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Original Article

The effect of a high-quality nursing model employing low-frequency pulse electrical stimulation combined with early systemic functional exercises on the function of the affected limb in brachial plexus injury patients

Xiaoyu Huang[1], Zongyuan Jiang[1], Haoran Sun[1], Bangzhu Xie[1], Fang Lu[1], Wenlong Huang[2], Ting Wang[2], Haiyan Xiong[2]

Departments of [1]Hand Surgery, [2]Nursing, People's Hospital of Longhua District, Shenzhen, Guangdong Province, China

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Abstract: Objective: To explore the effect of a high-quality nursing model employing low-frequency pulse electrical stimulation combined with early systemic functional exercises on the function of the affected limb in brachial plexus injury patients. Methods: A total of 98 brachial plexus injury patients admitted to our hospital were recruited as the research cohort. All the patients were treated with surgery to repair, release, and transfer or transplant nerves according to each patient's condition. After the operations, the patients were randomly divided into one of two groups: the control group (n=49) or the research group (n=49). The control group did early systemic functional exercises, while the research group was administered low frequency pulse electrical stimulation in addition to doing the early systemic functional exercises. The clinical efficacy, the visual analogue scale (VAS) scores before and after the treatment, the brachial plexus function scores, the nerve conduction velocities and amplitudes, the SF-36 questionnaires, the incidences of complications, and the nursing satisfaction were compared between the two groups. Results: After the treatment, the overall response rate to the treatment in the research group was significantly higher than it was in the control group (95.92% vs 81.63%, $P<0.05$). The VAS scores in both groups were decreased, and the scores in the research group were lower than the scores in the control group ($P<0.05$). The upper limb, lower limb, and the whole brachial plexus scores were increased in both groups, and the scores in the research group were higher than the scores in the control group ($P<0.05$). The motor conduction velocities, the sensory conduction velocities, and the amplitudes of the ulnar and median nerves in the two groups were increased, and the research group had higher levels than the control group ($P<0.05$). The emotional function, physical pain, physical health, role function, social function, mental health, energy, and general health scores in the two groups were increased, and the research group was higher than the control group ($P<0.05$). The incidence of complications in the research group was lower than it was in the control group, but the nursing satisfaction was higher than it was in the control group (all $P<0.05$). Conclusion: The high-quality nursing model based on low-frequency pulse electrical stimulation combined with early systemic functional exercise can effectively promote the functional recovery of the affected limb in brachial plexus injury patients. It can reduce pain and the incidence of complications and it can improve the quality of life and the satisfaction with the nursing at the same time.

Keywords: Brachial plexus injury, early systemic functional exercise, low-frequency pulse electrical stimulation, functional recovery of the affected limb, quality of life

Introduction

The brachial plexus nerve is composed of the cervical C5-8 and T1 nerve roots. Its main branches include the median nerve, the radial nerve, the thoracic and dorsal nerves, etc., which are mainly distributed in the upper limbs and control the sensations and movement of the upper limbs, chest, and shoulders [1]. Brachial plexus injury is a complicated disease, and its main treatment strategies include conservative treatment and surgical treatment. For patients with clear surgical indications, the surgical exploration and repair should be carried out as soon as possible to facilitate limb function reconstruction after injury [2]. However, due to the long process of postoperative nerve repair and many influencing factors, it is difficult to achieve a complete cure, and this causes the patients great physical and psychological trauma [3]. Therefore, it is of great significance to carry out early rehabilitation training to promote the recovery of neurological function after the operation.

Early systemic functional exercise is a traditional therapy rooted in the past, and it uses exercises to stimulate the motor nerves and induce the limbs' movement response, thereby repairing the damaged nerves and promoting the recovery of the patient's affected limbs. However, the therapy is not ideal in some patients, so their prognoses are poor [4]. In recent years, by inserting electrodes into the spinal cord through the skin and stimulating the nerves at relevant locations with a pulse current, electrical stimulation therapy can block the pain signal transmitted from the spinal cord to the brain, thereby relieving the pain, and it can improve the motor ability of the spinal cord system through electrical stimulation. Thus the patient can recover, and the patient's quality of life can be improved [5, 6]. There are few published studies on the combination of the two methods in the treatment of brachial plexus injury. Therefore, in order to provide more evidence-based medical support for the prognosis of the disease, this study will adopt high-quality nursing care using low-frequency pulse electrical stimulation combined with early systemic functional exercises to analyze the therapy's effect on the disease prognosis. The results are as follows.

