Evaluation of Motor Function Rehabilitation for Stroke Patients Based on Magnetic Resonance DTI Technology

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ABSTRACT
Based on functional imaging methods of resting state DTI (Diffusion tensor imaging), this study reveals the structural changes and functional abnormalities of white matter fibers in patients with stroke from two levels of structure and function, and analyzes the effects of exercise on brain function remodeling in patients with stroke. The effects of the process, explore the central effect mechanism of scalp acupuncture to promote the recovery of motor function, and provide ideas for optimizing the rehabilitation treatment after stroke. There was no statistically significant difference in the general situation of the motion observation group and the conventional rehabilitation treatment group based on DTI technology at the time of enrollment, the NIHSS S score, the Fugl-Meyer assessment score, the modified ashworth scale score, and the Brunnstrom staging assessment (P > 0.05). After the week, 8 weeks, and 12 weeks of follow-up, the national institutes of health stroke scale, Fugl-Meyer assessment score, modified ashworth scale score, and Brunnstrom motor function staging score of the two groups of patients were significantly improved over time before treatment. The difference was statistically significant (P > 0.05); the comparison between groups, the scores of patients in the action observation group and the difference before and after treatment were significantly higher than those in the conventional rehabilitation treatment group, and the difference was statistically significant (P > 0.05). Conclusion: Action observation therapy can improve the degree of neurological deficits and promote the recovery of neurological function in patients with stroke. It can improve the score of motor function, reduce the muscle tension of key muscles in patients with stroke, and promote the recovery of motor function in patients.

INDEX TERMS
Ischemic stroke, action observation therapy, stroke, motor function, neurological deficits.

I. INTRODUCTION
Stroke is the main cause of long-term paralysis of adults worldwide. Most stroke patients present with motor dysfunction, which seriously affects patients’ daily lives and also brings a huge burden on the family and society. Recent studies on functional recovery after stroke have suggested that the adult brain has recombination and can compensate for motor deficits [1]. According to the plasticity of the brain, there are many corresponding rehabilitation methods to improve the motor function of patients with stroke [2].

For patients with motor dysfunction after stroke, the judgment of the integrity of the corticospinal tract plays an important role in the prognosis of patients. Many studies have found that the integrity of white matter fiber structure is directly related to sports injuries [3]–[5]. Diffusion Tensor Imaging (DTI) can provide information on the extent and direction of water molecule diffusion in tissues, so it can reconstruct three-dimensional images of white matter fibers [6]–[8]. The anisotropy score or partial anisotropy is one of the parameters of DTI. It reflects the ratio of the anisotropic component of the water molecule diffusion to the entire diffusion tensor. The value range is 0-1, 1 represents the maximum anisotropy, and 0 represents the maximum. This value can reflect the degree of diffusion of white matter fibers along the axonal pathway and can reliably detect the microstructure damage of white matter fiber bundles [9]–[11]. Partially reduced anisotropy value represents axonal injury or Wallerian degeneration after stroke [12], [13]. The local partial anisotropy value can be used to detect sports injury and repair, the most important...
of which is to detect the partial anisotropy value of the inner capsule hind limbs. In short, DTI can non-invasively detect changes in brain tissue microstructure and changes in fiber bundle connections, providing an effective means for revealing the process of white matter fiber remodeling after stroke. Some DTI-based experiments have detected partial anisotropy of the cortical spinal tract in the affected side after stroke. Studies have found that the partial anisotropy of the cortical spinal tract in the affected side after stroke has decreased, which is closely related to subsequent exercise recovery [14], [15]. It is proposed that the decrease in the anisotropy of the affected part after stroke is related to poor exercise scores [16], [17]. In addition, some studies have suggested that the degree of anisotropy reduction in the affected part of the early stroke can predict the degree of prognosis of the affected limb [18]–[20]. Some scholars have conducted longitudinal studies on some anisotropy values and found that with the recovery of stroke, the anisotropy value of the affected cortical spinal cord gradually increases, and its subsequent functional recovery is also good [21]–[23]. In short, before Studies have suggested that there is a positive correlation between partial anisotropy of cortical spinal tract and motor function recovery in patients with motor dysfunction after stroke [24]. At present, there are many comparative studies on the brain structure and function of normal people in high-altitude and low-altitude areas using magnetic resonance imaging [25], [26], and researches on patients have focused on epidemiology, pathophysiology, neurochemistry, etiology And for the diagnosis and treatment of the disease [27]–[29], there are relatively few studies on neuroimaging. Magnetic resonance imaging is based on the principle that a hydrogen atomic nucleus in the human body can generate a resonance signal in an external constant magnetic field of certain intensity to display various information such as the internal tissue structure and functional status of the human body [30]–[32]. The imaging principle of magnetic resonance is completely different from the principles of other imaging techniques such as X-ray examination and ultrasound [33], [34]. Magnetic resonance has many advantages such as no X-ray radiation damage, high reproducibility, and extremely high soft tissue resolution. It also has the characteristics of multi-azimuth, multi-plane, multi-parameter, multi-sequence, and multi-functional imaging. And the clear display of the lesions can help doctors to diagnose and differentiate the disease [35]–[37]. Diffusion-weighted imaging technology is one of the more mature magnetic resonance imaging functional imaging technologies in recent years. It can reflect the movement of water molecules between human tissues at the molecular level. It has been used in all parts of the body, each Diagnosis and differential diagnosis of systemic diseases [38]–[40]. Combined with conventional magnetic resonance imaging sequence, it is possible to sensitively find combined fresh cavity infarcts. Conventional magnetic resonance imaging scans can only show the signs of lesions around the bilateral ventricles and the center of the semi-oval and patients with multiple lacunar infarctions. These imaging findings do not reflect cognitive dysfunction. Advantages [41]–[43] cannot reflect the correlation between them. Among the many functional imaging techniques of magnetic resonance, diffusion tensor imaging is the only non-invasive examination technique that can show white matter fiber bundles in living tissues. Not only can DTI visually display the distribution and arrangement of white matter fibers, the direction of travel, and the degree of tightness, etc., but its important parameters can reflect the myelinization of white matter fibers. By displaying the anatomy and pathological processes of white matter fibers, reflected the integrity of the white matter fiber bundle microstructure in the brain, and can provide some evidence for cognitive dysfunction [44]–[46]. In recent years, some scholars [46], [47] used magnetic resonance DTI technology to explore the changes in the white matter microstructure of stroke brain, and found that the anisotropy of patients with bilateral lesions around the ventricles and the semi-oval center lesion area was reduced to varying degrees. These findings suggest that there are extensive fine-grained structural changes in the white matter of the subcortical arteriosclerotic encephalopathy.

