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Effect of Electroacupuncture Combined with Rehabilitation Training on the Recovery of Quadriceps Femoris Muscle Strength After Knee Joint Surgery

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Abstract: *Objective:* This paper aims to discuss and analyze the effect of electroacupuncture combined with rehabilitation training on the recovery of quadriceps femoris muscle strength after knee joint surgery. *Methods:* The study period is from May 2021 to May 2023. 60 patients with postoperative knee joint surgery admitted to the rehabilitation department of our hospital were selected as the research objects, and divided into the study group and the control group by using the odd-even number lottery method with 30 cases in each group. The study group received electroacupuncture and rehabilitation training, and the control group received only rehabilitation training. The recovery of knee joint function, 60°/s isokinetic muscle strength test, and rehabilitation effect were compared between the groups. *Results:* Before rehabilitation, there was no statistically significant difference ($P > 0.05$) in the comparison of knee joint function recovery indicators such as function, muscle strength, flexion deformity, range of motion, and stability between the groups. After rehabilitation, the function, muscle strength, knee joint function recovery indexes such as flexion deformity, range of motion, and stability in the study group were significantly better than those in the control group, and the difference was statistically significant ($P < 0.05$). Before rehabilitation training, the peak torque (PT), total work (TW), and average power (AP) at 60°/s isokinetic muscle strength tests of the two groups were compared, and the difference was not statistically significant ($P > 0.05$). After rehabilitation, the PT, TW, and AP at 60°/s isokinetic muscle strength tests of the study group were significantly higher than those of the control group, and the difference was statistically significant ($P < 0.05$). The rehabilitation effect of the study group was significantly higher than that of the control group, the difference was statistically significant ($P < 0.05$). *Conclusion:* Electroacupuncture combined with rehabilitation training can promote the recovery of quadriceps femoris muscle strength after knee joint surgery, and the recovery of knee joint function is better, which is worthy of widespread application in clinical practice.

Keywords: Electroacupuncture; Rehabilitation training; Quadriceps muscle strength recovery; Knee joint surgery

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1. Introduction

Knee joint surgery is a treatment for knee joint diseases. It is a common type of surgery in orthopedics. This surgery will affect the knee joint and its related tissues. After surgery, patients need to take some measures to promote the recovery of knee joint function and restore the joint to normal range of motion, thus reducing the limitation of limb movement [1]. In recent years, great progress has been made in rehabilitation technology, especially traditional Chinese medicine rehabilitation technology, which has important clinical value for the recovery of patients' limb functions, such as massage, acupuncture, etc [2]. Electroacupuncture is a special acupuncture method. Electroacupuncture is used in the early stage of postoperative recovery to stimulate acupoints, promote wound healing, and activate damaged knee joint function [3]. Rehabilitation training usually refers to physical exercise methods. Performing joint function exercises after surgery can stimulate muscle contraction and restore muscle strength on the one hand, and promote the recovery of joint function and restore normal joint flexibility on the other hand [4]. Combined application of electroacupuncture and rehabilitation training in patients after knee joint surgery can effectively promote the recovery of quadriceps muscle strength. This article aims to study and analyze the effect of electroacupuncture combined with rehabilitation training on the recovery of quadriceps femoris muscle strength after knee joint surgery.

2. General information and methods

2.1. General information

60 cases of knee surgery patients admitted to the rehabilitation department of our hospital from May 2021 to May 2023 were selected as the research objects, and divided into the study group and the control group by using the lottery method with odd and even numbers, with 30 patients in each group. In the study group, there were 19 males and 11 females, aged 39–64 years old, with an average age of 51.24±0.76. In the control group, there were 20 males and 10 females, aged 38–64 years, with an average age of 51.43±0.65. There was no statistically significant difference ($P > 0.05$) in general information such as gender and age between the groups.

Inclusion criteria included patients after knee joint surgery, patients with informed consent, patients with normal cognitive function, and patients undergoing knee surgery for the first time.

Exclusion criteria were patients with mental illness, patients with severe cardiovascular and cerebrovascular diseases, patients with fractures in other parts, and patients with distant metastasis of malignant tumors.

