ISSN: 3065-5196
Research Article

World Journal of Molecular Medicine

A Clinical Study on the Improvement of Abnormal Gait in Children with Spastic Cerebral Palsy by the Integrative Medicine

Wang Hui[1], Song Hujie[1*], Liu Yan[1], Zhu Chaohui[1], Zhou Mengmeng[1], Bai Xinchao[1], Jiao Wenli[1], & Jiao Fuyong[2*]

[1]*Xi'an TCM Hospital of Encephalopathy, Xi'an 710032, China*
[2]*Children's hospital of Shaanxi Provincial People's Hospital, Xi'an, 710068, China*

[*]**Corresponding author:** Song Hujie, Xi'an TCM Hospital of Encephalopathy, Xi'an 710032, China.

Jiao Fuyong, Children's hospital of Shaanxi Provincial People's Hospital, Xi'an, 710068, China.

Submitted: 14 October 2024 **Accepted:** 21 October 2024 **Published:** 28 October 2024

https://doi.org/10.63620/MKWJMM.2024.1008

Citation: *Wang, H., Song, H., Liu, Y., Zhu, C., Zhou, M., Bai, X., Jiao, W., & Jiao, F. (2024). A Clinical Study on the Improvement of Abnormal Gait in Children with Spastic Cerebral Palsy by the Integrative Medicine Word Jour of Molecule Medicine, 1(4), 01-07.*

Abstract

Objective: *On the basis of real-world clinical studies, to investigate the clinical effect of the integrative medicine on improving abnormal gait in patients with spastic cerebral palsy, and to measure the gait data of patients before and after treatment with a foot space gait assessment and analysis system, in order to provide effective treatment methods for patients with spastic cerebral palsy.*

Methods: *Patients with spastic cerebral palsy were chosen for the study who met the inclusion criteria and were treated in Xi'an Brain Hospital of Traditional Chinese Medicine from July 2021 to December 2021.*

They were divided into the observation group and the control group by using a non-randomized controlled clinical study method, with 60 cases in each group. The control group was treated with modern rehabilitation techniques. In addition to this, the observation group was also treated with Traditional Chinese Medicine (TCM) therapy. The gait data of patients before and after treatment were measured by using a foot space gait assessment and analysis system. Results:

The total efficiency of the observation group was 96.67%, and the total efficiency of the control group was 86.67%.

Conclusions: *The study has shown that, both the integrative medicine and modern rehabilitation therapy can improve the abnormal gait of spastic cerebral palsy and enhance the walking ability of children with CP. Besides, in terms of improving the abnormal gait of spastic cerebral palsy, the integrative medicine is more effective than pure modern rehabilitation therapy.*

Keywords: Spastic Cerebral Palsy, Gait Analysis, The Integrative Medicine, Foot Space Gait, Assessment Analysis

Introduction

Cerebral palsy (CP) is the result of non-progressive brain injuries, such as immature brain, congenital developmental defects or injuries. The prevalence of CP reported at home and abroad is 1.4‰–3.2‰. In China, the overall prevalence of CP in children aged 0–6 is about 0.23%. In recent years, due to the advancement of emergency rescue technology of newborns, the progress in perinatology and the change of human daily habits, the survival rate of newborns has improved significantly. The incidence rate of CP in China and even around the world has also increased year by year [1].

According to clinical manifestations, CP can be divided into spastic quadriplegia, spastic diplegia, spastic hemiplegia, dyskinetic, ataxia, Worster-Drought syndrome, and mixed types. Spastic quadriplegia, spastic diplegia, and spastic hemiplegia are collectively called spastic cerebral palsy. This is the most common type of CP in children, accounting for about 60%–70%. For

this type of child patients, the main cause of disease is spasticity triggered by damage to the pyramidal tract of brain. Although the positions are different, the symptoms are basically the same, all manifested as increased muscle tension, abnormal posture, dyskinesia and so forth. About 50% or more may experience lower limb dyskinesia. Patients demonstrate different abnormal gaits when walking.

