Research on the Effect of Yoga on the Recovery of Motor and Neurological Functions of Stroke Patients

Fang Wang

ABSTRACT

Stroke refers to functional impairment of the brain that results from the blockage of the blood supply to the brain, which not only leads to motor and neurological dysfunction, but also causes deep distress to patients and their families. The previous studies show that aerobic exercise can promote the recovery of motor and neurological functions in stroke patients thus can effectively alleviate the symptoms of stroke. Based on the above, this paper focuses on the influence of the aerobic exercise, yoga, on the recovery of motor and neurological functions of patients with stroke, and track and analyzes statistically their rehabilitation effect by the experimental methods. The results show that yoga practice can effectively improve the health of the patients. It can promote the recovery of mobility in terms of balance ability, walking ability and ability to stand on one foot; and it can promote the recovery of neurological functions in patients. These findings provide a new theoretical basis and practical enlightenment for the treatment of stroke patients.

Key Words: Yoga, Stroke, Neurological Function, Motor Function

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Introduction

Stroke refers to apoplexy in general terms. The motor and neurological dysfunctions are the typical signs of stroke, which brings serious troubles to the patients and their families (Bastille and Gillbody, 2004). At present, stroke has become a global problem. Due to the large population base, China has a large number of stroke patients. In 2012, China released the first "*Stroke Island Index*" report, showing that more than 50 million stroke patients lack the timely rescue and treatment and more than 1.5 million people die of stroke in China each year. A large number of stroke patients are in urgent need of social attention and assistance.

Research shows that improving motor function is the key to alleviating the symptoms of stroke patients (Immink and Petkov, 2014; Brown & Kautz, 1999; Dunsky *et al*., 2008). The lower limb dysfunction is the most common symptom seen in stroke patients, resulting in lack of balance, consequently, the patients can not walk independently. The lack of balance has brought great troubles to patients' daily life. Because of this, most of the treatments for stroke patients begin with restoring the patients' ability to walk (Kim and Oh, 2014; Hawkins *et al.,* 2012). However, many patients will develop "hemiplegic gait" after walking ability rehabilitation training. This gait is far different from the normal gait. Therefore, it is the focus of many medical workers to improve the treatment and recovery effect as much as possible (Moreno and Ribera, 2010; Ohki and Takeuchi, 2014). Poor recovery of cranial nerves is the main reason that patients can not get rid of "hemiplegic gait".

Corresponding author: Fang Wang
Address: Sichuan University, Chengdu 610065, China
e-mail ✉ wangfangwfvip@163.com
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Exercises can enhance the recovery of the cranial nerves and their plasticity, and brain derived neurotrophic factor is the key to improve the plasticity of the cranial nerves. Aerobic exercise has the greatest impact on brain-derived neurotrophic factor among all exercises, thus is a common restorative therapy for stroke patients. Based on the above, this paper aims to develop a yoga rehabilitation program for stroke patients, track and statistically analyze the rehabilitation effect of stroke patients by experimental methods, and reveal the effect of yoga on recovery of motor ability and cranial nerves of stroke patients, providing a new theoretical basis and practical enlightenment for the treatment of stroke patients.

Summary of Stroke

Definition of stroke

Stroke, is commonly known as apoplexy. In the medical field, stroke belongs to a typical brain damage which is mostly caused by poor blood flow to the brain (Wittenberg *et al.,* 2001). WHO gives a very strict and standard definition of stroke: cranial nerves damage that persists beyond 24 hours. The 24-hour limit divides stroke from transient ischemic attack. Sometimes it is also referred to as "acute ischemic cerebrovascular syndrome" to reflect the urgency of stroke symptoms and the need to act swiftly.

In medical field, stroke can be classified into two major categories (Ferreri and Rossini, 2013; Crowell, 2015): ischemic and hemorrhagic. Ischemic stroke is caused by ischemia or interruption of the blood supply to the brain because of thrombosis, while hemorrhagic stroke results from the hemorrhage caused by the rupture of a vascular structure.

