Clinical Research on Effects of Acupoint Injection Combined with Task-Oriented Training on Post-Stroke Hemiplegic Gait Based on the Gait Watch Analysis System

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Abstract [**Objectives**] To investigate the clinical efficacy of acupoint injection of nerve growth factors combined with task-oriented training for patients with post-stroke hemiplegic gait, and quantitatively evaluate the outcomes using the Gait Watch analysis system. [**Methods**] A total of 90 patients with post-stroke hemiplegia, who were hospitalized at the Rehabilitation Center of Taihe Hospital between January 2023 and December 2023, were selected for this study. The participants were randomly assigned to three groups: the task-oriented rehabilitation training group (control group I, $n=30$), the ordinary acupuncture combined with task-oriented training group (control group II, $n=30$), and the acupoint injection combined with task-oriented training group (observation group, $n=30$). Each group underwent treatment for 4 weeks. The Gait Watch analysis system was employed to assess the spatiotemporal gait parameters of the patients prior to treatment, as well as 2 weeks post treatment and 4 weeks post treatment. The efficacy of the treatment was subsequently analyzed. [**Results**] After 4 weeks of treatment, the spatiotemporal gait parameters, specifically step length, step speed, step frequency, percentage of the standing phase, and percentage of the swinging phase, exhibited significant improvement in the observation group compared to those before treatment ($P<0.05$). Furthermore, the degree of improvement in the observation group was superior to that observed in both control group I and control group II, with the differences reaching statistical significance ($P<0.05$). [**Conclusions**] Acupoint injection combined with task-oriented training has been shown to significantly enhance gait function in patients with post-stroke hemiplegia. The Gait Watch analysis system offers an accurate and objective quantitative assessment, making it a valuable tool for clinical application and promotion.

Key words Stroke, Hemiplegia, Acupoint injection, Task-oriented training, Gait analysis, Gait Watch

1 Introduction

Stroke is a condition characterized by a high incidence and significant disability rates. Among the various functional disorders associated with stroke, abnormal gait is one of the most prevalent. This impairment severely impacts patients' ability to perform daily activities and participate in social interactions, thereby imposing a substantial burden on both the patients and their families[1]. Despite the availability of various rehabilitation methods, including traditional acupuncture, exercise therapy, and pharmacological interventions, these approaches exhibit certain limitations in their therapeutic efficacy. Consequently, the restoration of patients' ambulation capabilities continues to pose a significant clinical challenge[2-3]. This study aims to investigate the effectiveness of acupoint injection of nerve growth factors combined with task-oriented training on gait function in patients with post-stroke hemiplegia, and objectively and quantitatively evaluate the outcomes utilizing the advanced Gait Watch analysis system.

2 Research objects and methods

2.1 Research objects A total of 90 patients with post-stroke hemiplegia, who were hospitalized at the Rehabilitation Center of Taihe Hospital between January 2023 and December 2023, were selected for this study. All patients experienced their initial onset and were diagnosed with either cerebral hemorrhage or cerebral infarction through head computed tomography (CT) or magnetic resonance imaging (MRI). Their conditions were stable, and they possessed a certain degree of ambulation ability. Participants were included in the study following the completion of an informed consent form.

2.2 Inclusion and exclusion criteria Inclusion criteria: patients with a first diagnosis of stroke; stable condition without serious medical complications; clear consciousness; ability to walk at least 12 m independently or with supervision; aged 18 to 75 years; willing to cooperate and sign the informed consent form. Exclusion criteria: patients with severe cognitive dysfunction (MMSE score $\leqslant$24); severe cardiac, pulmonary, hepatic, or renal insufficiency; presence of comorbid osteoarticular or neuromuscular disorders that affect the ability to walk; allergies or drug intolerances.

2.3 Grouping Utilizing the random number table method, a total of 90 patients were randomly assigned to three groups, with each group comprising 30 participants: the task-oriented training group (control group I), the ordinary acupuncture combined with task-oriented training group (control group II), and the acupoint injection combined with task-oriented training group (observation group). Statistical analysis revealed no significant differences in baseline data among the groups ($P>0.05$), indicating a high degree of comparability (Table 1).