Materials and methods

General information

This study conforms to the standards of the Medical Ethics Committee of People's Hospital of Longhua District. 98 patients with brachial plexus injuries admitted to People's Hospital of Longhua District from March 2019 to April 2020 were recruited as the study cohort. All the patients were treated with repair, release, and nerve transfer according to their different conditions. After the operations, the patients were randomly divided into two groups according with 49 patients in each group. The control group was assigned early systemic functional exercises, and the research group was administered low frequency pulse electrical stimulation in addition to being assigned early systemic functional exercises.

Selection criteria

Inclusion criteria: Patients who met the relevant diagnostic criteria of *Diagnosis and Treatment of Brachial Plexus Injury and Disease*, and who were diagnosed with a brachial plexus injury through CT and electromyography [7], patients with no history of contraindications to the operation, patients whose mental cognition is normal, and patients who signed the informed consent forms.

Exclusion criteria: Patients who have a vital organ dysfunction, a coagulation disorder, immune dysfunction, patients with a history of upper limb surgery in the past three years, and patients who are allergic to the study drugs.

Methods

All the patients were treated with neurotrophic drugs (such as ganglioside, vitamin B1, B6) after their surgeries.

The patients in the control group were given routine nursing care based on early systemic functional. Each patient's affected limb was elevated and fixed to prevent compression, so as to promote blood circulation and avoid a secondary injury. The wound dressing was examined and replaced promptly if it was contaminated, and the aseptic principle was strictly followed. For the patients who underwent nerve transplantation, the affected limbs were immobilized, and their heads were tilted to the affected side or to a median position, so as to avoid a rupture of the nerve anastomosis area caused by traction. The exercise methods were chosen according to the patients' injury sites and the operation types:

1) For the patients who underwent a transfer of the spinal accessory nerve to the suprascapular nerve, the patients were asked to remain standing with their eyes looking straight ahead, and with their shoulders sagging to do movements like shrugging, abduction, and other movements to promote nerve regeneration. For patients who underwent a transfer of contralateral C7, omni-directional exercises were chosen for the healthy limb, with 200 repetitions/time, 6 times/day. 2) For patients who underwent a

transfer of the phrenic nerve, the exercises and breathing were combined to remain standing, letting the affected limb hang freely, lift the forearm of affected limb with healthy limb, and raise the elbow joint to the elbow flexion position during a deep inhalation. In the early stage, the frequency was maintained at 15-20 repetitions/time, 2 times/day, and then the amount of exercise was increased gradually to restore the elbow flexion function, and muscle massage was performed to help prevent muscle atrophy and repair the function of the affected limb. The acupuncture points of Jianhu, Bent Pond, Jianteng, Waiguan, Shousanli, Tianzong, Hegu, Jianzhen, etc. were chosen for massages lasting 20-30 minutes, as appropriate.

The patients in the research group received high-quality nursing care employing low-frequency pulse electrical stimulation based on early system function training. The KT-90A neuromuscular electrical stimulator manufactured by Beijing Yaoyang Kangda Medical Equipment Co., Ltd. was used for the treatment. The spinal cord type was prescribed. The positive electrode was placed at C5-T1, and the negative electrode was placed on the limb nerves and the related inner muscles to maintain the current at the lesion point, and the intensity was adjusted according to the patient's tolerance. After the power was turned on, the muscle at the lesion contracted rhythmically with a frequency of 25-30 min/time, 2 times/day. The patients in the two groups continued their treatment for one month.

Outcome measures

Main outcomes: Clinical efficacy: According to the evaluation in *Diagnosis and Treatment of Brachial Plexus Injury and Disease*, if the upper limb function restoration in the shoulder joint abduction, wrist extension, elbow joint flexion, finger extension, and flexion, thumb adduction, etc. had no influence on the patient's daily activities, or if the muscle strength of the affected limb is >4, it is considered to be markedly effective. When the functional restoration in most of the above-mentioned affected aspects has some influence on the patient's daily activities and has the muscle strengths of grades 3-4, it is considered to be effective. No improvement in the limb function, daily activities, or if the muscle strength is less than grade 3 is considered to be ineffective. Overall response rate = (Markedly effective + effective)/ total number of cases *100%.

