

Study on the Efficacy of Interference Electrotherapy Combined with Intensive Training of Gluteal and Core Muscles in the Recovery Period of Piriformis Syndrome

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Abstract: *Objective:* To investigate the practical efficacy of interference electrotherapy combined with hip and core muscle strengthening training in the recovery phase of piriformis syndrome, and to provide reference for clinical rehabilitation treatment. *Methods:* 80 patients with piriformis syndrome in the recovery phase admitted to our hospital from January 2024 to December 2025 were selected and divided into two groups using a random number table method, with 40 cases in each group. The conventional training group only received hip and core muscle strengthening training, while the combined treatment group received additional interference electrotherapy on the basis of the conventional training group. The pain scores (VAS), hip joint function scores (Harris), and incidence of adverse reactions were compared between the two groups. *Results:* After treatment, the VAS score in the combined treatment group was lower than that in the conventional training group, the Harris score was higher than that in the conventional training group, and the incidence of adverse reactions was lower than that in the conventional training group. The differences in each data were statistically significant ($p < 0.05$). *Conclusion:* The application of interference electrotherapy combined with hip and core muscle strengthening training in the recovery phase of piriformis syndrome can effectively reduce patient pain, improve hip joint function, and reduce the risk of adverse reactions, with high clinical application value.

Keywords: Interferential electrotherapy; Gluteal muscle group strengthening training; Core muscle group strengthening training; Piriformis syndrome; Recovery period; Pain score

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1. Introduction

Piriformis syndrome is a common clinical soft tissue injury disease. It is mainly caused by piriformis muscle injury, spasm or edema that compresses the sciatic nerve. Patients often experience symptoms such as buttock pain, radiating pain in the lower limbs, and limited hip joint movement. Improper rehabilitation treatment after entering the recovery period can easily lead to recurrence of the condition or even chronic pain, seriously affecting patients' daily activities and quality of life ^[1]. With changes in people's lifestyles, factors such as long-term sitting and poor posture have led to an increase in the incidence of piriformis syndrome year by year, and the patient population is gradually getting younger. Effective rehabilitation treatment during the recovery period is not only related to the relief of patients' symptoms, but also affects their ability to return to normal work and life ^[2]. Currently, patients in the recovery phase of piriformis syndrome

mostly use single muscle group strengthening training to strengthen muscle strength and improve local blood circulation by exercising the buttocks and core muscles. However, single training has a slow onset of effect. Some patients have poor training compliance due to lack of obvious pain relief, and even training interruptions. As a physical therapy method, interference electrotherapy can stimulate local tissues through low-frequency current, relieve muscle spasms, reduce pain, and promote the absorption of inflammation. Combining it with muscle group strengthening training may produce a synergistic effect, which can quickly relieve symptoms and enhance muscle function, thereby improving the overall recovery effect. Based on this, this study compares and analyzes the efficacy of interference electrotherapy combined with intensive training of the hip and core muscle groups and intensive training of a single muscle group to provide a better rehabilitation treatment plan for patients in the recovery period of piriformis syndrome and help patients recover faster and safer.

2. Materials and methods

2.1. General information

80 convalescent patients with piriformis syndrome admitted to our hospital from January 2024 to December 2025 were selected and divided into a conventional training group and a combined treatment group using a random number table method, with 40 cases in each group. Among them, there were 23 men and 17 men in the conventional training group, aged 28 to 65 years old, with an average age of (45.62 ± 5.38) years, and a disease duration of 1 to 3 months, with an average of (1.85 ± 0.42) months; in the combined treatment group, there were 22 men and 18 men, 29 to 64 years old, with an average age of (46.15 ± 5.24) years, and a disease duration of 1 to 3 months, with an average of (1.92 ± 0.38) months. There was no statistically significant difference in general data such as gender, age, disease course, etc. between the two groups of patients ($p > 0.05$), and they were comparable.

2.1.1. Inclusion criteria

- (1) Meet the diagnostic criteria for piriformis syndrome and be in the recovery period;
- (2) VAS score of buttocks and lower limb pain is 3 to 7 points;
- (3) The patient is informed and signs a consent form.

2.1.2. Exclusion criteria

- (1) Combined with other nerve compression diseases such as lumbar disc herniation;
- (2) Skin damage or allergies to electrode pads;
- (3) Severe heart, liver, and kidney dysfunction.

2.2. Method

The conventional training group only carried out strengthening training of the buttocks and core muscles. The specific content is as follows.

2.2.1. Buttock muscle training

- (1) Clam opening and closing
The patient lies on his side, bend the knees 90° , keep the pelvis stable, slowly open the knee joint to the maximum angle and then slowly lower it, 15 times per group, 3 groups a day;
- (2) Glute bridge exercise
The patient lies on his back, bend the knees, place both feet on the ground, slowly raise the buttocks to make the body in a straight line, hold for 3 seconds and then slowly lower it, 12 times per group, 3 groups per day;
- (3) Single-leg deadlift
The patient stands on one leg, straighten the other leg back, slowly lean forward until the back is parallel to the

ground, hold for 2 seconds and then stand up, 10 times per group, 2 groups per day.