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Table 1 General information of the three groups of patients prior to treatment ($n=30$)

Group	Age//years	Gender		Course of disease//month
		Male	Female	
Control I	58.70 ±8.587	14	16	8.00 ±1.3
Control II	59.20 ±9.459	15	15	7.90 ±1.8
Observation	59.05 ±8.783	17	13	8.30 ±1.6

2.4 Treatment methods

2.4.1 Task-oriented training. Task-oriented rehabilitation training was implemented in conjunction with standard pharmacological treatment. The training programs encompassed exercises aimed at enhancing upper limb functionality, lower limb functionality, and balance. Each training session was conducted for 30 – 45 min and was administered once daily, 5 times per week.

2.4.2 Ordinary acupuncture combined with task-oriented training. Based on control group I, ordinary acupuncture treatment was incorporated. Acupoints including Jianyu, Shousanli, and Waiguan on the affected side were selected for treatment. Each session lasted for 25 min and was administered once daily, 6 times per week.

2.4.3 Acupoint injection combined with task-oriented training. In accordance with control group I, an intervention involving acupoint injection of nerve growth factors was implemented. The acupoints selected on the affected side included Quchi, Hegu, Zusanli, and Fenglong. A volume of 0.5 mL of mouse nerve growth factors was administered into each acupoint 3 times per week over 4 weeks.

2.5 Evaluation tools and indicators The Gait Watch analysis system was employed to assess the gait of patients at three distinct time points: prior to treatment, 2 weeks post treatment, and 4 weeks post treatment. This evaluation aimed to observe changes in spatiotemporal parameters, including step length, step speed, step frequency, percentage of the standing phase, and percentage of the swinging phase.

2.6 Statistical analysis The analysis was performed utilizing SPSS 22.0 statistical software. Measurement data were presented as mean ± standard deviation ($\bar{x} \pm s$). A paired t-test was employed to compare results prior to and following treatment within groups, while one-way analysis of variance (ANOVA) was utilized for comparisons between groups. The least significant difference (LSD) method was applied for multiple comparisons. A P value of less than 0.05 was deemed statistically significant.

3 Results and analysis

Prior to treatment, there were no statistically significant differences among the three patient groups regarding gait spatiotemporal parameters, including step length, step speed, step frequency, standing phase, and swinging phase ($P>0.05$), indicating that the groups were comparable. Following 4 weeks of treatment, all three groups exhibited improvements in these parameters compared to those prior to treatment, with the observation group demonstrating the most pronounced enhancement. The step length of the observation group increased from (0.45 ± 0.12) m to (0.78 ± 0.14) m. Additionally, the step speed rose from (0.32 ± 0.10) m/sec to (0.68 ± 0.13) m/sec, and the step frequency increased from (71.2 ± 6.5) steps/min to (95.5 ± 8.2) steps/min. Furthermore, the percentage of the standing phase decreased from (60.1 ± 3.2)% to (52.4 ± 2.8)%, while the percentage of the swinging phase increased from (39.9 ± 2.9)% to (47.6 ± 3.1)%. The aforementioned changes demonstrated statistically significant differences within the group when compared to those prior to treatment ($^{a}P<0.05$). Furthermore, these changes were also statistically significant in comparison to control group I and control group II ($^{bc}P<0.05$). Although control group I and control group II exhibited some improvements, the extent of these improvements was significantly less than that observed in the observation group. The findings indicate that acupoint injection combined with task-oriented training offers a substantial advantage in enhancing gait function among post-stroke hemiplegic patients (Table 2).