2.2. Methods

The control group underwent rehabilitation training, during which the patients were taught to do closed-chain exercises such as leggings, squats, and pedal bicycles, and then performed isometric quadriceps contraction exercises. 10 actions were taken as a group, and 2–3 groups were performed every day. This was continued for 14 days.

The study group received electroacupuncture and rehabilitation training. Electrothermal acupuncture was done at 2.7Hz frequency with continuous fluctuation, the intensity should be controlled until the muscle contraction is observed, and Zusanli, Liangqiu, Futu, Dubi, and other acupoints were selected. The patient was asked to lie down, the acupoints were disinfected, and punctured with a 1.5-inch needle once a day for 20 minutes. Rehabilitation training is the same as above. These were continued for 14 days.

2.3. Observation indicators

The indicators below were observed in the two groups.

(1) The functional recovery of the knee joint was compared between the groups, and the Hospital for Special Surgery (HSS) score was used to evaluate the recovery, including function, muscle strength, flexion deformity, range of motion, and stability, with a total score of 100 points.
(2) The 60°/s isokinetic muscle strength test was compared between the groups, and isokinetic muscle strength indicators were measured, including PT (peak torque), TW (total work), and AP (Average Power).
(3) The rehabilitation effects between the groups were compared, including markedly effective (disappearance of joint symptoms and functional recovery), effective (almost complete recovery of function, but mild symptoms), and ineffective (severe impairment of joint function and muscle strength, with obvious symptoms).

2.4. Statistical analysis

SPSS21.0 statistical software was selected to process and analyze the data, the count data were expressed by the number of cases (n) and percentage (%), the x^2 test was implemented, the measurement data were expressed by the mean ± standard deviation (SD), and the t test was implemented, $P < 0.05$ were considered statistically significant.

3. Results

3.1. Comparing the recovery of knee joint function

Before recovery, there was no statistically significant difference in function, muscle strength, flexion deformity, range of motion, stability, and other knee joint function recovery indicators between the groups ($P > 0.05$). After recovery, knee joint function recovery indicators in the study group, such as function, muscle strength, flexion deformity, range of motion, stability, and other indicators were significantly better than those of the control group, and the difference was statistically significant ($P < 0.05$). These are presented in **Table 1**.

Table 1. Comparison of knee joint function recovery between groups (mean ± SD)

Group	Function		Muscle strength		Flexion deformity		Range of motion		Stability	
	Before recovery	After recovery	Before recovery	After recovery	Before recovery	After recovery	Before recovery	After recovery	Before recovery	After recovery
Study group (n = 30)	10.57±2.51	25.78±1.54	4.31±1.28	9.85±1.55	4.31±1.85	9.57±1.26	3.89±1.24	9.66±1.42	8.31±1.27	19.57±1.22
Control group (n = 30)	10.65±2.42	22.57±1.96	4.42±1.35	7.46±1.24	4.52±1.74	7.44±1.35	3.78±1.31	7.28±1.36	8.35±1.33	17.24±1.32
t value	0.1256	7.0535	0.3238	6.5948	0.4528	6.3176	0.3340	6.6298	0.1191	7.1000
P value	0.9044	0.0000	0.7472	0.0000	0.6523	0.0000	0.7396	0.0000	0.9056	0.0000

3.2. Comparing the 60°/s isokinetic muscle strength test

Before recovery, the PT, TW, and AP at 60°/s isokinetic muscle strength tests of the two groups were compared, and the difference was not statistically significant ($P > 0.05$). After recovery, the PT, TW, and AP at 60°/s isokinetic muscle strength tests of the study group were significantly higher than those of the control group, and the difference was statistically significant ($P < 0.05$). The results are shown in **Table 2**.