Exercise therapy for stroke

Studies have shown that aerobic exercise, including martial arts, walking, cycling and so on, plays an important role in restoring motor function and neurological function in patients with stroke. As to the martial arts, scholars believe that many moves in martial arts can enhance the patients' arm strength, leg strength as well as foot flexibility, thus contributing to the treatment of stroke patients (Fuhr and Hallet, 1991). As to walking and cycling, many foreign scholars have carried out long-term follow-up and comparative studies on stroke patients. The results shows that walking ability and balance ability of stroke patients have been improved significantly after walking training, but "hemiplegic gait" still exists in some patients; riding training effect is relatively better, but it still can not rule out the possibility of "hemiplegic gait"(Zhou *et al*., 1998). In addition, a small number of scholars have also studied the effect of yoga on the rehabilitation of patients with stroke. The results show that yoga training has effectively improved the patients' balance ability and mobility. However, there lacks follow-up study of a long term (Liepert, 2006; Bastille and Gillbody, 2004).

Research Objects and Methods

The effect of aerobic exercise on the rehabilitation of stroke patients was elaborated in the previous section. Judging from the research status quo, the impact of yoga on the rehabilitation of stroke patients has not yet received much attention. In this case, this article uses experimental methods to study whether yoga is beneficial to the recovery of mobility and cranial nerves of patients with stroke.

Research objects

The present research spanned from April 2017 to September 2017 for a period of 6 months. The objects were mainly the stroke patients in a key hospital in Beijing, with a total of 64. During the study, we conducted yoga exercise intervention in 64 patients. Before the formal experiment, all objects signed the informed consent to volunteer to participate in the experiment.

Research methods

The main method used in the study was clinical experiment method, and the experimental data were processed and analyzed by means of mathematical statistics. The whole 6-month experiment process was divided into three main stages, preparation, implementation stage and the effect evaluation.

The preparation stage and the implementation stage were relatively simple. During the one-week preparation stage, the acute investigation and statistics of the subjects' basic conditions were conducted and the initial exercise data and cranial nerves data were collected as the basis for effect comparisons. The implementation stages were divided into three sub-stages, simple yoga training from the 2nd week to the 6th week, combined exercise training from the 7th week to the 14th week, and the orthodox yoga training from the 15th week to the 24th week.

After the implementation stage, the study continued to test and analyze statistically the quality of life indicators, mobility indicators (including balance ability, walking ability and the ability to stand on one foot) and neurological function indicators of the subjects. The questionnaire method and the direct test method were mainly used in the index test. In the testing process, the principle of unified testing was followed to ensure data consistency and accuracy.

All the collected data were analyzed by SPSS19.0 software and $\chi 2$ test was used as the data test method. However, if the data fit the typical positive distribution, the T-test method was adopted, otherwise, the non-parametric test was adopted. The entire experimental process is as shown below.

