The Effect of an Acupuncture Intervention on Isokinetic Muscle Strength and Hand Dysfunction in Elderly Patients with Stroke

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Abstract: Objective: To evaluate the effect of an acupuncture intervention on isokinetic strength and hand dysfunction in elderly patients with stroke. Methods: Sixty elderly patients with hand dysfunction caused by stroke were divided into the control group (N=30) or the experimental group (N=30) according to a random number table. The control group received routine physical therapy, while the experimental group was treated with scalp acupuncture in addition to conventional physical therapy. Before and after treatment, indexes including peak torque (PT), average power (AP), total arc of motion (TAM), and activities of daily living (ADL) were measured to evaluate the treatment effect and changes in isokinetic muscle strength in hand flexion and extension. Results: There were no significant differences in PT, AP, TAM, and ADL scores between the two groups before treatment. After treatment, both groups witnessed a significant improvement in PT, AP, TAM and ADL scores ($P<0.05$).Furthermore, the PT, AP, TAM and ADL scores of the experimental group had significantly greater improvement than those of the control group ($P<0.05$). Conclusions: An acupuncture intervention enhanced muscle strength of the hand flexor and extensor muscles and improve the hand's movement ability in elderly patients with stroke, and therefore showed a good therapeutic effect.

Keywords: Acupuncture therapy; Muscle strength; Stroke; Elderly; Hand dysfunction

1. Introduction

Nearly 80% of elderly patients with early stroke and hemiplegia exhibit varying degrees of dysfunction in the upper limbs and hand muscles, which seriously affects their quality of life and social participation and increases their familial and social burden. Therefore, rehabilitation of stroke patients focusing on hand function has drawn increasing attention[1]. Acupuncture therapy is considered an effective and widely used rehabilitation method for the improvement of muscle strength and skeletal muscle motor function due to its ability to enhance muscle strength by restoring the neuromuscular biological state[2]. The isokinetic test system assesses muscle function by providing objective data with high accuracy and repeatability, and can therefore be employed to assess function following injuries of the skeletal muscle motor system. This data can provide a reference to assess the efficacy of conservative or surgical treatments as well as helping to determine the most appropriate treatment[3]. The author utilized acupuncture as a treatment for hand dysfunction in elderly stroke patients and observed the isokinetic muscle strength of their hand muscles.

1.1 General Background

Sixty subjects who were elderly stroke patients with hand dysfunction and were hospitalized during August 2018 and July 2019were randomly selected. The subjects were divided into the experimental group or the control group according to the admission order, with 30 patients in each group. The experimental group included 16 male and 14 female patients aged between 63-68 years (mean age: 64.98±3.14 years old). There were 12 cases of left hand dysfunction and 18 cases of right hand dysfunction in the experimental group, and the course of disease ranged between2-11 weeks, with an average course of 5.12±3.19 weeks. The control group consisted of 18 male and 12 female patients aged from 62 to 67 years old (mean age: 65.15±2.84 years old). There were 11 cases of left hand dysfunction and 19 cases of right hand dysfunction in the control group, with the course of disease ranging between 3-12 weeks, with an average course of 4.98±2.84 weeks. There were no significant differences between groups in patient age, distribution of hand dysfunction (left or right), or course of disease.

1.2 Diagnosis and inclusion criteria[4]

The definition of stroke patient for this study was based on a clinical diagnosis of stroke that was confirmed by head CT or MRI. In order to be included in this study, the following criteria were required to be met: 1) it must have been the patient's first episode of stroke, with the course of disease ranging between 2 weeks to 12 weeks and development of hand dysfunction following the stroke, 2) patient was aged between 60 to 70 years old, 3) patient must have had a mini-mental state test score ≤24,4) the unarmed muscle strength of the upper

limb on dysfunction side was greater than Brunnstrom's stage 4; 7) full consciousness, stable condition, and stable vital signs; and8)patients or their immediate family members or spouses provided informed consent.

1.3 Exclusion Criteria[5]

Patients were excluded from the study for the following reasons: 1)Previous history or recent diagnosis of intracranial tumor, brain trauma, brain parasitic diseases, or other brain diseases; 2)presence of serious speech, vision, hearing impairment, or mental disorders that might affect related assessments and examinations; 3)history of alcohol or drug abuse; 4)history of organ failure, critical illness, cancer, or other diseases and conditions that might seriously affect the activities of patients; 5) active pregnancy or lactation for female patients; 6)unable to complete the basic course of treatment in this experiment; 7)presence of metal implants in the upper limb with hand dysfunction.

1.4 Treatment method

Flexion and extension strength of the affected hand was tested using the German IsoMed2000 isokinetic strength test and training system. After the system was calibrated, the subject was instructed to take a seated position and perform 10 repetitions of an isokinetic flexion and extension movement with an angular velocity of 30 degrees per second. After the subject had adapted to the test procedure, they performed the extension exercises 10 times at maximum strength and maximum range of wrist flexion, and the average value of the 10 trials was calculated and recorded.