Table 2 Comparison of gait spatiotemporal parameters of the three patient groups prior to and following treatment

Group	Time	Step length//m	Step speed m/sec	Step frequency steps/min	Percentage of the standing phase//%	Percentage of the swinging phase//%
Observation	Prior to treatment	0.45 ±0.12	0.32 ±0.10	71.2 ±6.5	60.1 ±3.2	39.9 ±2.9
	4 weeks post treatment	0.78 ±0.14^{abc}	0.68 ±0.13^{abc}	95.5 ±8.2^{abc}	52.4 ±2.8^{abc}	47.6 ±3.1^{abc}
Control I	Prior to treatment	0.43 ±0.15	0.33 ±0.13	70.5 ±6.4	60.7 ±3.6	39.7 ±2.8
	4 weeks post treatment	0.58 ±0.11^{a}	0.48 ±0.09^{a}	80.2 ±6.1^{a}	56.7 ±3.0^{a}	43.3 ±3.3^{a}
Control II	Prior to treatment	0.47 ±0.16	0.31 ±0.25	69.5 ±5.8	60.4 ±3.7	39.3 ±2.5
	4 weeks post treatment	0.62 ±0.10^{a}	0.52 ±0.08^{a}	85.1 ±6.5^{a}	54.3 ±2.7^{a}	45.7 ±2.6^{a}

NOTE $^{a}P<0.05$, compared to those prior to treatment in this group; $^{b}P<0.05$, compared to control group I; $^{c}P<0.05$, compared to control group II.

4 Discussion

This study demonstrated that the combination of acupoint injection and task-oriented training significantly enhanced the ambulation ability of post-stroke hemiplegic patients, exhibiting greater efficacy than either task-oriented training alone or acupuncture in conjunction with task-oriented training[4]. This phenomenon may be associated with the administration of nerve growth factors at acupoints, which has been shown to facilitate nerve regeneration and functional recovery. Nerve growth factors enhances the local neural microenvironment, accelerates the repair and regeneration of neurons, and contributes to the improvement of nerve conduction and functional remodeling, ultimately leading to enhanced motor function in the limbs[5]. Furthermore, task-oriented training prioritizes

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spasms, and dispel wind and facilitate the flow through the collaterals. Rhizoma Pinelliae is effective in drying dampness and transforming phlegm. Caulis Bambusae in Taenia is known for its ability to clear heat and transform phlegm, while Arisaema Cum Bile is characterized by its bitter properties, which are effective in drying dampness. The combination of the four medicinal agents will primarily eliminate evil influences, thereby enhancing the regulation of qi and the management of epilepsy. Ostreae Concha is known to subdue yang and nourish yin, thereby calming the mind and soothing the spirit. Pheretima is recognized for its ability to clear heat, subdue wind, and unblock meridians. The synergistic effects of the various herbs may facilitate liver soothing, regulate qi, eliminate heat, alleviate blood stasis, mitigate wind, and stabilize conditions associated with epilepsy.

The findings of this study indicate that the total clinical effective rate and the QOLIE-31 score for the observation group were significantly higher than those of the control group following treatment. Additionally, the TCM syndrome score, as well as the frequency and duration of epilepsy onset, were lower in the observation group compared to the control group. Furthermore, improvements in EEG grading were more pronounced in the observation group, and the incidence of adverse reactions was relatively low. These results suggest that the combination of Tiaoqi Dingxian prescription and levetiracetam in the treatment of epilepsy enhances clinical efficacy, effectively improves patients' EEG results, TCM syndrome manifestations, and overall quality of life, while also reducing the frequency and duration of epilepsy onset. The treatment appears to be both safe and reliable.

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functional and individualized rehabilitation, which can more effectively enhance patients' active engagement in training and expedite the functional reconstruction of the central nervous system[6]. The application of acupoint injection of nerve growth factors, in conjunction with task-oriented training, demonstrates a significant improvement in gait function in patients with post-stroke hemiplegia. The Gait Watch analysis system offers a precise and reliable quantitative assessment of this intervention, which is markedly more effective than single rehabilitation training or ordinary acupuncture combined with rehabilitation programs, presenting an efficient and straightforward treatment option for clinical practice. In future research, it is imperative to enhance investigations aimed at verifying the long-term efficacy of this therapy, elucidating its therapeutic mechanisms, and facilitating its broader clinical application.

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