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The Impact of Guidance on Limb Function Exercises on the Recovery of Motor Function in Patients with Cerebral Infarction

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Abstract: *Objective:* To investigate the clinical value of guidance on limb function exercises in the rehabilitation of patients with cerebral infarction, providing objective data support for optimizing rehabilitation plans during the recovery period and enhancing overall rehabilitation outcomes. *Methods:* This study selected 114 patients with cerebral infarction admitted to our hospital from June 2024 to January 2026. They were randomly divided into a control group and an observation group, with 57 patients in each group. The control group received basic rehabilitation training, while the observation group received specialized guidance on limb function exercises in addition to basic rehabilitation training. Motor function, self-care ability, neurological function, and activities of daily living were compared between the two groups. *Results:* Compared to before the intervention, scores for motor function, self-care ability, and activities of daily living increased in both groups after the intervention, with higher scores in the observation group. Neurological function scores decreased in both groups, with lower scores in the observation group (all $p < 0.05$). *Conclusion:* Combining systematic guidance on limb function exercises with basic rehabilitation training can effectively improve motor and neurological functions, as well as enhance self-care ability and activities of daily living in patients with cerebral infarction.

Keywords: Cerebral infarction; Limb function; Exercise; Guidance; Motor function

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1. Introduction

Cerebral infarction is a clinically prevalent acute cerebrovascular disease characterized by sudden onset, high disability rates, and a long recovery period. Ischemia and hypoxia in brain tissue cause damage to nerve cells, leading to varying degrees of sequelae such as limb hemiplegia, motor dysfunction, and neurological deficits in most patients after onset. These sequelae directly result in restricted limb movement and decreased self-care ability, severely affecting patients' quality of daily life and imposing a heavy caregiving and economic burden on families and society. Rehabilitation interventions are crucial for improving prognosis and reducing disability during the recovery period of cerebral infarction. Currently, conventional basic rehabilitation

training is commonly used for patients with cerebral infarction in clinical settings; however, the training content is relatively general, and the process is rigid, often focusing on passive activities and lacking individualized, phased professional guidance for limb function exercises [1]. Guidance on limb function exercises relies on rehabilitation assessment results to develop stratified and systematic exercise plans for patients, while simultaneously conducting action demonstrations, home training education, and dynamic adjustments to training plans, thereby compensating for the deficiencies of basic rehabilitation [2]. At present, systematic comparative studies on the comprehensive rehabilitation effects of standardized guidance on limb function exercises in patients with cerebral infarction remain limited. Based on this, this grouped comparative study was conducted.

2. Materials and methods

2.1. General information

This study selected 114 patients with cerebral infarction admitted to the neurology department of our hospital from June 2024 to January 2026 as the research subjects. They were divided into two groups using a random number table method.

(1) Control group

31 males and 26 females; aged 45–78 (61.25 ± 5.14) years; disease duration 7–28 (16.52 ± 3.18) days; hemiplegia types: 52 cases of unilateral hemiplegia and 5 cases of bilateral hemiplegia.

(2) Observation group

30 males and 27 females; aged 44–79 (60.98 ± 5.21) years; disease duration 8-27 (16.57 ± 3.15) days; hemiplegia types: 50 cases of unilateral hemiplegia and 7 cases of bilateral hemiplegia.

Comparison of the aforementioned baseline data between the two groups showed $p > 0.05$, indicating comparability. This study was approved by the Medical Ethics Committee of our hospital.

2.2. Diagnostic criteria

This study referred to the diagnostic criteria for cerebral infarction in the "Chinese Consensus on the Diagnosis and Treatment of Hemorrhagic Transformation after Acute Cerebral Infarction 2019" [3].