The control group received conventional physical rehabilitation, including constraint-induced movement therapy (CIMT) and bilateral upper limb training. The constraint-induced movement therapy (CIMT) [6] consisted of the affected wrist joint being extended >20° and the meta carpophalangeal and interphalangeal joints of the thumb and the other four fingers being extended >10 °, with the movements repeated for 3 times within 1 min. During CIMT, the patient was placed in a position of passive flexion and abduction of shoulder joints >90 ° with lateral external rotation >45 °, elbow extension <30 °, and forearm supination and pronation >45 °.

Bilateral upper limb training included the following exercises[7]: 1) Horizontal abduction and adduction of bilateral shoulder joints under gravity, with the aid of a sling. 2) According to the patient's condition, the frosted plate was adjusted to a certain angle, and the two hands simultaneously and independently completed the flexion and extension of the shoulder and elbow. 3) Bilateral shoulder joint weight training. 4) Bilateral shoulder flexion gymnastics bar training, in which the patients held a gymnastic stick with both hands and straightened the elbow joint to achieve shoulder flexion. 5) Pronation and supination of both forearms, in which both forearms were placed on the treatment table and elastic rods were held in the patient's hands and both hands simultaneously performed pronation and supination. The total bilateral upper limb training time was 30 minutes,

The experiment group received acupuncture treatments consistent with conventional physical rehabilitation [8].Using a No. 30 1.5-inch needle, horizontal needling was performed in the sports area along the meridian on an oblique line of the vertex-temporal from front Shencong to Xuanli (E 6).Specifically, this point was at 2/5 of the distance along the scalp movement area of the uninjured side (the connecting line from 0.5 cm posterior to the midpoint of the anterior-posterior midline and the intersection of the eyebrow line and the rear of headline), 1 line near the top (1.5 inches next to the top center line which extended for 1.5 inches from Tongtian along the meridian), the 2/5 section of top oblique line of the vertex-temporal (from former Shencong to Xuanli (E 6)). With a slight twirling and twisting method, the patient felt a heavy, sore, or hot feeling. The needle was retained for 30 minutes, and the needle was punctured once every 5 minutes during the needle retention.

The above treatments were performed once per day over the course of 7 days. Two courses of treatment given, for a total of 14 days of treatment. After the end of the treatment period, muscle strength testing and upper limb motor function were evaluated again for both the affected side and the uninjured side of each subject. Changes in isokinetic muscle strength and activities of daily living index were compared between the two groups.

1.5 Data Processing and Analysis [9]

The obtained data were processed and analyzed using SPSS21.0 software. The normally distributed measurement data was analyzed using an independent t-test, paired data was analyzed using a paired t-test, categorical data were analyzed using chi-square tests, and grade data was analyzed using a rank sum test.

1.6 Evaluation of clinical efficacy after the end of the treatment period

Muscle strength testing[10-12]: Following routine system calibration, isokinetic muscle testing for hand flexion and extensor muscles was conducted with a preset test speed of 30 degrees per second. The testing was first performed 10 times at sub-maximal flexion and extension range of motion. After being familiarized with their safe wrist range of motion and the isokinetic muscle testing, the subject rested for 1 minute and then performed the wrist flexion and extension exercise 10 time sat maximum wrist flexion/extension range of motion. The affected side was always tested first, followed by the uninjured side. The observed indicators included peak torque (PT), average power (AP), and flexor and extensor peak torque ratio (H/Q) of the flexor and extensor muscles of the hand. Isokinetic muscle testing was performed before and after the treatment period.

Rehabilitation assessment [13-15] included total active movement (TAM) and activities of daily living (ADL)

assessments. Evaluation of the total active movement (TAM) of the patient's finger joints was calculated as the total interphalangeal joint flexion of meta carpophalangeal joint and the proximal interphalangeal joint minus total extension of the meta carpophalangeal and interphalangeal joints. The Barthel index was used to determine the patient's degree of ADL independence. Those with a score above 60 were considered to be able to care for themselves, those with a score from 40 to 60 were moderately disabled and in need of help for daily living, those with a score from 20 to 40 were severely disabled and in need of great help for daily living, and those with a score less than 20 were completely disabled, whose life were completely dependent on help for daily living.

2. Helpful Hints

2.1 Muscle strength test of hand flexor and extensor muscles

There were no significant differences in PT, AP, and H/Q values between the two groups before treatment. However, there were significant difference between the two groups after 2 weeks of treatment ($P<0.05$), suggesting that the recovery of isokinetic muscle function of hand flexor and extensor muscles in the experimental group was superior to the control group. (Table 1, 2, 3)

Table 1. Comparison of isokinetic muscle strength of hand flexion muscles between two (Mean SD)

	n	PT(Nm)		AP(W)	
		Before treatment	After treatment*	Before treatment	After treatment*
Experiment group	30	7.99±2.25	12.89±2.92	7.02±2.57	11.98±2.73
Control group	30	8.12±1.95	10.12±3.21	6.87±2.89	8.32±2.05

Note：*P＜0.05, indicating that the difference was statistically significant between experimental and control groups after treatment.

