in hemiplegia caused by cerebral infarction is due to the loss of the ability of the brain to control the voluntary movement of the tibialis anterior muscle after damage to the contralateral brain motor center or conduction pathway, resulting in paralysis of the tibialis anterior muscle and causing foot drop. Therefore, only by restoring the function of the motor center and conduction pathway in the cerebral cortex can the autonomous movement of the tibialis anterior muscle be restored, and then the function of dorsiflexion of the foot can be restored. The Brunnstrom method causes dorsiflexion of the toes, dorsiflexion of the feet, knee flexion, and hip flexion reactions through traction reflex. This method is similar in principle to the knee jump reflex caused by tapping the patellar tendon. The center of the reflex is located in the spinal cord and has little or no impact on the motor center of the cerebral cortex. Therefore, it lacks the effect of promoting changes in central nervous system plasticity and functional reorganization, which is the fundamental reason for the poor treatment effect of the control group.

Daoyin technique in traditional Chinese medicine is an important method that can inspire and mobilize people's perseverance, and strive to complete the autonomous movement of the brain controlling the limbs to achieve functional recovery. It originated from the book "Treatise on the Origins and Stages of Various Diseases" written in the Sui Dynasty [11] (610 AD). The process of regulating the mind, breath, and shape in this method has the functions of unblocking meridians, harmonizing qi and blood, coordinating organs, supporting the right and eliminating evil, and strengthening the body's homeostasis mechanism, and has a positive impact on the body's metabolism process. Modern medical research has proven that Daoyin technique has good regulatory effects and rehabilitation effects on diseases of cardiovascular, respiratory, neurological, digestive and other systems [12]. On the basis of inheriting the experience of predecessors, medical practitioners throughout history have supplemented and developed from various aspects, and there are many contents worth learning from and promoting by modern people [13]. It has close connections and similarities with modern psychotherapy, sports therapy, natural therapy, information therapy, etc., and can be considered as a comprehensive application of these therapies.

However, ancient guidance techniques mainly focus on completing overall limb movements and are suitable for healthy individuals to engage in self physical exercise, but are not suitable for rehabilitation training of patients with limb dysfunction.

The Six Step Method of Daoyin technique in Chinese Medicine (TCM) is based on the inheritance of ancient guidance techniques and improved according to modern medical theories. The functional training after CNS injury should mainly focus on the functional recovery of casual movement. The arrangement of motor programs and the process of motor initiation are closely related to the motor areas of the cerebral cortex when the brain performs purposeful and complex movements. After cortical motor center injury, this function will be damaged to varying degrees, and it needs to be rebuilt to restore the lost motor function. When starting a casual movement, the athlete needs to determine the initial movement target and their position in space to determine the way, time, and speed of the action before entering a critical state. Based on this, the first step of the six step Daoyin technique in Chinese medicine is to imagine and simulate movement, with the aim of helping patients establish the concept of voluntary movement, basic patterns of movement, and direction of effort. Furthermore, by using techniques to regulate the mind and breath, patients are brought into a critical state of movement. Based on determining the brain's control over a single target muscle, patients are guided to use a "firing" method to quickly release the energy flow stored in the brain to the target muscle. The purpose of this move is to concentrate our advantageous forces to attack various points, in order to activate more brain cells that are stored and waiting to be used. The induced resistance active exercise using counting in the adherence steps aims to guide the patient's brain to increase training intensity using counting, a clear quantitative indicator, on the basis of finding the target muscle to control, in order to better develop the patient's brain potential. During this period, use words of encouragement or intimidation, such as: work hard, you did well! Be a little higher, otherwise you will fall! Create a risk-free "crisis state" that maximizes the patient's ability to enter a "reactive state", thereby encouraging them to achieve designated training goals on their own, and promoting their better development of brain potential and functional reorganization during this process.

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