Table 2. Comparison of 60°/s isokinetic muscle strength test between groups (mean ± SD)

Group	PT (kgm)		TW (Nm)		AP (W)	
	Before recovery	After recovery	Before recovery	After recovery	Before recovery	After recovery
Study group (n = 30)	45.21±5.21	61.27±4.52	430.51±7.32	497.58±7.23	24.61±5.37	37.61±4.31
Control group (n = 30)	45.36±5.46	52.48±5.61	430.52±7.55	444.21±6.59	24.75±5.63	28.47±4.51
t value	0.1088	6.6827	0.0052	29.8813	0.0985	8.0249
P value	0.9137	0.0000	0.9959	0.0000	0.9218	0.0000

3.3. Comparing the recovery effect

The recovery effect of the study group was significantly higher than that of the control group, the difference was statistically significant ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of the effective rate of recovery among the groups [n (%)]

Group	Markedly effective	Effective	Ineffective	Total recovery effect
Study group (n = 30)	19 (63.33)	11 (36.67)	0 (0.00)	30 (100.00)
Control group (n = 30)	15 (50.00)	11 (36.67)	4 (13.33)	26 (86.67)
x^2 value	-	-	-	4.2857
P value	-	-	-	0.0384

4. Discussion

The knee joint is the most complex joint, and it is easily damaged during exercise. Mild cases can be treated conservatively, while severe cases require surgical treatment [5]. Knee joint surgery is a large-scale operation, which will cause damage to human tissue during the operation, and requires long-term immobilization of the patient after the operation, thus the muscle function is likely to decline, which will cause joint dysfunction [6]. The quadriceps is an important muscle group of the knee joint. It is the largest and most powerful muscle. Poor recovery of this muscle will directly affect the function of the lower limbs. Therefore, the rehabilitation of patients after knee joint surgery is very important [7]. In Chinese medicine, joint damage is regarded as damage caused by blocked meridians, and poor *qi* and blood. Electroacupuncture is a new type of acupuncture based on traditional acupuncture and uses the principle of electric pulses to apply electroacupuncture to acupuncture points in order to stimulate blood flow and dredge the meridians [8,9]. Under the action of electric current, the capillaries will gradually expand after stimulation, which will speed up circulation, provide blood supply to joints and nearby muscles, and also eliminate local hematoma and relieve pain [10,11]. Rehabilitation training is mainly aimed at exercising limb functions, activating and exercising the quadriceps, promoting the recovery of muscle function, restoring the original range of motion of the knee joint, reducing the adhesion between ligaments, strengthening muscle strength, effectively preventing muscle pain, and strengthening muscle control [12,13]. The combination of electroacupuncture and rehabilitation training stimulates the muscles from the inside out, which can not only promote the recovery of joints and muscles, but also effectively prevent the occurrence of joint deformities and protect the normal physiological structure of joints, which has a certain value to the rehabilitation of patients after surgery [14,15].

Before recovery, there was no statistically significant difference ($P > 0.05$) in the recovery indexes of knee joint function such as function, muscle strength, flexion deformity, range of motion, and stability between the groups. After recovery, the function, muscle knee joint function recovery indicators such as strength, flexion

deformity, range of motion, and stability in the study group were significantly better than those in the control group, and the difference was statistically significant ($P < 0.05$). Before recovery, the PT, TW, and AP at 60°/s isokinetic muscle strength tests of the two groups were compared, and the difference was not statistically significant ($P > 0.05$). After recovery, the PT, TW, and AP at 60°/s isokinetic muscle strength tests of the study group were significantly higher than those of the control group, the difference was statistically significant ($P < 0.05$). The recovery effect of the study group was significantly higher than that of the control group, the difference was statistically significant ($P < 0.05$). Under the implementation of electroacupuncture combined with rehabilitation training, the recovery of joint function in patients is more ideal, the degree of recovery of quadriceps muscle strength is more significant, and the overall recovery effect is better. The application of this program in patients after knee joint surgery has achieved high clinical value and is significant in the recovery of quadriceps muscle strength.

In summary, the application of electroacupuncture combined with rehabilitation training after knee joint surgery can promote the recovery of quadriceps muscle strength and improve knee joint function. This rehabilitation program is worthy of wide application in clinical practice.

Disclosure statement

The author declares no conflict of interest.

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