2.3. Inclusion criteria

Patients who met the clinical diagnostic and imaging confirmation criteria for cerebral infarction and were in a stable rehabilitation phase of their condition; those with sequelae such as limb hemiplegia and restricted motor function; those who were conscious with normal cognitive, comprehension, and communication abilities, enabling them to cooperate in completing rehabilitation training and scale assessments; those with stable vital signs and no severe acute complications; those with complete clinical data who voluntarily participated in this study and signed informed consent forms, and were able to cooperate in completing the entire intervention.

2.4. Exclusion criteria

Patients with diseases affecting limb movement, such as cerebral hemorrhage, brain tumors, Parkinson's disease, and severe bone and joint diseases; those with failure of vital organs such as the heart, liver, and kidneys, malignant tumors, severe mental illnesses, and cognitive impairments; those with pre-existing limb disabilities or motor dysfunctions before onset.

2.5. Withdrawal and exclusion criteria

Patients who actively withdrew, gave up rehabilitation interventions, or transferred to another hospital during the study period, making it impossible to complete the entire observation; those whose condition suddenly worsened, experienced new cerebrovascular accidents, or developed severe complications during the study, interfering with the determination of various indicators.

2.6. Methods

2.6.1. Control group (basic rehabilitation training)

(1) Basic positional care

Assist patients in maintaining proper limb positions and regularly assist in turning every 2 hours to prevent pressure sores and limb joint contractures.

(2) Passive limb training

Conduct basic limb activities twice daily for 30 minutes each time. Nursing staff assist patients in performing simple flexion, extension, and rotation movements of major joints such as the shoulders, elbows, wrists, hips, knees, and ankles, as well as regular muscle massages for hemiplegic limbs.

(3 Simple active training

Verbally encourage patients to independently perform simple movements such as raising their hands and legs and grasping objects.

(4) Basic activities of daily living training

Briefly instruct patients on performing daily actions such as dressing, eating, and washing, providing procedural prompts.

(5) Rehabilitation education

Provide a verbal explanation of rehabilitation precautions upon admission.

2.6.2. The observation group (limb function exercises in addition to basic rehabilitation training)

(1) Phased guidance on limb function exercises

① Bedridden phase: Demonstrate one-on-one passive movement techniques for all body joints, moving major joints in order from proximal to distal ends, controlling the angle and intensity of movements to avoid traction injuries; instruct family members to assist in completing training and correct incorrect techniques on-site. Demonstrate massage techniques for hemiplegic limbs, focusing on massaging the upper arm, thigh, and calf muscle groups, explaining massage frequency and intensity requirements to promote local blood circulation and prevent muscle atrophy. Guide patients in using their unaffected limbs to drive their affected limbs to complete lifting, translation, flexion, and extension movements, providing hands-on guidance on force application; practice basic hand movements such as clenching fists and extending fingers in bed to exercise hand muscle strength. Standardize demonstrations of three standard proper limb positions: supine, affected-side lying, and unaffected-side lying, explaining the key points and effects of different positions, and regularly check and correct improper positions. ② Bed-exit transition phase: Gradually guide patients from lying flat to semi-sitting and then to sitting up completely, practicing unsupported sitting balance at the bedside; demonstrate body weight shift movements, correcting issues such as body leaning and weight shift, and gradually extend sitting time. Assist patients in standing with the support of beds or walkers, demonstrating proper standing posture, guiding patients to distribute their weight on both feet evenly, and

practicing marching in place to improve standing stability gradually. Increase training for lifting, abducting, and adducting the affected limbs to strengthen muscle strength; continue to consolidate joint movement training, appropriately increasing the range of motion. Guide patients in practicing front-to-back and left-to-right weight shift exercises to lay the foundation for walking training. ③ Functional enhancement phase: Demonstrate proper walking posture, stride length, and speed, initially assisting with walking and then transitioning to independent walking; provide real-time corrections for patients with abnormal gaits and gradually practice turning and short-distance walking. Increase lifting and stretching training for the upper limbs; practice knee flexion, hip extension, and stair climbing for the lower limbs, following a gradual and progressive principle to gradually increase training intensity. Conduct training such as threading beads, buttoning buttons, holding chopsticks, and grasping small objects, providing one-on-one guidance on action details to improve hand dexterity. Combine limb exercises with daily actions, providing specialized guidance on actions such as dressing, using the toilet, washing, and climbing stairs, breaking down steps and practicing repeatedly to improve self-care ability.