Table 2. Comparison of isokinetic muscle strength of hand extensionmuscles between groups (Mean SD)

	n	PT(Nm)		AP(W)	
		Before treatment	After treatment*	Before treatment	After treatment*
Experiment group	30	6.56±2.17	11.21±3.03	6.17±2.08	10.18±2.89
Control group	30	6.32±2.95	9.56±2.68	5.99±1.87	7.67±3.14

Note：*P＜0.05, indicating that the difference was statistically significant between experimental and control groups after treatment.

Table 3. Comparison of H/Q values of hand flexors and extensors between groups. (Mean SD)

Group	n	Beforetreatment	After treatment*
Experiment group	30	1.95±0.36	1.09±0.41
Control group	30	2.21±0.28	1.69±0.18

Note：*P＜0.05, indicating that the difference was statistically significant between experimental and control groups after treatment.

2.2 Hand Function

There was no significant difference in TAM and ADL scores between the two groups before treatment. However, there were significant differences between groups in both scores after 2 weeks of treatment ($P<0.05$), suggesting that the hand movement function recovery in the experimental group was better than that of the control group (Table 4).

Stroke hemiplegic patients often have decreased limb motor function due to declines in muscle strength and abnormal muscle tension. Performing muscle strength tests under dynamic conditions is an important way to assess motor function and especially upper limb motor function [16].Muscle strength assessment an important part of the rehabilitation of stroke patients with hemiplegia. An accurate muscle strength assessment plays a significant role in goal setting and training plan formulation during the rehabilitation process. The isokinetic muscle strength test and training technique (hereinafter referred to as isokinetic technique) is a professional electromechanical device that controls the movement speed of the limb through resistance and measures the muscle strength of the patient's active limb[17]. The isokinetic technique is currently the best method for muscle function assessment and one of the most effective methods for muscle mechanics training. The isokinetic technique is a highly sensitive, safe, reliable, and efficient measure of abnormal muscle motor function, and can provide accurate and objective quantitative data during the evaluation and training of muscle function [18]. At the same time, the isokinetic

technique has the characteristics of variable resistance and gravity compensation, so it can also be performed when the muscle strength of the hemiplegia limb is relatively weak.

Table 4. Comparison of hand movement function between groups.($\bar{x} \pm s$)

	n	TAM(°)		ADL(scores)	
		Before treatment	After treatment*	Before treatment	After treatment*
Experiment group	30	106.84±13.12	165.51±16.32	49.86±3.63	76.38±4.98
Control group	30	107.15±12.97	133.71±18.12	50.06±3.27	63.64±5.05

Note：*P＜0.05, indicating that the difference was statistically significant between experimental and control groups after treatment.

There are numerous clinical reports regarding the use of acupuncture to treat hand dysfunction of patients with stroke alongside conventional rehabilitation techniques [19].After several decades of development, scalp acupuncture has undergone varying degrees of innovation and change, and has shown improvements in its acupoint matching, manipulation methods, and indication range. Early research of acupuncture consisted of treatment on the uninjured side together with movement of the affected side for the treatment of soft tissue sports injury or cardiopulmonary dysfunction. The research then advanced to scalp acupuncture for the treatment of soft tissue sports injury, and most recently to scalp acupuncture in combination with simultaneous movement of hemiplegic limbs for the treatment of motor dysfunction caused by stroke[20].

The results of this study showed that there were no significant differences in PT, AP, H/Q, TAM, and ADL scores between the two groups before treatment. After treatment, both groups witnessed significant improvement of PT, AP, H/Q, TAM, and ADL scores ($P<0.05$), but the improvement of PT, AP, H/Q, TAM, and ADL scores in the experiment group was greater than the control group ($P<0.05$). The results of this study indicate that an acupuncture intervention can effectively improve hand dysfunction in elderly patients with stroke. Through scalp acupuncture, immediate adjustment of the direction of the sputum needle and the patient's breathing could result in "arrival of qi". By stimulating the control of the central nervous system on the hand, in combination with increasing the frequency of training, it could improve the operating speed and coordination of activities to improve the muscle strength of the upper limbs, active joint movement and stability of joint activities, and coordinate complex movements.

There are several limitations to note in this study. Several rehabilitation intervention methods were used in this study. Due to the small sample size, no grouping and stratification comparisons of various training effects were carried out. There are also some confounding factors in the study, such as the education level and social background of patients, both of which may impose different influences on the effects of rehabilitation interventions, and therefore further research and analysis is needed.

In summary, the results of this study provided a clinical basis for acupuncture intervention as a treatment for hand dysfunction in elderly patients with stroke. Scalp acupuncture can enhance the muscle strength of the hand flexor and extensor muscles in elderly patients with stroke and improve the ability of hand movement and is worthy of promotion in clinical practice.

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