This seriously affects patients' daily living ability, and increases the burden on the family and society. Therefore, how to effectively improve abnormal gait is now one of the most important rehabilitation goals for children with spastic cerebral palsy.
Gait analysis is an important index for assessing the motor ability of lower limbs. The foot space gait analysis system (Sennotech InsoleX1.0) used in this study is a portable gait analysis system that avoids the shortcomings of 3D systems very well. It is portable and easy to operate. The measurement data is objective, and the cost is low. So, this system is often used clinically to assess the rehabilitation treatment of spastic cerebral palsy gait [2].

In this study, the clinical efficacy of the integrative medicine on improving the abnormal gait of spastic cerebral palsy were mainly explored. The spatiotemporal parameters and kinematics parameters of patients with spastic cerebral palsy during walking were assessed quantitatively with the foot space gait assessment and analysis system. Then, appropriate treatment plans were developed for child patients. These measures contribute to improving the abnormal posture of children with SCP and improving their motor ability.

Data and Methods

Source of Cases

Patients with spastic cerebral palsy aged 1 to 18 were chosen for the study who met the inclusion criteria and were treated in Xi'an Brain Hospital of Traditional Chinese Medicine from July 2021 to December 2021. By utilizing a non-randomized controlled study method, cases that met the inclusion criteria and were treated with pure Western medicine rehabilitation therapy were included in the control group, and cases that met the inclusion criteria and were treated with the integrative medicine were included in the observation group, with 60 cases in each group [3].

The control group was treated with modern rehabilitation techniques, including therapeutic exercise, occupational therapy, and sensory integration training. The treatment was performed once a day, and 30 minutes each time. It lasted for 3 months, and 5 days a week. In addition to the treatment of the control group, the observation group was also treated with TCM, including acupuncture, massage, and TCM bathing treatment.

Diagnostic Criteria of Disease

According to the definition, diagnosis, and clinical classification of spastic cerebral palsy in 2022 "Chinese rehabilitation guidelines for cerebral palsy", and the fifth chapter of "Chinese rehabilitation guidelines for cerebral palsy (2022 edition)": in TCM rehabilitation therapy, strong liver and weak spleen in TCM syndrome differentiation of cerebral palsy is the diagnostic basis. For clinical diagnosis, it is necessary to combine with motor function scores, nervous system examination, imaging, biology and other indexes for comprehensive judgment [4].

Essential Conditions

- Central movement disorders exist permanently.
- Abnormal development of movement and posture.
- Abnormal muscle tension and myodynamia.
- Abnormal reflex development.

Reference Conditions

- There is etiological basis for the cause of CP.
- Cranial imaging may be used as evidence (52%–92%).\

Inclusion Criteria

- Those whose first diagnosis meets the diagnostic criteria of spastic cerebral palsy as well as the strong liver and weak spleen type in five kinds of retardation and five kinds of stiffness;
- Patients aged 1 to 18;
- Those who are able to walk independently for more than 1 minute;
- Those whose statutory guardian agrees and signs the informed consent form.

Exclusion Criteria

- Those whose first diagnosis doesn't meet the diagnostic criteria of spastic cerebral palsy as well as the strong liver and weak spleen syndrome in five kinds of retardation and five kinds of stiffness;
- Those whose cognitive function is poor and cannot cooperate with the assessment;
- Those who cannot walk independently for more than 1 minute;
- Those who are accompanied by epileptic seizure and poor epilepsy control;
- Those who have other lesions and are not suitable to participate in this trial.

Dropout Criteria

- Those who met the inclusion criteria and have been included in one of the groups, but did not participate in the therapy for some reason;
- Those who experienced adverse reactions or other unexpected events during the therapy and are not suitable to continue with the trial;
- Those who had poor compliance and failed to follow the prescribed plan for treatment;
- Those who refused to cooperate and withdrew from the trial at their discretion.

Study Methods

Treatment Methods

Treatment of Control Group

The control group was treated with modern rehabilitation techniques, including therapeutic exercise, occupational therapy, and sensory integration training. The treatment was performed once a day, and 30 minutes each time. It lasted for 3 months, and 5 days a week [5].

Treatment of Observation Group

In addition to the treatment of the control group, TCM therapy was also included, such as acupuncture, massage, and TCM bathing treatment.