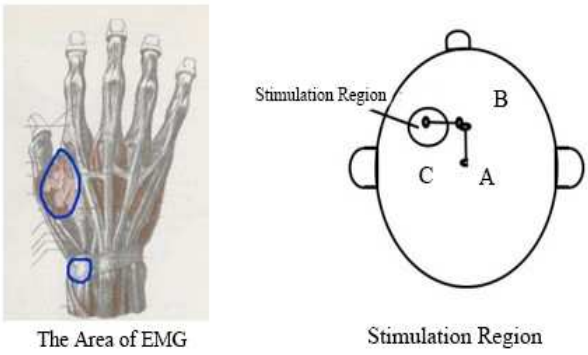

Figure 1. Nerve Stimulation Region

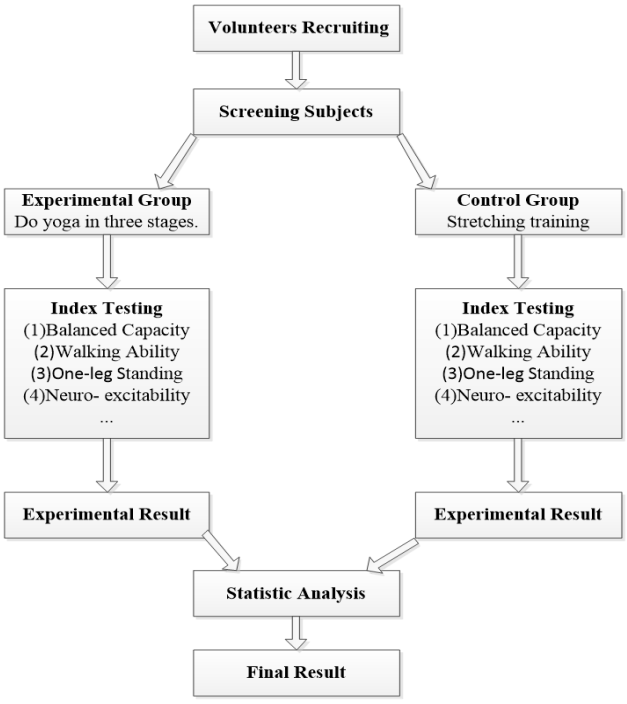

Figure 2. Experimental Procedures

Experimental Results and Discussions

Basic information of the research objects

Table 1 shows the basic information of all the subjects. The subjects were divided into two groups: the experimental group and the control group, of which 32 were in the former group and 32 in the latter group. During the 6-month experiment, one patient dropped out of the experiment, so the patient's relevant information was removed from the statistics. Statistical analysis showed that there was no significant difference between the experimental group and the control group in terms of age, height and weight, which meant, $p>0.05$.

In addition, we conducted a more in-depth study of the subjects' basic situation, including the subjects' gender, educational level, working condition, severity of illness, time of onset, other diseases, etc., to rule out the significant differences in these aspects so as to ensure the validity of the experimental results.

Table 1. Comparison of Two Groups

	Experimental Group	Control Group	P-value
Age	57±5.27	59.12±4.98	0.558
Stature(cm)	169±7.22	170±6.23	0.413
Weight(kg)	72.09±8.55	73.18±7.35	0.263

Test results of quality of life for stroke patients

At the end of the study, the quality of life of the subjects was investigated first with SF-36 health questionnaire in terms of physiology, victory intelligence and other aspects. In addition, the statistics on changes in the patients' health was also included in the questionnaire. Health changes was graded by using a scoring system, including five grades, of which Grade One stood for the poor health status, while Grade Five for good health status.

Table 2 shows the survey results of the subjects' quality of life. Data analysis showed that the quality of life in the experimental group did not change significantly before and after yoga exercise, $p>0.05$. However, the health status of the experimental group significantly improved, the average score before the experiment was 2.83, which became 4.54 after the experiment, and there was significant difference ($p=0.002$) between the two. As to the control group, there was no significant improvement in the quality of life and health. In addition, there was no significant difference in health change score between the two groups before the experiment ($p=0.322$), but there was a significant difference after it ($p=0.001$).

Table 2. SF-36 Questionnaire Scores

	Quality of Life		Changes in Health		P-value (Within Groups)	
	Before Experiment	After Experiment	Before Experiment	After Experiment	Quality of Life	Changes in Health
Experimental group	70.11±9.12	72.15±8.46	2.83±1.45	4.54±1.12	0.425	0.002
Control Group	68.45±8.57	67.13±6.77	2.46±1.28	1.77±0.76	0.158	0.074
P-value	0.406	0.771	0.322	0.001	--	--

The results suggested that 6 months of Yoga has not improved the quality of life of the subjects, but has significantly improved their health.

Test results of stroke patients' mobility

The patients' mobility tests included: balance ability test, walking ability test and test for the ability to stand on one foot.