(2) Supporting management measures

Accompany patients throughout each training session, promptly correcting non-standard movements; dynamically adjust training duration and intensity based on patients' fatigue levels and limb tolerance. Both groups received continuous interventions for 4 weeks.

2.7. Observation indicators

(1) Limb motor function

Before and after the intervention, the Fugl-Meyer Motor Function Assessment Scale (FMA) was used for evaluation. This scale has a total score of 100 points and includes two major dimensions: upper limbs (66 points) and lower limbs (34 points).

(2) Self-care ability

Before and after the intervention, the Exercise of Self-Care Agency Scale (ESCA) was used for evaluation. The scale consists of 43 items and includes four dimensions: self-concept (32 points), self-care responsibility (24 points), self-care skills (48 points), and health knowledge level (68 points), with a total score of 172 points. A higher score indicates stronger self-care ability in patients.

(3) Neurological function and activities of daily living

Before and after the intervention, the National Institutes of Health Stroke Scale (NIHSS) was used to assess the degree of neurological deficits in patients, with a total score of 42 points. A higher score indicates more severe neurological deficits. The Barthel Index (BI) was used to assess patients' activities of daily living, with a total score of 100 points. A higher score indicates stronger independent living ability in patients.

2.8. Statistical analysis

The data from this study were analyzed using SPSS 26.0 statistical software. Measurement data conforming to a normal distribution were expressed as ($\overline{x} \pm s$), and differences between groups were compared using the *t*-test. Count data were expressed as frequencies and percentages (%), and differences between groups were compared using the χ^2 test. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Limb motor function

Compared to before the intervention, limb motor function scores increased in both groups after the intervention, with higher scores in the observation group ($p < 0.05$). See **Table 1**.

Table 1. Limb motor function [$\overline{x} \pm s$, points]

Group	Number of cases	Upper limb function		Lower limb function	
		Before intervention	After intervention	Before intervention	After intervention
Control group	57	38.12 ± 5.06	45.79 ± 4.32	19.41 ± 3.24	24.25 ± 2.86
Observation group	57	37.98 ± 5.16	51.13 ± 3.16	19.27 ± 3.35	26.24 ± 2.53
t value	-	0.146	7.532	0.227	3.935
p value	-	0.884	< 0.001	0.821	< 0.001

3.2. Self-care ability

Compared to before the intervention, the self-care ability scores of both groups increased after the intervention, with the observation group showing a higher score, $p < 0.05$. See **Table 2**.

Table 2. Self-Care Ability [$\overline{x} \pm s$, score]

Group	Number of cases	Self-concept		Self-care responsibility		Self-care skills		Health knowledge level	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Observation group	57	18.37 ± 2.75	21.56 ± 2.63	14.22 ± 2.14	16.86 ± 2.07	20.21 ± 3.25	26.92 ± 3.14	29.36 ± 4.04	36.75 ± 3.94
Control group	57	18.32 ± 2.69	25.19 ± 2.43	14.18 ± 2.09	19.87 ± 1.92	21.03 ± 3.43	39.53 ± 2.79	29.25 ± 3.98	48.27 ± 3.65
t value		0.098	7.654	0.101	8.049	1.310	22.705	0.146	16.194
p value		0.922	< 0.001	0.920	< 0.001	0.193	< 0.001	0.884	< 0.001

3.3. Neurological function and daily living abilities

Compared to before the intervention, both groups showed a decrease in neurological function scores after the intervention, with the observation group having a lower score. Both groups also exhibited an increase in daily living ability scores, with the observation group scoring higher ($p < 0.05$). See **Table 3**.