Pain before the treatment and one month after the treatment: VAS was used to assess the pain: 0 points indicated no pain; 1-3 points indicated mild pain acceptable to the patient; 4-6 points indicated severe pain, which affected sleep, and some aspects of life and work cannot be performed; 7-10 points indicated intolerable pain, seriously affecting sleep, and most aspects of life and work are almost impossible.

The brachial plexus nerve function scores before and one month after the treatment: According to the "Criteria for Upper Limb Function Evaluation of the Chinese Society of Hand Surgery of Chinese Medical Association", the function scores of the upper limbs, lower limbs, and the whole brachial plexus were evaluated, with scores ≤4 points were considered poor, 5-8 points were considered fair, 9-12 points were considered good, and scores ≥13 were considered excellent [8].

Nerve conduction velocity and amplitude before and 1 month after treatment: The motor conduction velocity (MCV) and sensory conduction velocity (SCV) and the amplitude of the ulnar nerve and median nerve were measured with the MyoTraceTM 400 electromyography instrument produced by Shanghai Hanfei Medical Equipment Co., Ltd., China.

Secondary outcomes: Quality of life before and at 6 months after the treatment: The patients were followed up for 6 months and assessed using the short form 36 questionnaire (SF-36) [9]. The questionnaire contains 8 dimensions and a total of 36 items including emotional function, bodily pain, physical health, role function, social function, mental health, energy and general health. The scoring is from 0-100 points, and the higher the score, the higher the quality of life.

The incidences of complications in the two groups were recorded, and the complications included muscle atrophy, joint stiffness, chronic neuritis, etc. A self-made nursing satisfaction questionnaire was used to evaluate each patient's satisfaction with the nursing, with a

Table 1. Comparison of the baseline data (n, %; $\bar{x}$ ± sd)

Index	Control group (n=49)	Research group (n=49)	t	P
Gender (male/female)	28/21	26/23	0.165	0.685
Age (years)	38.2±5.3	38.4±5.2	0.189	0.851
Pathological type			0.195	0.907
Upper brachial plexus injury	14 (28.57)	13 (26.53)		
Lower brachial plexus injury	14 (28.57)	16 (32.65)		
Whole brachial plexus injury	21 (42.86)	20 (40.82)		
Cause of injury			0.660	0.417
Car accident injury	29 (59.18)	25 (51.02)		
Heavy object injury	20 (40.82)	24 (48.98)		

Table 2. Comparison of the clinical efficacy (n, %)

Group	Markedly effective	Effective	Ineffective	Total effective rate
Control group (n=49)	18 (36.73)	22 (44.90)	9 (18.37)	40 (81.63)
Research group (n=49)	26 (53.06)	21 (42.86)	2 (4.08)	47 (95.92)
Z		2.102		5.018
P		0.036		0.025

Table 3. Comparison of the patients' VAS scores ($\bar{x}$ ± sd)

Group	Before treatment	After treatment	t	P
Control group (n=49)	6.34±1.22	2.72±0.68	18.143	0.000
Research group (n=49)	6.68±1.78	1.56±0.12	20.089	0.000
t	1.103	11.759		
P	0.273	0.000		

Note: VAS: visual analog scale.

total possible score of 50, of which 46-50 indicated very satisfied, 36-45 indicated generally satisfied, 0-35 indicated dissatisfied, and the degree of nursing satisfaction is the sum of the general satisfaction rate and the very satisfied rate.

Statistical methods

SPSS 23.0 software was used for data processing, and measurement data were expressed as the mean ± standard deviation ($\bar{x}$ ± sd). Independent sample t tests were used for the comparisons between two groups, and paired *t* tests were used for the comparisons within groups. The enumeration data was expressed as a percentage, and χ^2 tests were used to analyze the data. Log-rank tests were used for the ranked data, and P<0.05 indicated that a difference was statistically significant.

Results

Baseline data

There were no significant differences between the two groups in their baseline data, such as gender, age, pathological type, or cause of injury (all P>0.05). Therefore, the two groups of were comparable. See **Table 1**.

Clinical efficacy

The overall response rate of the treatment in the research group was significantly higher than it was in the control group (95.92% vs 81.63%, P=0.025). It can be seen that, compared with the simple early systemic functional exercises alone, the exercises combined with low-frequency pulse electrical stimulation are more helpful at improving the clinical effect. See **Table 2**.