Therefore, in this study, Siemens 3.0T magnetic resonance DTI technology was used to conduct a comparative analysis of the changes in the brain white matter fiber microstructures before and after treatment of patients with different degrees of cognitive dysfunction and in the control group explore the imaging basis of cognitive impairment, and explore the clinical application value of 3.0T magnetic resonance resonance DTI technology in subcortical arteriosclerotic encephalopathy. A prospective, randomized group, parallel control, and blinded clinical study will be conducted on patients with hemiplegia during stroke recovery. The motor function scores and neurological deficits of stroke patients based on action observation therapy based on mirror neurons will be explored. The effect of the degree of daily life and the ability of daily activities, combined with DTI technology, to explore the effect of motion observation therapy on real-time brain function imaging of stroke patients, and to explain its possible mechanism of action, to provide clinical evidence for the exploration of new stroke rehabilitation technology theoretical support. Action observation therapy can improve the degree of neurological deficits in stroke patients and promote the recovery of their neurological functions. It can improve the motor function score, reduce the muscle tension of stroke patients’ key muscles, and promote the recovery of motor function of patients.

II. STUDY ON FUNCTIONAL REHABILITATION OF PATIENTS WITH STROKE USING FUNCTIONAL MAGNETIC RESONANCE

A. RESEARCH METHOD

The patient group underwent head magnetic resonance imaging and resting functional magnetic resonance DTI on the first day of enrollment, and on the 14th and 30th days after enrollment, they underwent initial magnetic
resonance imaging and resting functional magnetic resonance DTI. The normal group also made this test and compared it.

These 20 patients were examined in the magnetic resonance room of a hospital by Philips Intera acheva 1.5T Nova magnetic resonance scanner. Before the examination, the study subjects were prohibited from taking foods that stimulated the nerve center, such as strong tea and coffee, as well as sleeping and sedative drugs, to keep them in a supine position. The head was fixed with an 8-channel phased array coil of the skull, and then positioning images and DTI Image scanning. For conventional image scanning, b value = 1000 s / mm² is used. The number of scanning layers is 25 and the layer thickness is 5mm. DTI adopts single shot-SE-EPI sequence: SPIR pressure grease, b value = 0/800s/mm², TR = 11061ms, TE = 63ms, FOV = 224 × 224mm, acquisition matrix = 96 * 96, number of acquisitions 2, layer thickness / interval = 3/0mm, number of layers = 48, 1632 images per scan, total scan time 12 minutes 32 seconds. T2 * W sequence for DTI: fat pressure, 3000ms, TE = 60ms, FOV = 220 × 220mm, acquisition matrix = 64 × 64, acquisition times 1, layer thickness / interval = 3.6/0.72mm, layer number = 5, acquisition Rotation angle = 90degrees, dynamic number = 100, each dynamic scan time = 3 seconds, a total of 3500 images per scan, the total scan time is 5 minutes 06 seconds. In addition, the patient group underwent DTI and quantified diagnostic criteria for stroke symptoms on the 1st, 14th, and 30th days of enrollment, as shown in Figure 1.

B. DATA PROCESSING ANALYSIS

The white matter of the brain was divided into 48 sections through the Comprehensive Library of Functional Magnetic Resonance Imaging Analysis Tools (FSL), which are the cerebellar midfoot, pontine bundle, umbilical cord knee, umbilical cord body, umbilical cord pressure, bilateral corticospinal tract, bilateral medial thalamus, bilateral cerebellar lower feet, bilateral cerebellar upper feet, bilateral cerebral feet, bilateral internal capsule forelimbs, bilateral internal capsule hindlimbs, bilateral internal capsule pressure posterior cortex, Front of bilateral radiation crown, upper of bilateral radiation crown, rear of bilateral radiation crown, bilateral vision radiation, bilateral longitudinal beams, bilateral outer capsules, bilateral cingulate beams, bilateral hippocampal gyrus, bilateral Terminal striate bundle, bilateral upper forehead pillow bundle, bilateral hook bundle, and bilateral photo-fiber, as shown in Figure 2.

Then, measure the average value of the anisotropy index and the average diffusion rate of each white matter region, and select the region of interest from the pontine bundle, the knee of the fit body, the body of the umbilical cord, the pressure of the umbilical cord, bend, bilateral corticospinal tract, bilateral medial thalamus, bilateral cerebral feet, bilateral internal capsule forelimbs, bilateral internal capsule hindlimbs, front of bilateral radiation crown, upper portion of bilateral radiation crown, posterior portion of bilateral radiation crown, Bilateral upper and lower longitudinal bundles, bilateral outer
TABLE 1. Collection of samples and clinical information.