Acupuncture Therapy

Main acupoints of scalp acupuncture: anterior oblique line of vertex-temporal, lateral line 1 of vertex, lateral line 2 of vertex. Main acupoints of body acupuncture: bilateral Ganshu, Pishu, Taichong, Taibai,Yanglingquan, Sanyinjiao acupoints. Acupuncture method: for scalp acupuncture, strong stimulation was applied. For body acupuncture, the reducing method was used via Taichong acupoint, while other acupoints were mostly uniform reinforcing-reducing. Beishu acupoint was punctured without retaining the needle. and adjuvant points were selected according to local symptoms. The patients were treated 6 days a week, once a day, with a needle retention of 30 minutes each time. They took a rest for 1 day per week, and received 12 weeks of treatment as one course.

Massage Therapy

Lower limbs were massaged with rolling manipulation while passively moved. Acupoints of meridian of lower limb-Yangming were tapped and kneaded. For patients with Achilles tendon contracture, the plucking method was applied. For underpronation and overpronation, flaccidity of foot and so on, corresponding pulling-extending and pressing manipulations were used to balance and coordinate the relevant flexors and extensors and to correct joint deformities. The patients were treated once a day, and received one month of treatment as one course. A total of 3 courses of treatment were observed [6].

TCM Bathing Treatment

The prescription of TCM bathing: 50g of baked Astragalus, 30g of white peony root, 20g of Chuanxiong, 30g of Poria, 30g of Spatholobi Caulis, 40g of Lycopodium clavatum, 30g of Tuberculate Speranskia herb, 20g of achyranthes root, 10g of baked Licorice root. The above medicines were decocted for 30 minutes. Then, 1000ml of the liquid was taken, and appropriate amount of water was added into it. The mixture was put into a medicated bath basin.

Operation: The room temperature was adjusted to 22–25°C, and the temperature range of medicated bath was between 38–40°C. The specific temperature can be adjusted according to the compliance of the child patient. The bath time is 10 minutes. After bathing for 10 minutes, the child patient was taken out and put in a lukewarm water bath to completely wash off the residual liquid on the child patient. The patients were treated once a day, and received one month of treatment as one course. A total of 3 courses of treatment were observed.

Observation Indexes

Efficacy Indexes

Symmetry, standard degree, stride length (m), stride height (cm), swing speed (cm/s), stance phase (%), contact phase (%), foot flat phase (%), forefoot push off phase (%), swing phase (%), heel-off angle (°), and toe-off angle (°) are included.