VAS scores

Before the treatment, there was no significant difference in the VAS scores between the two groups (P>0.05). After the treatment, the VAS scores of the patients in the two groups were decreased, and the research group had lower scores than the control group (all P<0.001). It can be seen that compared with simple early systemic functional exercises alone, the combination of low-frequency pulse electrical stimulation and the exercises are more helpful in reducing pain. See **Table 3**.

Brachial plexus function scores

Before the treatment, there was no significant difference in the brachial plexus scores between the two groups (P>0.05). After the treatment, the function scores of the upper limbs, lower limbs, and the whole brachial plexus of the two groups increased, and the research group had higher scores than the control group (all P<0.001). It can be seen that

Table 4. Comparison of the patients' brachial plexus function scores ($\bar{x}$ ± sd)

Groups	Control group (n=49)	Research group (n=49)	t	P
Upper limb				
Before treatment	4.58±0.64	4.43±0.47	1.322	0.189
After treatment	9.34±1.52***	11.68±2.08***	6.358	0.000
Lower limbs				
Before treatment	5.65±0.82	5.47±0.75	1.134	0.260
After treatment	9.42±1.68***	12.52±2.12***	8.022	0.000
Whole brachial plexus				
Before treatment	5.12±0.75	5.24±0.79	0.771	0.373
After treatment	8.98±1.07***	11.62±2.09***	7.871	0.000

Note: Compared with this group before the treatment, ***P<0.001.

compared with just the simple early systemic functional exercises alone, the combination of low-frequency pulse electrical stimulation and the exercises is more helpful in improving the brachial plexus function. See **Table 4** and **Figure 1**.

Nerve conduction velocities and amplitudes

Before the treatment, there were no significant differences in the nerve conduction velocities and amplitudes in the two groups (P>0.05). After the treatment, the MCV, SCV, and amplitude of the ulnar nerves and median nerves of patients in the two groups were increased, and the research group had higher values than the control group (all P<0.05). It can be seen that when compared with simple early systemic functional exercises alone, the combination of low-frequency pulse electrical stimulation and the exercises is more helpful at enhancing the nerve conduction velocity and amplitude. See **Table 5** and **Figure 2**.

The SF-36 scores

Before the treatment, there was no significant difference in the SF-36 scores of the patients in the two groups (P>0.05). After the treatment, the emotional function, bodily pain, physical health, role function, social function, mental health, energy, and overall health scores of the patients in the two groups were increased, and the scores in the research group were higher than the scores in the control group (all P<0.01). It can be seen that compared with the simple early system functional exercises alone, the combination of low-frequency pulse electrical stimulation and the exercises is more helpful at improving the quality of life. See **Table 6** and **Figure 3**.

Complications

One case of muscle atrophy occurred in the research group, for an incidence rate of 2.04%. In the control group, there were 3 cases of muscle atrophy, 3 cases of joint stiffness and 2 cases of chronic neuritis, for an incidence rate of 16.33%. The incidence rate of complications in the research group was lower than it was in the control group (χ^2=4.405, P=0.036). Therefore, compared with the simple early systemic functional exercises alone, the exercises combined with low-frequency pulse electrical stimulation is more helpful at reducing the incidence of complications.

Nursing satisfaction

In the research group, 35 patients were very satisfied, 12 patients were generally satisfied, and 2 cases were dissatisfied, so the nursing satisfaction rate was 95.92%. The corresponding values in the control group were 25 cases, 15 cases, and 9 cases respectively, so the group's nursing satisfaction was 81.63%. The nursing satisfaction of the research group was higher than the control group's nursing satisfaction (χ^2=5.018, P=0.025). Therefore, compared with the simple early systemic functional exercises alone, the exercises combined with low-frequency pulse electrical stimulation are more helpful at improving the nursing satisfaction.

Discussion

After brachial plexus injury, the regenerative ability is weak, and the peripheral effectors and distal muscles of the damaged part are changed [10]. The patient's upper limb motor function will be severely impaired. Even if the operation is successful, the postoperative disability rate is high, so the prognosis is poor, and there is no specific scheme for a complete cure at present [11]. Most post-rehabilitation exercises are used to stimulate the muscles and the nerve movement and to promote limb recovery, but the effect is not ideal [12].