Table 3. Neurological function and daily living abilities [$\overline{x} \pm s$, points]

Group	Number of cases	NIHSS score		BI index	
		Before intervention	After intervention	Before intervention	After intervention
Control group	57	17.85 ± 3.12	11.24 ± 2.89	46.33 ± 6.72	65.27 ± 6.23
Observation group	57	18.04 ± 3.17	6.51 ± 2.32	45.98 ± 6.63	83.11 ± 4.02
t value	-	0.323	9.636	0.280	18.166
p value	-	0.748	< 0.001	0.780	< 0.001

4. Discussion

After the onset of cerebral infarction, ischemic damage occurs in the brain tissue, which is prone to causing neurological deficits and leaving sequelae such as limb hemiplegia and motor dysfunction. This not only restricts patients' limb movements but also weakens their self-care abilities, seriously affecting their quality of daily life. Conventional basic rehabilitation training typically involves simple limb activities, postural care, and verbal instructions, with a monotonous and unsystematic training format. It fails to develop personalized plans based on patients' muscle strength and recovery status, lacks professional movement demonstrations and error corrections, and struggles to fully activate the repair potential of nerves and limbs, resulting in limited overall rehabilitation effects [4].

The results of this study showed that after the intervention, the Fugl-Meyer Assessment (FMA) scores for both the upper and lower limbs in both groups improved compared to before the intervention, with the observation group scoring higher than the control group ($p < 0.05$). The reasons for this are as follows: simple basic rehabilitation training primarily focuses on passive activities with general training content, making it easy for patients to exhibit problems such as non-standard movements and incorrect force application, which are ineffective in exercising limb muscle strength and coordination. In contrast, limb function exercise guidance is divided into three stages, bedridden period, bed-leaving transition period, and functional enhancement period—based on patients' recovery conditions, following a step-by-step rehabilitation principle. It involves one-on-one demonstrations of standard movements, timely correction of incorrect postures, and incorporates diverse content such as joint activities, muscle strength training, and gait exercises. This approach continuously stimulates damaged neural pathways, promotes neural function remodeling, gradually improves limb muscle strength, joint range of motion, and motor coordination, and thereby enhances limb motor ability [5].

The results of this study also indicated that after the intervention, the scores in each dimension and the total score of the Exercise of Self-Care Agency (ESCA) scale were higher in both groups compared to before the intervention, with the observation group showing a more pronounced improvement ($p < 0.05$). The reasons for this are as follows: basic rehabilitation only provides one-time verbal education upon admission, leaving patients with insufficient knowledge of rehabilitation and self-care skills. In contrast, the observation group concurrently conducted regular rehabilitation education, explaining disease knowledge, exercise essentials, and home rehabilitation methods during the training process, while integrating limb training with daily activities such as dressing and washing, breaking down movement steps and practicing repeatedly [6]. As patients master rehabilitation skills, they gradually learn to independently complete daily tasks, leading to a significant improvement in their self-care abilities.

Furthermore, the results of this study showed that after the intervention, the National Institutes of Health Stroke Scale (NIHSS) scores decreased and the Barthel Index (BI) scores increased in both groups, with the observation group demonstrating greater improvements in these indicators compared to the control group ($p < 0.05$). The reasons for this are as follows: limb function exercise guidance, through scientific and regular limb activities, can improve systemic blood circulation, provide favorable repair conditions for damaged brain tissue, facilitate neural function recovery, and reduce the degree of neurological deficits [7]. Meanwhile, the simultaneous improvement in limb motor function and self-care abilities enables patients to gradually independently perform daily activities such as eating, walking, and toileting, significantly reducing their reliance on others for care and thereby enhancing their daily living abilities.

5. Conclusion

In summary, combining systematic limb function exercise guidance with basic rehabilitation training for patients with cerebral infarction can effectively improve their limb motor and neurological functions, enhance their self-care abilities, and improve their daily living abilities.

Disclosure statement

The author declares no conflict of interest.

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