| Serial number | Gender | Age | Infarct   | Acquisition time | ADL score | Wind score | Sputum score | Qi deficiency score |
|---------------|--------|-----|-----------|------------------|-----------|------------|--------------|---------------------|
| 1             | Male   | 56  | Left base | Day 1            | 1         | 65         | 13           | 6                   | 5                   |
|               |        |     |           | Day 14           | 3         | 95         | 2            | 5                   | 4                   |
|               |        |     |           | Day 30           | 2         | 98         | 2            | 5                   | 3                   |
| 2             | Female | 81  | Left base | Day 1            | 3         | 82         | 14           | 12                  | 3                   |
|               |        |     |           | Day 14           | 3         | 93         | 4            | 3                   | 2                   |
|               |        |     |           | Day 30           | 2         | 97         | 4            | 4                   | 1                   |
| 3             | Female | 55  | Right base| Day 1            | 4         | 88         | 13           | 13                  | 1                   |
|               |        |     |           | Day 14           | 2         | 89         | 4            | 2                   | 0                   |
|               |        |     |           | Day 30           | 2         | 96         | 4            | 2                   | 0                   |
| 4             | Female | 62  | Right base| Day 1            | 4         | 64         | 8            | 12                  | 3                   |
|               |        |     |           | Day 14           | 3         | 92         | 1            | 1                   | 2                   |
|               |        |     |           | Day 30           | 2         | 96         | 0            | 1                   | 1                   |
| 5             | Female | 54  | Left base | Day 1            | 4         | 96         | 13           | 9                   | 4                   |
|               |        |     |           | Day 14           | 2         | 94         | 3            | 7                   | 2                   |
|               |        |     |           | Day 30           | 2         | 99         | 4            | 7                   | 3                   |
| 6             | Male   | 53  | Left base | Day 1            | 4         | 93         | 11           | 15                  | 6                   |
|               |        |     |           | Day 14           | 2         | 98         | 2            | 8                   | 2                   |
|               |        |     |           | Day 30           | 2         | 99         | 4            | 8                   | 4                   |
| 7             | Female | 58  | Right base| Day 1            | 4         | 63         | 17           | 10                  | 5                   |
|               |        |     |           | Day 14           | 2         | 65         | 3            | 6                   | 3                   |
|               |        |     |           | Day 30           | 2         | 72         | 4            | 2                   | 2                   |
| 8             | Male   | 54  | Right base| Day 1            | 4         | 84         | 12           | 19                  | 0                   |
|               |        |     |           | Day 14           | 2         | 94         | 4            | 9                   | 0                   |
|               |        |     |           | Day 30           | 2         | 99         | 4            | 6                   | 3                   |
| 9             | Female | 60  | Right base| Day 1            | 4         | 66         | 13           | 14                  | 3                   |
|               |        |     |           | Day 14           | 2         | 99         | 2            | 8                   | 2                   |
|               |        |     |           | Day 30           | 2         | 99         | 2            | 7                   | 1                   |
| 10            | Female | 61  | Left base | Day 1            | 3         | 67         | 14           | 19                  | 6                   |
|               |        |     |           | Day 14           | 2         | 73         | 2            | 6                   | 7                   |
|               |        |     |           | Day 30           | 2         | 88         | 2            | 4                   | 2                   |

capsules, bilateral buckle straps, bilateral hippocampal gyrus. ① For the normal group, compare the anisotropy index and the average value of the average diffusivity of the regions of interest on the left and right sides; ② For the patient group, enter the three time points at the 1, 14, and 30 days of the group. The average values of the anisotropy index and the average diffusivity of the regions of interest in the center, affected side, and healthy side were compared with the corresponding regions in the normal group. ③ The directions of the regions of interest in the center, affected side, and healthy side of the patient group were compared. The average values of the heterosexual index and the average diffusivity were compared longitudinally at three time points: 1, 14, and 30 days after enrollment. ④ On the basis of DTI data processing, reconstruct the diffusion tensor fiber tracer (DTT map) to fully show the integrity and direction of the white matter fiber bundle.

Statistical analysis was performed using SPSS 19.0 software package. Measurement data are expressed as mean ± standard deviation (z ± s). First, a normal test is applied. If the data is normally distributed, homogeneity test of variance is performed, t test and paired t test are performed; if the data is non-normal distribution, A rank sum test and a paired rank sum test are performed. The correlation between the main parameters of functional magnetic resonance imaging results and the scale score is tested. If the data is normally distributed, the correlation test is used. If the data is non-normally distributed, the correlation test is used. Statistical results were statistically significant with P<0.05.

The patient group was 10 patients with acute ischemic stroke, and the normal group was 10 normal persons. There was no study dropout between the two groups of study subjects.

The infarcts of these 10 patients were all on one side of the basal ganglia or radiocoronary region. Clinical information was collected at three time points: day 1, day 14 and day 30, as shown in Table 1.
TABLE 2. Comparison of anisotropy values on the left and right sides of the region of interest in the normal group.

| Area of interest          | Partial anisotropy | P    |
|---------------------------|--------------------|------|
| Corticospinal tract Left  | 0.5787 ± 0.04290  | 0.163|
| Corticospinal tract Right | 0.5640 ± 0.02540  |      |
| Medial mound Left         | 0.5645 ± 0.02859  | 0.078|
| Medial mound Right        | 0.5878 ± 0.02665  |      |
| Brain feet Left           | 0.6739 ± 0.03271  | 1.002|
| Brain feet Right          | 0.6739 ± 0.03308  |      |
| Inner capsule forelimb Left | 0.5428 ± 0.02831 | 0.056|
| Inner capsule forelimb Right | 0.5533 ± 0.03701 |      |
| Inner capsule hindlimb Left | 0.6647 ± 0.02773 | 0.342|
| Inner capsule hindlimb Right | 0.6723 ± 0.02788 |      |
| Front of radiation crown Left | 0.4657 ± 0.02898 | 1.003|
| Front of radiation crown Right | 0.4657 ± 0.04190 |      |
| Upper radiation crown Left | 0.4763 ± 0.03473 | 0.256|
| Upper radiation crown Right | 0.4782 ± 0.02641 |      |
| Posterior crown Left      | 0.4628 ± 0.02872 | 0.008|
| Posterior crown Right     | 0.4829 ± 0.02627 |      |
| Upper longitudinal beam Left | 0.4883 ± 0.02335 | 0.254|
| Upper longitudinal beam Right | 0.4829 ± 0.02815 |      |
| Lower longitudinal bundle Left | 0.5171 ± 0.02796 | 0.378|
| Lower longitudinal bundle Right | 0.5225 ± 0.03012 |      |
| Outer capsule Left        | 0.4385 ± 0.02586 | 0.735|
| Outer capsule Right       | 0.4346 ± 0.02432 |      |
| Buckle harness            | 0.5258 ± 0.03767 | 0.067|
| Hippocampus Left          | 0.5326 ± 0.06754 | 0.724|
| Hippocampus Right         | 0.5243 ± 0.03709 |      |

The anisotropy values of the left and right sides of the normal region of interest in the normal group were compared. The normal distribution test showed a normal distribution. After the paired t test, the anisotropy value at the back of the radiation crown was higher on the right than on the left. The difference is statistically significant (P<0.05), as shown in Table 2 and Figure 3.