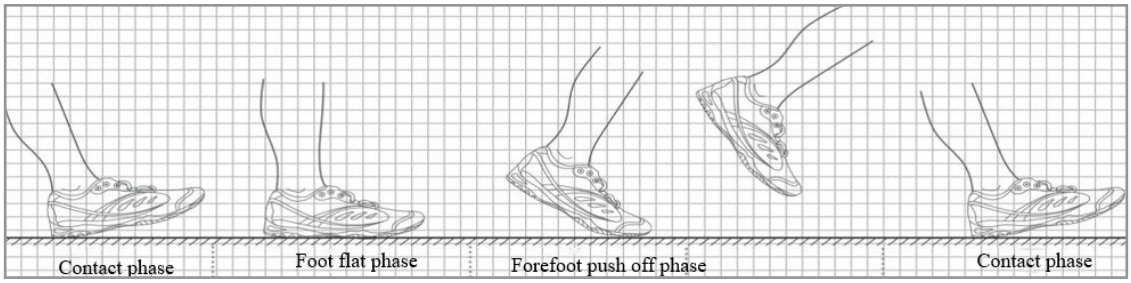

Figure: 1

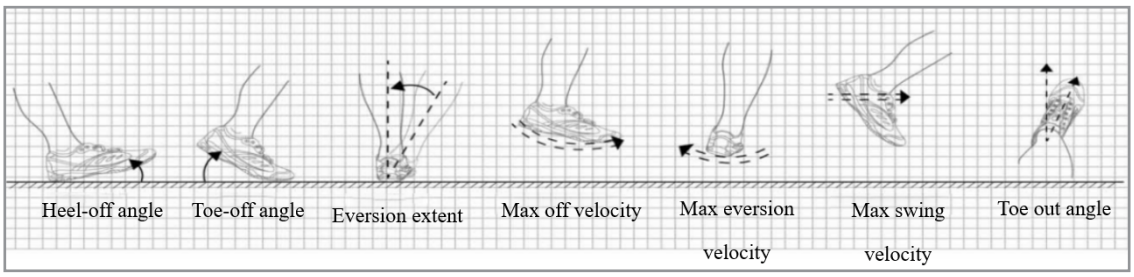

Figure: 2

Data Collection

In this study, gait data was collected with the foot space posture assessment system (Sennotech Insole X1.0). This system was developed by Shenzhen Sennotech Co., Ltd. It can obtain gait information dynamically and accurately. Moreover, the system can also conduct a comprehensive assessment of movement status through the cloud system, assess the motor coordination ability of lower limbs, and provide objective data as a reference standard for disease diagnosis and treatment as well as rehabilitation training.

Efficacy Assessment Criteria

According to the data index results measured before and after treatment, the efficacy is divided into three levels: significantly

effective, effective, and invalid:

- **Significantly effective:** improvement of key parameters of gait analysis ≥ 20%.
- **Effective:** improvement of key parameters of gait analysis 10%–20%.
- **Invalid:** improvement of key parameters of gait analysis <10%.

Safety Observation

During treatment, the adverse reactions of child patients were observed, such as rash, body temperature, syncope, urination and defecation, etc. In case of any adverse reaction, the occurrence time, symptom, severity and treatment method were recorded in time [7].

Statistical Method

A database was established using Microsoft Excel. Clinical data was analyzed with the statistical software SPSS 26.0. All statistical tests involved in this study were two-sided tests, with a significance level of α=0.05. Enumeration data was expressed with frequency or rate (%). Comparison was performed using c2 test. The statistical description of normally distributed measurement data was expressed with X±S. Comparison within groups was performed using paired samples t-test. Comparison between groups was performed using independent samples t-test. The difference of 0.05 was statistically significant.

Results

The Comparison of Baseline Data of the Two Groups was as follows:

Table 1: Comparison of Baseline Data of the Two Groups ($\bar{x}\pm s$)

Group	Number of cases	Gender		Age (years)	Height (cm)	Weight (kg)
		Male	Female			
The observation group	60	34	26	5.38±1.52	110.0±11.4	19.1±9.2
The control group	60	28	32	5.69±1.27	107.5±8.8	18.7±3.3

According to statistical analysis, there was no significant difference between the observation group and the control group in terms of age, gender, height, and weight distribution (P0.05).

Comparison of Gait Parameter Results Between the Two Groups Before Treatment.

Table 2: Comparison of Gait Data Results Between the Two Groups Before Treatment ($\bar{x}\pm s$)

	The observation group	The control group	t value	p value
Symmetry	92.71±2.53	91.93±3.20	0.727	0.474
Standard degree	87.43±3.55	86.63±2.99	1.671	0.111
Stride length (m)	0.89±0.27	0.83±0.32	0.497	0.623
Stride width (cm)	12.85±2.8	12.42±3.73	0.345	0.733
Swing velocity (m/s)	2.90±0.56	2.89±0.67	0.215	0.831
Stance phase %	67.64±10.03	67.87±5.17	-0.148	0.883
Contact phase %	10.93±3.51	9.13±3.52	1.372	0.181
Foot flat phase %	33.57±2.87	33.63±9.02	-0.039	0.969
Forefoot push off phase %	23.0±4.18	24.93±6.55	-0.953	0.35
Swing phase %	33.54±5.08	32.0±5.35	1.053	0.302
Heel-off angle (°)	11.27±6.32	8.37±10.30	0.906	0.373
Toe-off angle (°)	54.58±4.59	58.80±10.70	-1.394	0.179

Two independent-sample t-test revealed that in terms of symmetry, standard degree, stride length, stride height, maximum swing velocity, stance phase, contact phase, foot flat phase, forefoot push off phase, swing phase, toe-off angle and heel-off angle, there was no statistically significant difference between the observation group and the control group before treatment (P0.05).