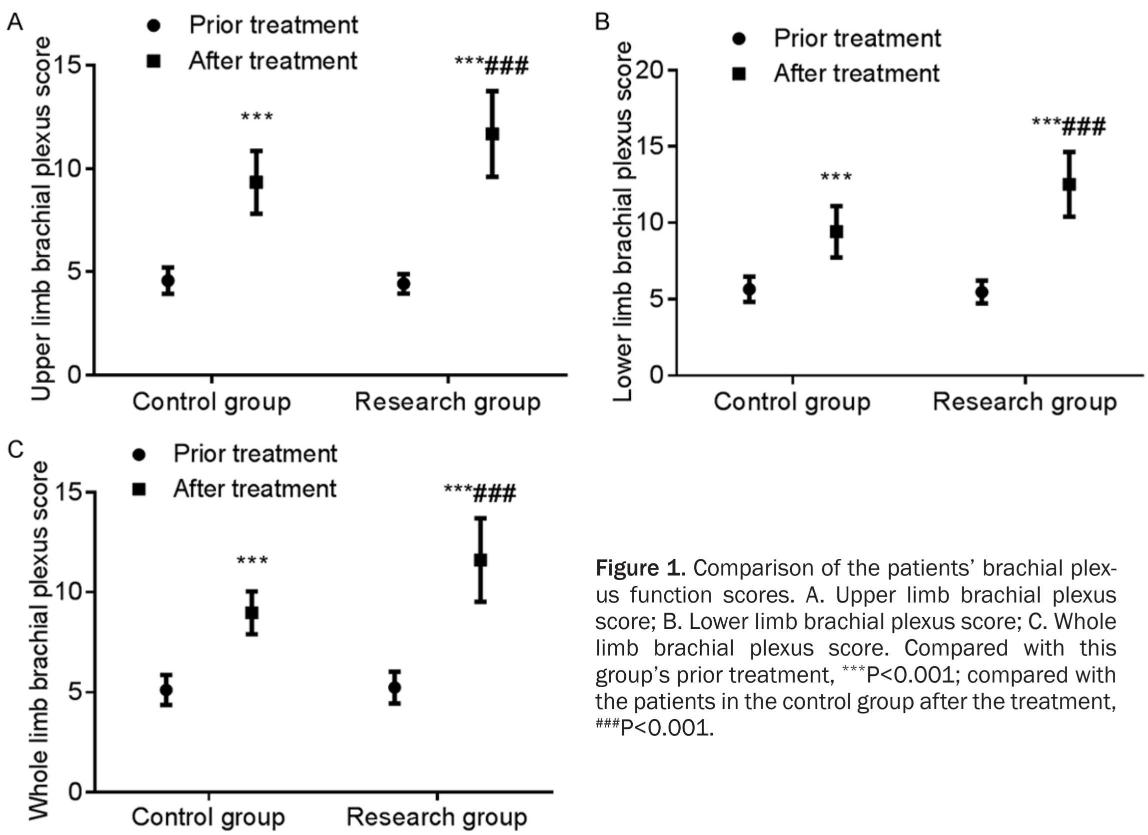


Figure 1. Comparison of the patients' brachial plexus function scores. A. Upper limb brachial plexus score; B. Lower limb brachial plexus score; C. Whole limb brachial plexus score. Compared with this group's prior treatment, ***P<0.001; compared with the patients in the control group after the treatment, ###P<0.001.

Table 5. Comparison of the nerve conduction velocity and amplitude ($\overline{x}$ ± sd)

Outcome measures	Control group (n=49)	Research group (n=49)	t	P
Ulnar nerve MCV (m/s)				
Before treatment	39.58±4.64	40.33±5.77	0.709	0.480
After treatment	41.34±5.22***	47.68±6.78***	5.187	0.000
Ulnar nerve SCV (m/s)				
Before treatment	37.65±4.72	37.47±4.31	0.197	0.844
After treatment	40.42±4.98***	46.52±6.12***	5.412	0.000
Ulnar nerve amplitude (mV)				
Before treatment	3.12±0.25	3.20±0.29	1.463	0.147
After treatment	3.98±0.67***	4.62±0.99***	3.748	0.000
Median nerve MCV (m/s)				
Before treatment	41.21±5.43	42.42±5.65	1.081	0.282
After treatment	43.21±3.83***	48.49±7.05***	4.607	0.000
Median nerve SCV (m/s)				
Before treatment	41.14 ±5.24	40.16 ±4.63	0.981	0.329
After treatment	44.39±5.66***	47.24±6.63***	2.289	0.024
Median nerve amplitude (mV)				
Before treatment	3.26±0.29	3.21±0.28	0.868	0.388
After treatment	3.89±0.65***	4.57±0.96***	4.106	0.000

Notes: Compared with this group's prior treatment, ***P<0.001. MCV: motor conduction velocity; SCV: sensory conduction velocity.