Comparing the MD(Mean Deviation) values of different regions of the normal region of interest, there are some differences in the MD values of different partitions, among which the curvature MD value is the largest, and the pontine tract MD value is the smallest, as shown in Table 3 and Figure 4.

The DTT(Brain nuclear magnetic white matter fiber bundle imaging) map was reconstructed based on the DTI data of the patient group, which can clearly show the changes of white matter fiber bundles in patients with acute ischemic stroke. For example, in one of the patients, the infarct site was the right basal ganglia area. On the first day of enrollment, the national institutes of health stroke scale score was...
PATIENTS WITH DTI STROKE

The fugl-meyer assessment scale gives three scoring levels: 0 points, that is, the neural function is significantly damaged; 1 point indicates that part of the exercise can be performed, but the intensity, speed and accuracy are weakened than normal; 2 points represent slowness / both of them are incorrect, 3 points represent complete obstacles, and 9 points represent amputations. The barthel scoring items include urine, grooming, toileting, eating, activities, dressing, going up and down stairs, and bathing. Each item is divided into three levels: 0, 5, and 10. The larger is the fugl-meyer assessment and the barthel, the lighter the functional impairment, and the larger the national institutes of health stroke scale, the greater the injury.

B. DTI IMAGE POST-PROCESSING

First use dcm2nii software to convert the original .dcm image file into three-dimensional images that SPM can process. Then use SPM8 toolkit to align 30 dispersion-weighted images to non-dispersion-weighted B0 images to reduce the effect of head movement.

Using the Diffusion Toolkit software, an interpolated streamline dispersion algorithm was used to track whole brain fiber bundles for each subject’s pre-processed DTI image. The tracking stop threshold was: partial anisotropy $>0.15$, and tracking angle $<350$ to obtain various dispersions parametric images: anisotropic diffusion parameter images, apparent diffusion coefficient images, diffusion-weighted images, and whole brain fiber bundle images.

Taking the peak coordinates of the brain regions with different anisotropy values between stroke patients and normal elderly as the center, the surrounding 27 individual pixel points were selected as the region of interest (ROI). The partial anisotropy of the ROI before and after treatment was measured separately value.

Brain regions with structural changes in patients with motor dysfunction after stroke: left inner capsule hind limbs, bilateral inner capsule forelimbs, and bilateral umbilical muscle radiation. The anisotropy values of the above regions were reduced ($t = 1.71$, $p < 0.05$, uncorrected). In post-stroke patients with motor dysfunction, the left inner capsule hindlimb, the left radiation crown, and the right part of the medullary anisotropy and fugl-meyer assessment scores were positively correlated ($r = 0.70$, $p = 0.003$; $r = 0.61$, $p = 0.010$, as shown in Figure 6).

In this study, DTI technology was used to observe the brain white matter fiber microstructure damage in patients with stroke. Before treatment, 15 patients with stroke had lower anisotropy compared with normal subjects, including the left inner capsule hindlimbs, bilateral inner capsule forelimbs, and bilateral double capsules. Radiation front of lateral umbilical muscle, bilateral radiating crown, umbilical body, pressure, left central anterior gyrus and right medullary part. Some studies based on DTI on the anisotropy value of the cortical spinal cord in the affected side have reached a unified conclusion: the anisotropy value of the cortical spinal cord in the affected side of patients with stroke is reduced. DTI and exercise score data were collected at 1 week, 4 weeks, and 12 weeks, respectively, and compared with normal and age-matched normal people. It was found that with time,

III. EFFICACY OF EXERCISE REHABILITATION IN PATIENTS WITH DTI STROKE

A. CLINICAL MOTOR FUNCTION SCORE

Three types of scales, national institutes of health stroke scale, and barthel were used to evaluate motor function impairment, neurological deficits, and daily living ability after stroke. The fugl-meyer assessment scale gives three scoring levels: 0 points indicate that a certain exercise cannot be performed, 1 point indicates that part of the exercise can be performed, but the intensity, speed and accuracy are weakened than normal, and 2 points indicate that a certain action can be successfully completed. The upper and lower limbs were tested 33 items each (66 points) and 17 items (34 points). The 33 scoring items for the upper limb include movement, reflex, and coordination tests for shoulders, elbows, forearms, wrists, and hands. The 17 scoring items for the lower limbs include movement, reflexes, and coordination of the narrow, knee, step, heel, and foot. The national institutes of health stroke scale score is an evaluation of the overall condition of stroke patients, including consciousness level, gaze, visual field, facial paralysis, upper and lower limb movements, ataxia of limbs, sensation, speech, dysarthria, and neglect. Among the indicators, 0 points represent normal, 1 point represents minor or partial obstacles/one is correct, 2 points represent slowness / both of them are incorrect, 3 points represent complete obstacles, and 9 points represent amputations. The barthel scoring items include urine, grooming, toileting, eating, activities, dressing, going up and down stairs, and bathing. Each item is divided into three levels: 0, 5, and 10. The larger is the fugl-meyer assessment and the barthel, the lighter the functional impairment, and the larger the national institutes of health stroke scale, the greater the injury.
cortical spinal cord the anisotropy value of the beam walking area, including the primary motor cortex on the affected side, the cerebral feet, and the auxiliary motor area, is reduced. Microstructural changes in stroke-related, upper and lower stroke area, and post-stroke motor-related white matter fiber pathways can occur early in the stroke. The corticospinal tract is the main pathway to control the voluntary movement of the limbs. In patients with stroke motor dysfunction, the white matter microstructure is damaged, and the water molecules are restricted from spreading along the axon, which is manifested in the lesion area and part of the motion-related white matter area away from the lesion. The heterogeneous value decreased, which is consistent with the conclusion of this experiment (left central anterior gyrus-left radiation crown-left inner capsule hind limb-right medullary).