Comparison of Gait Parameter Results Within the Two Groups Before and After Treatment

Table 3: Comparison of Gait data Results in the Observation Group Before and After Treatment ($\bar{x}\pm s$)

	Before treatment	After treatment	t value	p value
Symmetry	92.71±2.53	96.79±1.31	-9.572	<0.01
Standard degree	87.43±3.55	93.64±1.86	-10.747	<0.01
Stride length (m)	0.89±0.27	1.14±0.24	-7.398	<0.01
Stride width (cm)	12.85±2.8	17.51±1.43	-8.684	<0.01
Swing velocity (m/s)	2.90±0.56	3.83±0.33	-10.305	<0.01
Stance phase %	67.64±10.03	62.29±1.44	12.179	<0.01
Contact phase %	10.93±3.51	15.29±1.49	-6.523	<0.01

Foot flat phase %	33.57±2.87	27.71±1.85	10.787	<0.01
Forefoot push off phase %	23.0±4.18	29.86±3.32	-10.924	<0.01
Swing phase %	33.54±5.08	39.57±2.44	-1.586	0.137
Heel-off angle (°)	11.27±6.32	22.93±4.06	-9.106	<0.01
Toe-off angle (°)	54.58±4.59	68.71±3.81	-12.154	<0.01

After analyzing and comparing before and after treatment, it has been found that in terms of symmetry, standard degree, stride length, stride height, maximum swing velocity, contact phase, forefoot push off phase, heel-off angle, and toe-off angle, the observation group showed improvement after treatment, and the difference was statistically significant (P<0.05). But the proportion of stance phase and foot flat phase was reduced in the entire gait cycle, and the difference was statistically significant (P<0.05). Compared with the proportion before treatment, the proportion of swing phase was increased in the gait cycle, and the difference was not statistically significant (P<0.05).

Table 4: Comparison of Gait Data Results in the Control Group Before and After Treatment ($\bar{x}\pm s$)

	Before treatment	After treatment	t value	p value
Symmetry	91.93±3.20	94.93±2.02	-4.743	<0.01
Standard degree	86.63±2.99	91.27±3.33	-4.824	<0.01
Stride length (m)	0.83±0.32	1.06±0.28	-5.192	<0.01
Stride width (cm)	12.42±3.73	15.83±3.57	-4.405	0.001
Swing velocity (m/s)	2.89±0.67	3.31±0.77	-10.597	<0.01
Stance phase %	67.87±5.17	63.33±3.57	6.785	<0.01
Contact phase %	9.13±3.52	13.07±2.68	-6.967	<0.01
Foot flat phase %	33.63±9.02	31.4±5.16	1.828	0.089
Forefoot push off phase %	24.93±6.55	29.47±5.22	-3.859	0.002
Swing phase %	32.0±5.35	36.47±3.81	-5.683	<0.01
Heel-off angle (°)	8.37±10.30	17.77±5.31	-5.541	<0.01
Toe-off angle (°)	58.80±10.70	63.97±5.06	-2.629	0.02

From the analysis and comparison before and after treatment, it can be seen that in terms of symmetry, standard degree, stride length, stride height, maximum swing velocity, contact phase, forefoot push off phase, swing phase, heel-off angle, and toe-off angle, the control group showed improvement after treatment, and the difference was statistically significant (P<0.05). But the proportion of stance phase was reduced in the entire gait cycle, and the difference was statistically significant (P<0.05). The proportion of foot flat phase was reduced in the entire gait cycle, and the difference was not statistically significant (P,<0.05).

Comparison of Gait Parameters Between the Two Groups After treatment

Table 5: Comparison of Gait Data Between the two Groups After Treatment ($\bar{x}\pm s$)

	The observation group	The control group	t value	p value
Symmetry	96.79±1.31	94.93±2.02	2.909	0.007
Standard degree	93.64±1.86	91.27±3.33	2.393	0.026
Stride length (m)	1.14±0.24	1.06±0.28	0.808	0.426
Stride height (cm)	17.51±1.43	15.83±3.57	1.641	0.112
Swing velocity (m/s)	3.83±0.33	3.31±0.77	2.362	0.029
Stance phase %	62.29±1.44	63.33±3.57	-1.047	0.309
Contact phase %	15.29±1.49	13.07±2.68	2.776	0.011
Foot flat phase %	27.71±1.85	31.4±5.16	-2.943	<0.01
Forefoot push off phase %	29.86±3.32	29.47±5.22	0.242	0.811
Swing phase %	39.57±2.44	36.47±3.81	2.589	0.015
Heel-off angle (°)	22.93±4.06	17.77±5.31	2.949	0.007
Toe-off angle (°)	68.71±3.81	63.97±5.06	2.834	0.009

Two independent-sample t-test demonstrated that in terms of symmetry, standard degree, swing velocity, contact phase, foot flat phase, swing phase, toe-off angle, and heel-off angle, there was statistically significant difference between the observation group and the control group (P<0.05). However, there was no statistically significant difference between the two groups in terms of stride length, stride height, stance phase, and forefoot push off phase after treatment (P<0.05).