Therefore, how to effectively improve the function of the affected limb in patients with brachial plexus injury is drawing increased interest in clinical work.

The results of this study showed that after treatment, the pain, brachial plexus function scores, nerve conduction velocities, and the amplitudes of the patients in the research group were better than they were in the control group, suggesting that the combination of low-frequency pulse electrical stimulation treatment combined with the early system function exercises has a better therapeutic effect. The reasons are as follows: First, the body's nervous

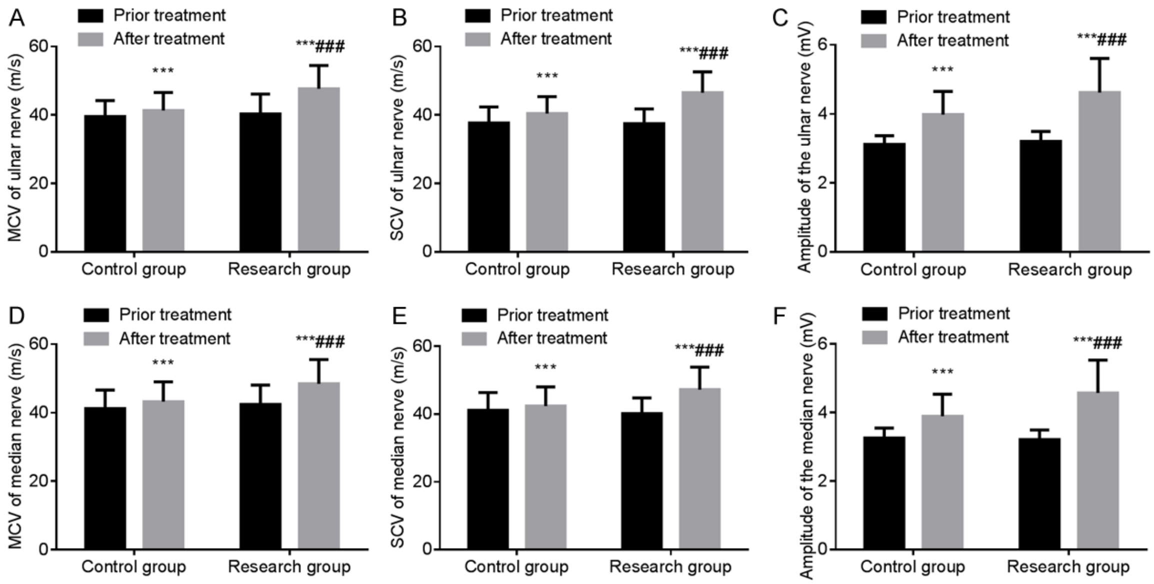


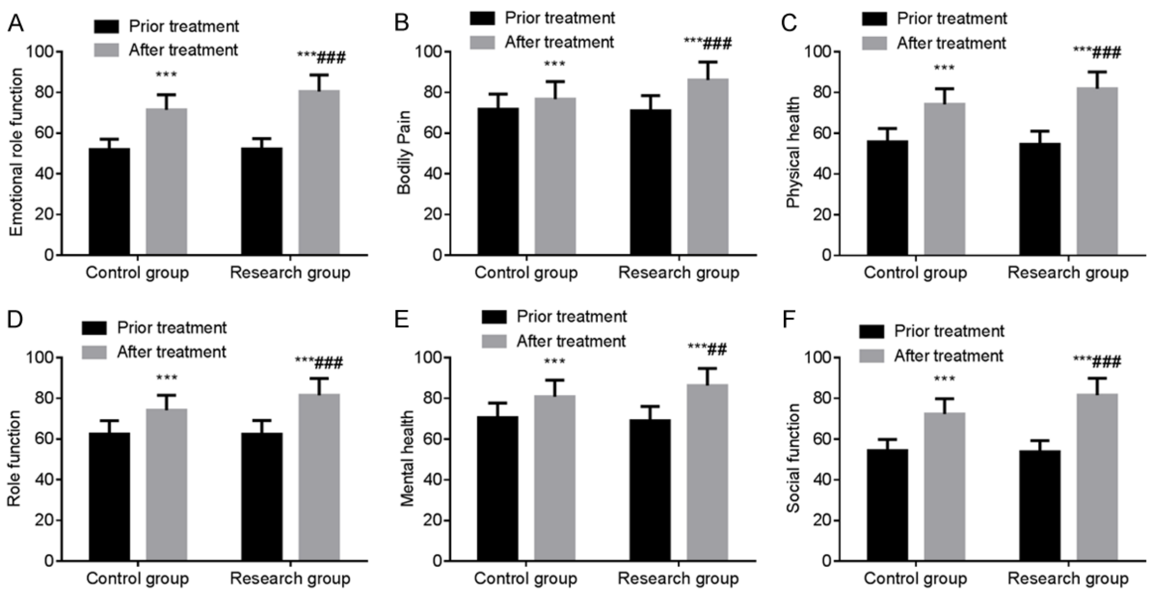
Figure 2. Comparison of nerve conduction velocity and amplitude. A. MCV of the ulnar nerve; B. SCV of the ulnar nerve; C. Amplitude of the ulnar nerve; D. MCV of the median nerve; E. SCV of the median nerve; F. Amplitude of the median nerve. Compared with before the treatment, ***P<0.001; compared with the control group after the treatment, ###P<0.05. MCV: motor conduction velocity; SCV: sensory conduction velocity.