According to the scale scoring criteria, it can be known that the higher the National Institutes of Health Stroke Scale score and the lower the Barthel Index score, the more severe the neurological dysfunction and the poorer self-care ability. Therefore, it is positively related to the National Institutes of Health Stroke Scale and negative to the Barthel Index. Correlation means that the clinical manifestations of neurological function are worse. It can be seen that the poor recovery of patients’ function may be related to the reorganization of white matter fibers near the bilateral motor cortex. Although previous studies have shown that fiber reorganization has a positive significance for motor function recovery, fiber reorganization may also contribute to rehabilitation because it promotes functional compensation. The effect has an adverse effect. Combined with the results of DTI in this study, bilateral hemisphere cortex in patients with stroke may have abnormally enhanced or weakened functional connections at the same time, and the abnormally enhanced functional connections mainly exist between the cortex and the basal ganglia in the ipsilateral hemisphere. Reduced functional connections exist between the cortex and the contralateral basal ganglia, suggesting that fiber reorganization of the bilateral cortex that is not clinically effective may have a certain relationship with the enhancement of abnormal functional connections in the hemisphere. The effect of rehabilitation effect may not only be related to the functional area positioning, but also the connection relationship between different brain areas, and its specific fiber connection needs to be further explored in future research.

C. EVALUATION OF EXERCISE EFFECTS IN PATIENTS WITH STROKE

All patients in the movement observation group and the conventional rehabilitation treatment group were given the same conventional rehabilitation treatment by the same rehabilitation therapist, including exercise therapy, muscle training, exercise relearning, neuromuscular electrical stimulation, acupuncture treatment, routine operation treatment, 2 times a day, 5 days a week. For a total of 8 weeks. Patients in the motion observation group were given motion observation therapy at the same time, observed in a quiet environment specific video materials, and instructed the patients to imagine and imitate the observed movements twice a day, 30 minutes each time, 5 days a week for a total of 8 weeks. Patients in the conventional rehabilitation data group were given comfort video treatments that did not include people and human movements, twice a day, 30 minutes each time, 5 days a week, for a total of 8 weeks.

All video materials were completed by the same model and required to be completed with left and right limbs respectively to accommodate patients with left or right hemiplegia after stroke. The main actions of the action video content include: pointing the thumb with other fingers, grasping empty-handed, grasping the ball, grasping the cylinder, withdrawing money from the wallet, opening and using an umbrella, pinching coins, screwing the bottle cap, using a key to open the door, There are 20 videos of upper limb movements in writing with a pen, drinking water with a spoon, using chopsticks, pulling a zipper, holding a mouse, using a computer, using a mobile phone, turning a book, brushing teeth, washing your face, and combing your hair. Each action video is about 10-30 seconds, and each action video is equipped with a synchronized voice prompt during playback.

The main outcome measures were modified to evaluate the daily living ability of stroke patients using the modified Papillon index scale. The secondary outcome measures were Rankin Scale (mRS) to qualitatively assess the motor function and muscle tension of patients at different time points. The Modified Papillon Index Scale is the most commonly used assessment scale for living activities, with a total of 10 items, including eating, bathing, dressing, washing, dressing, controlling stool, controlling urination, toileting, bed and chair transfer, walking, going up and down stairs, etc. The total score is 100 points. Based on the score, it can be used to distinguish the degree of disability. 0-20 points: complete disability, complete dependence on life; 20-40 points: severe dysfunction, obvious dependence on life; 40-60 points: moderate dysfunction, life needs help; more than 60 points: basic self-care.

The modified Rankin scale is a commonly used scale for assessing the prognosis and functional disability of patients with stroke. It can assess the independent living ability of patients, and is easy to operate. By simply asking the patient or family members, the corresponding score can be obtained. Good reliability and authenticity, compared with modified Barthel index, the disadvantage is that mRS lacks specific indicators of daily life, the evaluation method is relatively subjective, and it is susceptible to other factors. The scale is an application grade score, which is divided into 7 grades, with 0 being asymptomatic and 6 being death. When evaluating the prognosis, a score of <2 was considered a good outcome. The mRS scores were assessed at the time of enrollment, 8 weeks, and 12 weeks later.

Data analysis was performed using the SPSS 22.0 statistical software package. The patient’s modified Barthel index score and mRS score were measured data, which were
expressed as (x ± s). For data analysis, repeated measurement analysis of variance was performed first, and then performed at different time nodes the stratification was used to compare the differences in modified barthel index and mRS scores between the action observation group and the conventional rehabilitation treatment group at the time of enrollment, 4 weeks, 8 weeks, and 12 weeks. The comparison between different time nodes in the group uses repeated measurement analysis of variance, and the pairwise comparison between different time points uses Bonferroni test. The test level was bilateral α = 0.05, and P < 0.05 indicated that the difference was statistically significant.

For mRS score comparison, repeated measurement analysis of variance was first performed. The group factor analysis result was (F = 6.79, P = 0.01). The time factor analysis result was ((F = 774.79, P = 0.00). The factor analysis results were (F = 2.455, P = 0.12); and then stratified by time to compare the differences in mRS scores between the conventional rehabilitation group and the action observation group at the time of enrollment, 4 weeks, 8 weeks, and 12 weeks. Using the t-test method comparing the two sample means and using the t-test method comparing the two samples, it can be seen from Table 4 that there was no statistical difference in the mRS scores between the action observation group and the conventional rehabilitation group at the time of enrollment, and that at treatment 4 At the follow-up of weeks, 8 weeks, and 12 weeks of treatment, the mRS scores of the action observation group were significantly higher than those of the conventional rehabilitation group; and then stratified by groups to compare time points to compare the patients in the movement observation group and the conventional rehabilitation treatment group. Groups, 4 weeks, 8 weeks, 12 weeks and other different time points of the different mRS scores, using repeated measurement analysis of variance, the results show that the movement observation group, conventional rehabilitation treatment group patients at 4 weeks, 8 weeks, 12 weeks, etc. There are significant differences in the mRS scores of time nodes, and the mRS scores are all significant. Plus trend. Specific results can be seen in Table 4 and Figure 7.