Comparison of Overall Efficacy Between the Two Groups

Table 6: Assessment of Overall Efficacy Between the Two Groups

Group	n	Significantly effective (number of cases)	Effective (number of cases)	Invalid (number of cases)	Efficiency (%)
The observation group	60	34	24	2	96.67
The control group	60	20	32	8	86.67

After treatment, the total efficiency of the observation group was 96.67%, and the total efficiency of the control group was 86.67%. From statistical analysis, it can be seen that the difference between the two groups in terms of overall efficacy was statistically significant (c2=3.901, P =0.021, P<0.05), and the efficacy of the observation group was significantly better than that of the control group (P<0.05).

Safety Assessment

During the rehabilitation treatment, no obvious adverse reactions were found in child patients in both groups, such as syncope, rash, fever, and diarrhea. This indicates that the therapy is safe and effective.

Study Conclusions

1. Both the integrative medicine and pure Western medicine rehabilitation therapy can improve the abnormal gait of spastic cerebral palsy, and enhance the walking ability of children with CP.
2. In terms of improving the abnormal gait of spastic cerebral palsy, the integrative medicine is more effective than pure Western medicine rehabilitation therapy.

Discussion

Through experimental studies, it has been found that compared with normal healthy people, the gait characteristics of children with CP during walking are mainly manifested as follows: shorter stride length, stride width, and stride height; faster cadence; longer time in stance phase, with increased proportion; relatively shorter time in swing phase, with reduced proportion; limited hip flexion, extension, and external rotation angles. But the internal rotation angle is significantly increased.

The knee flexion angle and ankle plantar flexion angle are clearly limited. This study has found that in addition to the above characteristics, the heel-off angle and toe-off angle of children with spastic cerebral palsy are both significantly smaller than those of normal people. After analysis of the cause, this may be due to ankle muscle spasm and myasthenia, resulting in limited dorsiflexion of ankle. Because of non-progressive brain damage in the process of development, a series of symptoms have occurred in children with spastic cerebral palsy, such as increased muscle tension in lower limbs, and uncoordinated strength between muscle groups. The manifestations include poor balance and coordination during walking, body instability, poor overall motor control ability of limbs, and a high risk of falling [8].

After making a general survey of various descriptions by ancient doctors, the name “cerebral palsy” was not found. This disease can be classified into categories such as “five kinds of retardation”, “five kinds of flaccidities”, and “five kinds of stiffness”. Among them, the proportion of spastic cerebral palsy is relatively high, which usually presents with symptoms including tendon-vessel spasm, limb tension, and contracture of hands and feet. TCM believes that cerebral palsy is usually caused by congenital endowment deficiency or postnatal malnutrition. Parents’ essence blood is insufficient, congenital essence blood of the fetus during pregnancy is insufficient, and malnutrition of brain marrow occurs. Or the mother takes improper medicine during pregnancy and doesn’t recuperate well, leading to defects of fetal primordial qi and causing damage to the cerebral ventricles.

These cases belong to congenital factors. Factors such as intrapartum asphyxia, brain injury, and intoxication may belong to acquired factors. According to traditional medicine, kidney governs essence. The excess and deficiency of kidney essence would affect the growth and development of human body. In case of kidney essence deficiency, malnutrition of bones and inadequacy of marrow would occur, resulting in growth retardation and stunting of children. Liver governs conveyance and dispersion, regulates qi-activity throughout the body, and dominates tendon. The physiological activities of tendons and vessels around the body rely on the essence of liver to nourish. If liver blood is insufficient, contractures would occur in tendons and vessels, and the movement of joints is not smooth. Liver corresponds to wood, while spleen corresponds to the earth [9].