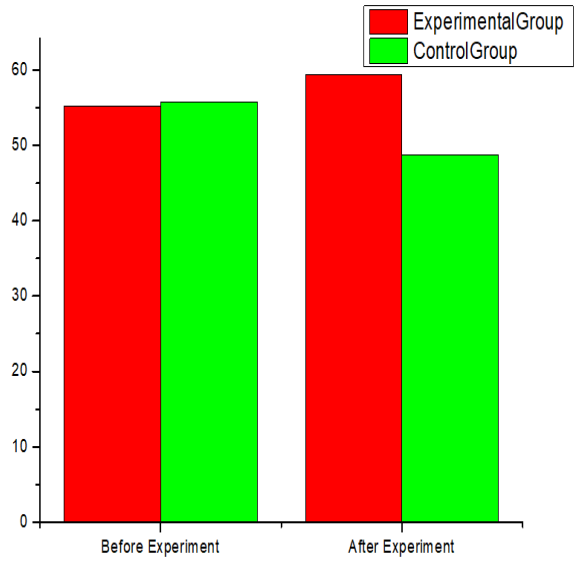

Figure 3. Comparison of BBS Scores

Table 3. Comparison of BBS Scores

	Before Experiment	After Experiment	P-value (Within Groups)
Experimental Group	55.24±4.12	59.45±3.08	0.012
Control Group	55.79±5.27	48.72±4.87	0.017
P-value (Between Groups)	0.425	0.001	--

Balance ability test

Balancing ability test was performed using the Berg Balance Scale (BBS). The experimental results showed that for the experimental group, the balance ability of the subjects before and after the experiment changed significantly ($p<0.05$), and their balance ability improved significantly. As for the control group, there was no significant change in the balance ability of the subjects before and after the experiment ($p>0.05$). The above results showed that the 6-month yoga training could significantly improve the patients' balance ability.

Walking ability test

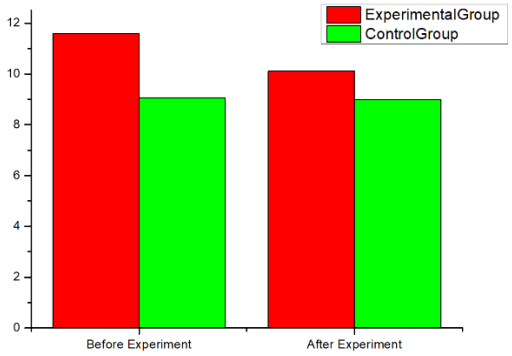

Figure 4. Comparison of BBS TUGT

The walking ability was represented and counted by TUGT. The experimental results showed that there was significant change in the walking ability of the experimental group before and after the experiment, and the change was statistically significant ($p<0.05$). Thus their walking ability was obviously improved. But no significant improvement was found in the control group before and after the experiment ($P>0.05$). The experimental results showed that 6-month yoga exercises could significantly improve the patients' walking ability.

Table 4. Comparison of TUGT

	Before Experiment	After Experiment	P-value (Within Groups)
Experimental Group	11.58±2.37	10.11±3.11	0.002
Control Group	9.07±3.05	8.99±1.89	0.675
P-value (Between Groups)	0.512	0.143	--

Test for the ability to stand on one foot

The ability to stand on one foot was represented by standing time. The experimental results showed that for the experimental group, the standing time on one leg increased significantly from 18.96 seconds to 23.06 seconds after the

yoga training, which was statistically significant ($p<0.01$). As far as the control group was concerned, the standing time on one leg before and after the experiment was basically unchanged. The above results suggested that the 6-month yoga exercises can significantly improve the patients' ability to stand on one leg.

Table 5. Comparison of Time of One-leg Standing

	Before Experiment	After Experiment	P-value (Within Groups)
Experimental Group	18.96.58±4.55	23.06±2.17	0.001
Control Group	20.78±3.87	20.67±2.99	0.725
P-value (Between Groups)	0.872	0.401	--

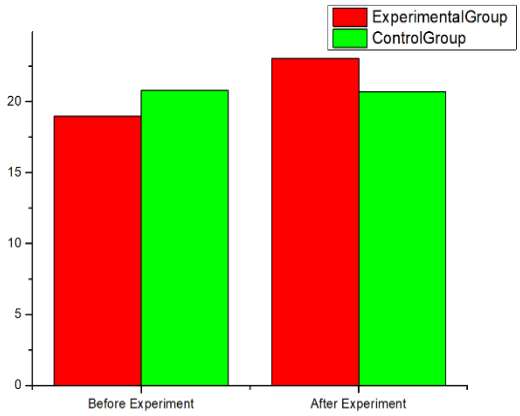

Figure 5. Comparison of Time of One-leg Standing

Nerve excitability test

During the experiment, the nerve excitability of the subjects was tested every week. However, only the results of the 1st week, the 12th week and the 24th week were presented here, which should be enough to show the results.