Modified barthel index is one of the most widely used scales for assessing the ability of daily living activities of patients with stroke. It has high validity and reliability, and repeated measurements do not affect its reliability. It can be repeated multiple times at the same time for the same patient. Modified barthel index also has good structural validity and reliability for stroke patients in China. The improved scale mainly assesses the independent living ability of patients, and is often used to evaluate the prognosis of patients with stroke and the efficacy of functional disability during rehabilitation. The scale is an application scale score scale with a total of 7 levels. A score of 0 indicates asymptomatic. The score of 6 indicates death. A score of <2 indicates a good outcome. The scale is easy to operate and can be scored by simple inquiry. It also has good reliability and authenticity. Compared with modified barthel index, mRS uses walking ability as a clear scoring standard, but there are no other details of specific indicators of daily life. The evaluation method is relatively subjective. It can be used in combination with modified barthel index. The results in this section show that the general data and modified barthel index scores of patients in the movement observation group and the conventional rehabilitation treatment group were not
IV. EVALUATION OF THE EFFECT OF MAGNETIC RESONANCE DTI ON STROKE REHABILITATION

DTI data acquisition uses a single-shot spin-echo planar imaging (SE-EPI) sequence. Scanning parameters: TR / TE = 10000ms/90ms, flip angle 90°, layer thickness 2mm, layer spacing, layer number 75, field of view 256mm. Each layer collects 33 directions, where the b value in the first direction spacing, layer number 75, field of view 256mm Each layer = imaging (SE-EPI) sequence. Scanning parameters: TR / TE, DTI data acquisition uses a single-shot spin-echo planar.

Observation group: The patients received traditional rehabilitation training, including exercise therapy, balance training, occupational therapy, acupuncture therapy, and functional electrical stimulation therapy. Each of the above treatments was performed for 30 min, 1 time / d, 6 times a week, and the treatment was continued for 4 weeks. At the same time, on this basis, he received brain-computer interface rehabilitation training 5 times per week, 1 hour each time, and continued training for 20 times for 4 weeks.

Control group: In addition to the same amount of traditional rehabilitation training as the observation group, the patients also received physical feedback training of lower limb flexion and extension for the same duration as the observation group. Physical feedback training of lower limb flexion and extension was performed 5 times a week for 1 hour, and the treatment was continued for 20 times for 4 weeks.

The brain-computer interface system includes a computer, an EEG (electroencephalography) amplifier, a physical feedback device for the lower limbs, and an EEG cap to collect the user’s original EEG signals, as shown in Figure 8. Before performing brain-computer interface rehabilitation training, all patients should be trained in motor imagination: “…appears on the screen, indicating a break between treatments,” ↑, which indicates the start of treatment, ↑, ↓, respectively, indicates the extension and flexion of the affected leg, θ means stand still without any imagination. The patient uses a sitting position and places his legs where he can see; when the “↑” appears on the screen, he starts to prepare for imagination, and then makes relevant imaginations according to the prompts that appear on the screen; during motor imagination, Minimize physical movements such as movements of the limbs; when the system requires “still / no imagination”, the patient needs to hold his breath as much as possible, staring at the screen without doing any brain movement. The method of imagination requires the patient to repeatedly practice to ensure that they have only after fully understanding the required steps. When collecting the patient’s EEG signals, once a certain kind of motor imaging method, static and
Brain-computer interface rehabilitation training includes: model acquisition training, monitoring test training, rehabilitation training. Acquisition training is the most important part of the training process. There are 4 rounds in which the patient repeatedly imagines the flexion and extension of the affected lower limb as a training task, each round is about 8 minutes, with an interval of 2 minutes. The purpose of acquisition training is to model each patient and determine its response to motor imagination according to the different EEG conditions of the patient’s brain. After completing the collection, it is necessary to monitor the test once for a total of 8–10 minutes, and then systematically evaluate the imagination accuracy of brain-computer interface. The accuracy rate is greater than 50% and the rehabilitation training will start the next day. The specific form of rehabilitation training is: at the beginning of training, a “+” appears on the computer screen and is ready to perform imagination with a vibration prompt, and then ↑, ↓ appears on the screen to indicate the extension and flexion of the knee and knee of the affected leg. Then, the EEG acquisition device performs decoding analysis based on the collected EEG signals, and finally determines whether it is correct to give the patient a passive motion feedback of the lower extremity (a passive lower limb knee flexion and extension), and finally the rest process. The above is a complete training process, 40 times/group.

### B. EVALUATION OF MOTOR FUNCTION REHABILITATION THERAPY

After the health education and rehabilitation education during the investigation, we found that the number of people willing to undergo rehabilitation treatment increased from 221 to 368 (of which 2 people who were still unwilling to undergo rehabilitation treatment had significant depression), and finally received in-hospital rehabilitation and the number of family rehabilitation was 269. Further analysis was made on the factors affecting the rehabilitation of 101 people who did not continue their rehabilitation. As is shown in Table 5 and Figure 9.

| variable                        | n   | Percentage |
|---------------------------------|-----|------------|
| Cost problem                    | 26  | 23.5%      |
| I don't know about rehabilitation| 24  | 22.5%      |
| Too far                         | 23  | 22.9%      |
| I do n't want to change         | 2   | 0.74%      |
| I do n’t want to participate    |     |            |
| Not convinced of the healing effect| 3  | 4.36%      |
| No time                         | 6   | 6.83%      |
| Without family                  | 17  | 18.6%      |

The main factors affecting the rehabilitation of patients and their families after stroke are the following: 26 people (23.5%) because of cost problems, 24 people (22.5%) who do not know about rehabilitation, and 23 people (total distance) 22.9%, 17 people (18.6%) without family members, and the patients themselves felt that there were 6 people (6.83%) without time; 3 people (4.36%) did not believe in the effect of rehabilitation, and only 2 people (accounting for 0.74%) do not want to change the status quo, do not accept participation in rehabilitation treatment.