Liver affects the function of spleen. If the essence of liver cannot nourish the acquired spleen-earth, the muscle would be weak, tendons and vessels would suffer from contractures and convulsions, and limbs would become stiff and cannot be moved. According to the pathogenesis of children with spastic cerebral palsy, WANG Xuefeng et al. utilized the method of four diagnosis integration, and classified this disease into the strong liver and weak spleen syndrome based on syndrome differentiation. In summary, the main disease location of children with spastic cerebral palsy is in the brain, which is closely related to the liver, spleen, and kidney.

From this study, it has been proved that with regard to improving the abnormal gait of children with spastic cerebral palsy and enhancing their walking ability, the integrative medicine and pure Western medicine rehabilitation therapy are both effective

to a certain extent. The efficacy of the integrative medicine is superior than pure Western medicine rehabilitation therapy in gait improvement. Modern rehabilitation training can improve the clinical symptoms of children with spastic cerebral palsy in some degree. By contrast, TCM starts with the pathogenesis, and synthetically uses various treatments, such as acupuncture, massage, and TCM bathing, to achieve the effect of comprehensive treatment.

Therefore, it is necessary to further optimize the integrative medicine treatment plan, identify the specific mechanism and action pathway of treatment, and explore more effective combinations of treatments. These should be future research directions. At the same time, a unified treatment standard and assessment system should be established to promote standardization and scientific development in clinical practices. With these efforts, we are expected to provide more effective and safer treatment plans for children with spastic cerebral palsy, thus improving their quality of life, and paving the way for their future development and rehabilitation [10].

To sum up, the integrative medicine has shown remarkable clinical efficacy and broad application prospects in the treatment of spastic cerebral palsy. But it still needs to be further refined and promoted, so as to better serve clinical practices and the health of child patients.

References

1. FENG, Y., PANG, W., LI, X., YANG, S., LIU, S., & LU, S. (2021). The prevalence of cerebral palsy in children aged 0-6 years in China: a meta-analysis. Chinese general practice, 24(5), 603.
2. Chen, J. (2017). Analysis of rehabilitation treatment effect of language disorder in children with cerebral palsy. The Medical Forum, 21, 341-343.
3. Chinese Association of Rehabilitation Medicine Pediatric Rehabilitation Committee, Chinese Association of Rehabilitation of Disabled Persons Rehabilitation Committee for Cerebral Palsy, & Chinese Medical Doctor Association Pediatric Rehabilitation Committee. (2022). Chinese rehabilitation guidelines for cerebral palsy (2022) part 1: Overview. Chinese Journal of Applied Clinical Pediatrics, 2022(12), 887-892.
4. Mao, J., Lu, Y., & Jin, S. (2023). Recent progress of gait analysis in the field of lower limb orthosis in spastic cerebral palsy. Chinese Pediatrics of Integrated Traditional and Western Medicine, 29-33.
5. Galea, C., Mcintyre, S., Smithers-Sheedy, H., Reid, S. M., Gibson, C., Delacy, M., ... & Australian Cerebral Palsy Register Group. (2019). Cerebral palsy trends in Australia (1995–2009): a population-based observational study. Developmental Medicine & Child Neurology, 61(2), 186-193.
6. Kakooza-Mwesige, A., Andrews, C., Peterson, S., Mangen, F. W., Eliasson, A. C., & Forssberg, H. (2017). Prevalence of cerebral palsy in Uganda: a population-based study. The Lancet Global Health, 5(12), e1275-e1282.
7. Wang, X., Yan, S., & Zheng, H. (2018). Kinematic characteristics of gait for children with spastic cerebral palsy. Journal of Medical Biomechanics, 33, 459-464.
8. Ning, M. (2019). Current status and progress of rehabilitation treatment of children with cerebral palsy. Medical Equipment, 32, 201-202.
9. Wang, X., & Hu, X. (2023). The analysis of spastic cerebral palsy of children (stagnation of the liver-qi and deficiency of the spleen) in traditional Chinese medicine. Journal of Pediatrics of Traditional Chinese Medicine, 25, 3143-3149.
10. Lv, C. (2019). Influence of point injection combined with acupuncture on the degree of spasm and walking ability in children with spastic cerebral palsy. Chinese Journal of Convalescent Medicine, 28, 265-267.