Table 6. Comparison of the SF-36 scores ($\overline{x}$ ± sd, points)

Outcome measures	Control group (n=49)	Research group (n=49)	t	P
Emotional function				
Before treatment	51.95±5.12	52.17±5.09	0.120	0.842
After treatment	71.45±7.46***	80.45±8.21***	5.302	0.000
Bodily pain				
Before treatment	71.75±7.47	71.06±7.38	0.243	0.808
After treatment	76.68±8.66***	86.14±8.84***	5.005	0.000
Physical health				
Before treatment	55.79±6.56	54.53±6.47	0.957	0.341
After treatment	74.17±7.67***	81.87±8.28***	4.461	0.000
Role function				
Before treatment	62.45±6.63	62.34±6.76	0.076	0.940
After treatment	74.21±7.33***	81.54±8.21***	4.351	0.000
Social Function				
Before treatment	54.34±5.53	53.77±5.51	0.478	0.634
After treatment	72.36±7.51***	81.65±8.30***	5.424	0.000
Mental health				
Before treatment	70.59±7.18	69.06±7.08	0.994	0.323
After treatment	80.84±8.19***	86.37±8.45***	3.076	0.003
Energy				
Before treatment	53.48±5.56	52.32±5.71	0.148	0.883
After treatment	76.41±7.24***	83.53±8.76***	4.086	0.000
General health				
Before treatment	52.59±5.47	51.44±5.36	0.984	0.328
After treatment	73.49±7.14***	82.33±8.19***	5.312	0.000

Note: Compared with this group's prior treatment, ***P<0.001. SF-36: Short form 36 questionnaire.

system is highly reconstructive, and the motor nerves can be stimulated through realizable postures and movement patterns. The stimulation can induce a motor response in the limbs and produce motor imagination to carry out a reconstruction of the nervous system to improve the neurological function [13]. There are a large number of Na^+ channels and K^+ channels on the nerve cell membranes. In the process of nerve conduction, when the nerve is stimulated, the permeability of the cell membrane will change. When the cell is stimulated, the ion channel on the membrane will be activated, thus affecting the nerve conduction velocity and amplitude [14]. However, low-frequency pulse electrical stimulation can destroy the membrane polarization state, cause neuromuscular excitement, release acetylcholine from nerve endings, and increase the release of contractile transmitters of muscle fibers to improve nerve function conduction speed and amplitude [15]. In addition, low-frequency pulse electrical stimulation can excite the glial cells and close the gate by inhibiting fiber terminal conduction, so that the



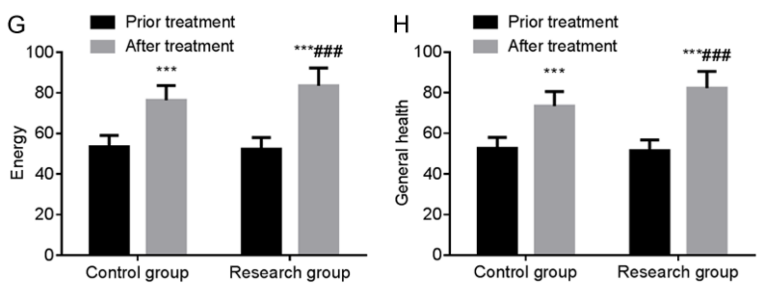


Figure 3. Comparison of the SF-36 scores. A. Emotional function; B. Bodily pain; C. Physical health; D. Role function; E. Mental health; F. Social function; G. Energy; H. Overall health. Compared with before the treatment, $^{***}P<0.001$; compared with the control group after the treatment, $^{\#\#}P<0.01$, $^{\#\#\#}P<0.001$.