The analysis results showed that the patient’s symptoms knowledge, high risk factors knowledge, treatment knowledge awareness rate, total score and age, education level, history of first stroke and surrounding relatives with or without stroke history were all statistically significant. The knowledge of knowledge has a significant correlation with its own education level; the statistical significance of age and knowledge understanding may be because respondents generally less than 60 years of age have a higher education level than those over 60 years of age, which is not completely Exclude the results that age and education affect each other. According to the results of surveys in various places in China, the effects of age, education level, and occupation are all influential factors on disease knowledge and awareness of stroke patients. Studies have further explored the impact of...
the lack of disease knowledge and found that the knowledge of disease knowledge has a significant impact on compliance, onset and consultation time, etc. This will further affect the grasp of rescue timing and mortality in the acute phase of stroke, and may affect the Residual rate. This experiment is aimed at re-stroke patients and patients with relatives and friends who have suffered a stroke. The comparison of disease knowledge with other patients is statistically significant. The relevant studies in China have confirmed that medical personnel’s understanding of rehabilitation treatment is also not optimistic. This shows that during the previous illness (including the illness of relatives and friends), patients and their families learned and improved their knowledge about stroke through their own experiences, medical staff’s missions, the influence of surrounding patients, books, newspapers, and the Internet. In the middle of the 20th century, developed countries such as Europe and the United States began to conduct research on the knowledge and impact of disease knowledge, noted the importance of education on stroke disease knowledge, and established specialized educational institutions. For example, the Mississippi State Stroke Education Commission promotes stroke knowledge through radio, newspapers, magazines, television and other media. Based on this, we can see that the education level of the respondent will affect their knowledge acquisition, but after health education (symptoms, etiology, high-risk factors, treatment methods, etc.), the patient’s understanding of the disease has improved significantly. Studies have pointed out that early health education can help improve patient compliance and rehabilitation participation. The results suggest that in the prevention and treatment of stroke, we should pay full attention to the role of medical staff and patients themselves, make full use of their impact on the surrounding population, and spread relevant medical knowledge through them to improve the population’s awareness of the disease. Fully embodies the important role of health education in disease prevention. At the same time, we should take people with low educational level and older age as the focus of health education.

C. MOTOR FUNCTION ASSESSMENT

Simplified Fugl-Meyer motor function assessment: During the examination, the patient is required to complete standard movements in a specific position. At the same time, the examiner determines the score by touching the abdominal muscles and observing the degree of completion of the movement. It is mainly divided into the evaluation of upper and lower limbs: ① The upper limb mainly includes 9 parts including upper limb reflex activity, common flexor muscle movement, common extensor muscle movement, activity accompanied by common movement, and separation activity. During the joint extensor exercise test, let the patient touch the healthy knee with the affected upper limb, taking care to prevent the patient from using gravity to replace active movement, rotate the chest, or swing the affected limb; the examiner can assist the patient to maintain the posture during the wrist stability check; Coordination and speed tests should be ordered to close the eyes and repeat 5 times quickly. Upper limb examinations were performed in the sitting position. ② The lower limbs mainly include 6 parts, common motion, joint common motion, and separation motion. The flexor muscle joint exercise test should allow the patient to flex the medulla, knee flexion and step back flexion to the greatest extent; the common position of the extensor muscle flexion exercise should be the position of the flexor muscle common exercise, allowing the patient to stretch the marrow, knee and step, and apply resistance In order to eliminate the alienation of resistance,. The adduction of the medullary joint can be evaluated with the extension of the medullary joint; during the coordination and speed test, the affected heel should be touched to the healthy knee 5 times, and it should be performed continuously as soon as possible. Upper limb examinations were performed in the sitting position; lower limb examinations were performed in the supine, sitting, and standing positions. During the examination, try to complete the relevant content of the required examination in one posture to avoid the patient’s physical consumption caused by the change of posture, which will affect the accuracy of the results.

Magnetic resonance imaging: During the examination, the patient is required to complete standard movements in a specific position, and the examiner determines the score by observing the degree of completion of the movements. In addition to the four stairs and running up and down to observe, the other items can be inquired, which can be used for anisotropy assessment Assess magnetic resonance imaging to prevent patients from repeating the same actions and assessments.

Modified Barthel Index: During the examination, the patient is required to complete standard actions under the conditions of reduced gravity, anti-gravity, and resistance in a specific position. At the same time, the examiner touches the abdomen of the muscle, observes the movement of the muscle and the range of motion of the joint, and the ability to overcome resistance to determine muscle strength. Patients are required to actively participate and cooperate. Examiners must mobilize appropriately before the test to avoid changes in the subjective effort of patients and affect the reliability of test results. Strictly follow the test specifications to improve the comparability of test results. Muscle testing should not be performed in fatigue, meals, or in environments where the subject has been disturbed. If the patient has joint instability, poor fracture healing, acute exudative synovitis, severe pain, extremely limited range of motion of the joint, acute sprain, tumor of bone and joint, etc., the muscle strength test should not be performed. At the same time, if the patient is accompanied by limited joint movement at the same time when the force is reduced, the range of joint movement should be marked when recording the muscle strength test result, indicating that the muscle strength is the test result within the range of joint movement.
Modified ashworth scale: Patients need to actively participate and cooperate during the test. The examiner must mobilize appropriately before the test to prevent the patient’s subjective effort from changing and affecting the reliability of the test results. And try to avoid the following factors that affect the results of the modified ashworth scale assessment: (1) the interaction of body position and limb position with stretch reflex; (2) the state of the central nervous system; (3) psychological factors, such as tension, anxiety and other psychological factors; (4) patients’ Competent role; (5) taking certain drugs, such as tonic drugs.; (6) the overall health level of the patient; (7) ambient temperature; (8) others, such as opacity (filling or emptiness), fever and infection, metabolism and / or Effects of electrolyte disorders.