The experimental results presented that as far as the ill side was concerned, the amplitude of the dorsal muscle potential of the patients' hands in experimental group increased significantly after 12 weeks of exercise compared to that of the patients before exercises, which indicated that yoga could indeed improve the nerve excitability of the patients. After 24 weeks of practice, the amplitude of the dorsal muscle potential of the patients' hands was further improved compared with the results at the 12th week, and the increase was statistically significant, suggesting that yoga continued to improve the nerve excitability of the patients. There was no significant change in the amplitude of the dorsal muscle potential of the patients in the control group during the entire experiment. These experiments showed that yoga could significantly improve the nerve excitability of the patient in terms of the ill side.

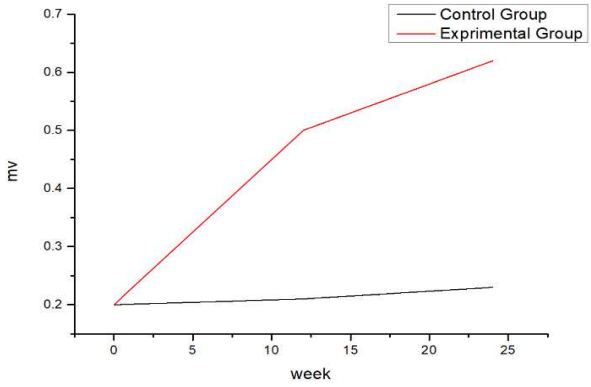

Figure 6. Ill Side Amplitude Comparison

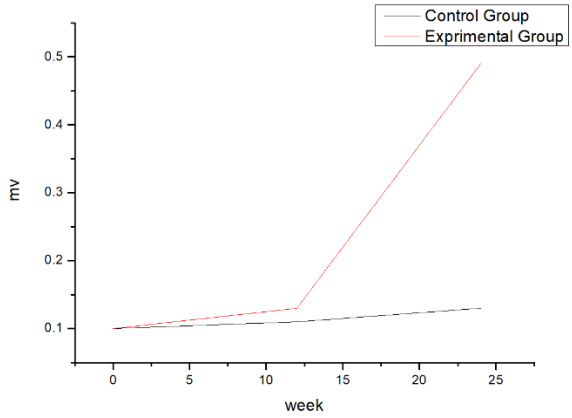

Figure 7. Health Side Amplitude Comparison

Research Conclusions

This paper aims to develop a yoga rehabilitation program for stroke patients, track and statistically analyze the rehabilitation effect of stroke patients by experimental methods, and reveal the effect of yoga on recovery of motor ability and cranial nerves of stroke patients, providing a new theoretical basis and practical enlightenment for the treatment of stroke patients. The results are as follows:

Table 6. Ill Side Amplitude Comparison (1\12\24 WEEK)

	1 WEEK	12 WEEK	24 WEEK	P-value(Within Groups)		
Experimental Group	0.225±0.021	0.500±0.017	0.062±0.023	0.009	0.002	0.011
Control Group	0.200±0.018	0.210±0.011	0.230±0.007	0.534	0.171	0.251
P-value (Between Groups)	0.552	0.298	0.176	--		

Table 7. Health Side Amplitude Comparison (1\12\24 WEEK)

	1 WEEK	12 WEEK	24 WEEK	P-value(Within Groups)		
Experimental Group	0.100±0.023	0.13±0.001	0.49±0.043	0.010	0.003	0.009
Control Group	0.101±0.012	0.11±0.007	0.13±0.026	0.341	0.541	0.342
P-value (Between Groups)	0.761	0.571	0.011	--		

(1) The 6-month yoga exercises have not improved the quality of life for stroke patients, but have improved the patients' health.
(2) The 6-month yoga exercises can effectively restore the patients' mobility. Their balance ability, walking ability and ability to stand on one foot have been enhanced.
The 6-month yoga exercises can effectively enhance the amplitude of muscle movement potential in patients with stroke, which means that yoga improves their nerve excitability and promotes the recovery of their nerve functions.

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