stimulation signal from the pain impulses cannot be transmitted and the endogenous analgesic effect can be activated, thus relieving pain [16]. At the same time, it can dilate the blood vessels and promote blood circulation, so it can further improve the analgesic effect. Second, through correct posture guidance, it can also reduce the pain caused by improper posture, traction, and excessive force, etc. in the process of exercise, and the affected limb can be raised and fixed to avoid compression, which can effectively promote blood circulation while avoiding secondary injury [17]. The combination of exercise and breathing can strengthen the phrenic nerve and the innervation ability. Shrugging the shoulders can excite the neurons to help with nerve regeneration. The comprehensive exercising of the healthy limbs can stimulate neurons and play a positive role in restoring the innervated muscle group [18]. Through the above targeted, selective, and systematic training, step by step, the training induces the reorganization and compensation of brain tissue, so that the defective nerves can replace the original damaged nerves by learning normal nerve movement, transforming the activity of the brain nerve cells around the lesion, inhibiting the abnormal nerves and rebuilding the functional coordination between the muscle groups [19].

In this study, the clinical efficacy in the research group was higher than of the clinical efficacy in the control group, suggesting that the combination of low-frequency pulse electrical stimulation and early system function exercises can effectively improve clinical efficacy. The reason may be due to the fact that acupoint massage is a traditional Chinese medicine nursing therapy, and it can adjust the function of the viscera by using the principles of relaxing the tendons and activating the collaterals, promoting blood circulation to dispel blood stasis. In traditional Chinese medicine, meridians are considered to be the essence of the human Qi and blood and have the function of communicating with the organs of whole body and the peripheral limbs of the viscera [20, 21]. However, there is an inseparable relationship between the meridian and acupuncture points, and the relationship is the most basic condition for connecting the whole to form and maintain nerve activity [22]. The acupoints are the direct reaction points on the surface of the human body. The application of acupoint massage nursing can effectively promote the circulation of the qi and blood, communicate inside and outside, adjust the function of the viscera, stimulate the body's resistance, and play a role in the treatment and overall health care [23]. This nursing, combined with low-frequency pulse electrical stimulation therapy stimulates a patient's sensory and motor nerves and enhances the muscle contraction ability through the nerve reflexes by adjusting the low-voltage and low-frequency current, so as to wake up the damaged nerve, increase the muscle strength of the affected limb, and improve the nerve function [24]. At the same time, electrical stimulation therapy can also improve the blood circulation in the affected limbs, promote the elimination of edema and peripheral nerve inflammation, and prevent harmful metabolites from accumulating in the blood vessels or being immobilized for a long time, resulting in slow blood circulation and the abnormal coagulation of the blood in the blood vessels, causing complications such as deep venous thrombosis [25].

After a 6-month follow-up we found that the patients' quality of life in the research group was better than the patients' quality of life in the control group, further indicating that the combination of low-frequency pulse electrical stimulation and early systemic functional exercises is more helpful for the recovery of the functions and the improvement of the quality of life of brachial plexus injury patients. However, due to the small cohort and the fact that this was a single-center study, the efficacy of low-frequency impulse electrical stimulation combined with early systemic functional exercises in the treatment of different pathological types of brachial plexus nerve injury has not been evaluated. In the future, the scale of this clinical research should be expanded.

In conclusion, the combination of low-frequency pulse electrical stimulation and early systemic functional exercises can effectively relieve pain and promote the functional recovery of the affected limbs, thus improving the quality of life in patients with brachial plexus injuries.

Disclosure of conflict of interest

None.

Address correspondence to: Haiyan Xiong, Department of Nursing, People's Hospital of Longhua District, No. 38 Jinglong Jianshe Road, Longhua District, Shenzhen 518109, Guangdong Province, China. Tel: +86-0755-27741585 Ext. 8798; E-mail: xionghaiyan01sz@163.com

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