BerG balance scale: Before the test, the examiner introduces and guides the patient to the item. If the test is bilateral or the test is unsuccessful once and needs to be tested again, the minimum score for this item is recorded when scoring. In most projects, patients need to stay in the required position for a certain period of time. If the required time or distance cannot be reached, or the patient’s activities require monitoring, or the patient needs external support or the help of the examiner, they will be given according to the evaluation criteria. Patients need to realize that they must maintain balance while completing each task, as to which leg to stand or how far forward depends on the patient. And the inspector should clearly evaluate the standards to ensure the reliability of the test results. The test content mainly includes 14 items: standing up, sitting down, standing independently, standing with eyes closed, upper arm forward extension, turning around for a week, alternately stepping on both feet with steps, standing on one leg, etc. The test generally needs to be completed within 20 minutes. Evaluation tools: a stopwatch or a watch with a second hand, a ruler, or a measuring ruler with a 5, 12, 25cm scale. The chair required for the test should be of a moderate height. One of the 12 tasks will be used.

All motor function assessments need to be performed in a quiet, independent environment to avoid the impact of the external environment on the patient’s attention; and to protect the patient from falling during the test.

Exercise therapy is performed according to the specific dysfunction of the patient. The therapist mainly conducts passive movement training for hemiplegia limbs, including: comprehensive rehabilitation training for hemiplegia limbs, joint loosening training, joint compression training, active muscle training, bridge exercise, sitting position and Standing position balance training, etc. The treatment time is 20-30 minutes / time, 1-2 times/day.

Electric riser training: For patients with stable vital signs, according to the principle of gradual and progressive, under the condition of patient tolerance, gradually increase the standing angle, the treatment time is 20 minutes / time, once / day.

Rh41 was significantly higher in the aerobic exercise group than in the control group (13.42.29 points vs.6.73 ± 1.28 points), P = 0.000< P<0.05); the Berg balance scale score of the aerobic group was significantly higher than the control group (10.13 ± 2.75 points vs7.73 ± 0: 7 points), and the combined exercise group was significantly higher than the aerobic group (16.53 ± 2.17 points vs10), P = 0.000, P<0.05); the upper limb s-mffugl-meyerassessmenta of the aerobic exercise group was significantly higher than the control group (23.676.49 points vs 21.8 ± 1.47 points), and the upper limb s-mffugl-meyerassessmenta was significantly higher than the aerobic exercise group (28.67 ± 3.66 points vs 23.67 ± 6.49 points), P = 0.000 (P<0.05); the lower extremity s-mffugl-meyerassessmenta of the aerobic group was significantly higher than the control group (20.7312.71 points vs 18.1 persons 1.36 points), the lower limb s-mffugl-meyerassessmenta in the combined exercise group was significantly higher than the aerobic group (28.53 persons 3.96 points vs 20.73 persons 2.71 points), P = 0.000 (P<0.05). See Table 6, Figure 10 for details.

Disability in patients with stroke is mainly manifested in two aspects, motor dysfunction. Motor dysfunction affects the decline of the patient and leads to the decline of the patient’s exercise endurance, which in turn further limits the improvement of the patient’s exercise capacity and puts the patient into a vicious circle. Therefore, the quality of life is an indispensable part in the evaluation of aerobic and resistance exercise rehabilitation effects. The quality of life assessment mainly uses the Barthel index as its main evaluation index, but its effectiveness in clinical trials has been reduced due to the large differences in each score. Therefore, in recent years, there has been a large amount of literature to support the assessment of the quality of life of stroke patients. At the same time, intelligence and mental state are also important components of quality of life assessment. This experiment uses a comprehensive assessment of changes in patients’ quality of life after aerobic and combined exercise. The results showed that the three groups had statistical significance before and
after the intervention, that is, rehabilitation treatment was beneficial to the patient’s cognitive and psychological state. In the comparison between the groups, it was shown that all evaluation indicators except MMSE showed significant differences after 4 and 8 weeks of aerobic and combined exercise intervention, and all had statistical significance. The improvement of the combined exercise group was more significant than that of the aerobic exercise group. This indicates that combined exercise is of great benefit to improve the quality of life of patients. The MMSE in the combined exercise group and the aerobic exercise group showed a significant increase in all relevant evaluation scores after 4 weeks, and there was statistical significance. Although the scores were still increased after 8 weeks of intervention, there was no statistics between the groups. significance. These are consistent with some foreign studies showing that early aerobic or resistance exercise improves the quality of life, which also shows that aerobic and resistance exercise, especially combined exercise is meaningful for improving quality of life, and should be carried out as soon as possible.

V. CONCLUSION

The combination of DTI can be used to observe the changes in plasticity of brain function from different perspectives of function and structure. Scalp acupuncture does not completely change the functional connection and white matter fiber structure of patients with post-stroke hemiplegia. The direct connection of the microfibrous structure cannot fully explain the functional connection and reflect the plasticity changes of the central nervous system from different dimensions. It is feasible to apply DTI training to the lower extremity rehabilitation training for stroke thinkers. The traditional rehabilitation therapy combined with DTI training can more effectively improve the lower extremity function and daily living ability of stroke patients. Regarding the mechanism by which the DTI training system promotes neurological remodeling in patients with stroke, future studies can further clarify the characteristics of the brain activation area when performing functional imaging of the lower limbs using functional magnetic resonance imaging. For changes in neural electrical signals, further analysis can be performed with the help of related software programs, in order to predict and judge the rehabilitation efficacy and prognosis of stroke patients in the later stage, and provide guidance for clinical treatment, thereby improving the effectiveness and targeting of treatment and facilitating the later clinical promotion.; Further promote the rehabilitation of lower limb motor function in patients with stroke and hemiplegia. The next step is to stimulate the primary motor cortex of the affected side with high frequency to promote the structural reorganization and function improvement of the brain of patients with acute ischemic stroke, and the DTI parameter value will be used as a tool to study structural plasticity and can effectively prevent the therapeutic effect.

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