2.2.2. Core muscle training

(1) Plank support

The patient lies prone, support the body with the forearms and toes, and keep the body in a straight line, hold for 30 seconds each time, 3 times a day;

(2) Abdominal curling exercise

The patient lies on his back, bends the knees, holds the head with both hands, and slowly lifts the upper body to the scapula leaves the ground, 15 times per group, 3 groups a day;

(3) Side plank support

The patient lies on his side, using one forearm and the outside of the foot to support the body to keep the body stable, hold for 20 seconds each time, 2 groups a day, the above training lasts for 8 weeks.

The combined treatment group additionally applied interfering electric therapy on the basis of the conventional training group, using ultrasound and electrical stimulation therapy devices produced by Shenzhen Dongdixin Technology Co., Ltd. CT2404; Specific operation: The patient lies prone, exposes the buttock pain area, and sticks four electrode pads around the pain area. Waveform: continuous wave, pulse wave; pulse repetition frequency: 16 Hz, 48 Hz, 100 Hz; acoustic working frequency: 1 MHz–10%, 3 MHz \pm 10%; effective sound intensity: no more than 3.0 W/cm², each treatment is 20 minutes, 5 times a week, for 8 weeks, and the treatment time is more than 1 hour apart from the muscle group training time.

2.3. Observation indicators

The pain VAS score (0 to 10, the higher the score, the more severe the pain), the hip joint function Harris score (the full score is 100, the higher the score, the better the hip joint function), and the incidence of adverse reactions during treatment (statistics of the number of adverse reactions such as skin redness and swelling, aggravation of muscle soreness, etc. to the total number of cases) were compared between the two groups before treatment and after 8 weeks of treatment.

2.4. Statistical methods

SPSS24.0 was used to analyze the data. Measurement data used *t*-test and count data used χ^2 test. $p < 0.05$ represented significant differences.

3. Results

3.1. Comparison of VAS scores between the two groups before and after treatment

There was no statistically significant difference in VAS scores between the two groups before treatment ($p > 0.05$). After treatment, the VAS score of the combined treatment group was lower than that of the conventional training group ($p < 0.05$), see **Table 1**.

Table 1. Comparison of VAS scores between the two groups before and after treatment ($\bar{x} \pm s$, points)

Group	Total number of cases	Pre-treatment score	Post-treatment score
Regular training group	40	5.36 \pm 0.82	3.15 \pm 0.68
Combined treatment group	40	5.42 \pm 0.79	1.28 \pm 0.53
<i>t</i>		0.333	13.718
<i>p</i>		0.740	0.000

3.2. Comparison of Harris scores between the two groups before and after treatment

After treatment, the Harris score of the combined treatment group was higher than that of the conventional training group ($p < 0.05$), see **Table 2**.

Table 2. Comparison of Harris scores between the two groups before and after treatment ($\bar{x} \pm s$, points)

Group	Total number of cases	Pre-treatment score	Post-treatment score
Regular training group	40	62.35 ± 5.42	78.62 ± 4.85
Combined treatment group	40	63.18 ± 5.27	91.36 ± 4.12
<i>t</i>		0.694	12.662
<i>p</i>		0.490	0.000

3.3. Comparison of the incidence of adverse reactions between the two groups

The incidence of adverse reactions in the combined treatment group was lower than that in the conventional training group ($p < 0.05$), see **Table 3**.

Table 3. Comparison of the incidence of adverse reactions between the two groups [n (%)]

Group	Total number of cases	Red and swollen skin	Worsening of muscle soreness	Overall incidence
Regular training group	40	4 (10.00)	5 (12.50)	9 (22.50)
Combined treatment group	40	1 (2.50)	0 (0.00)	1 (2.50)
χ^2				7.314
<i>p</i>				0.007

4. Discussions

The core treatment goals of piriformis syndrome during the recovery period are to relieve pain, improve muscle function and prevent recurrence of the disease. Although strengthening training of a single muscle group can improve local mechanical balance by strengthening the strength of the hip and core muscle groups, it is difficult to quickly relieve muscle spasm and inflammatory reaction, leading some patients to give up training because the pain is not significantly relieved in the early stage of treatment. As a low-frequency pulse electrotherapy technology, interference electrotherapy uses two sets of medium-frequency currents of different frequencies to cross-act on human tissues to form a low-frequency interference electric field in the body. This electric field can stimulate nerve endings, inhibit pain signal transmission, promote local blood circulation and lymphatic return, and accelerate inflammatory mediators. This is also an important reason why the VAS score of the combined treatment group is significantly lower than that of the conventional training group after treatment, because the rapid relief of pain can allow patients to feel the treatment effect more intuitively, thereby enhancing treatment confidence and increasing enthusiasm for subsequent training^[3].

From the perspective of neurophysiological mechanisms, the low-frequency current generated by interference electrotherapy can also activate the body's endogenous analgesic system, promote the release of endorphins and other analgesic substances, and further enhance the analgesic effect. However, the conventional training group only relies on the indirect analgesic effect brought by the improvement of muscle blood circulation during training, and the onset of effect is much slower than that of the combined treatment group. In addition, long-term spasm of the piriformis muscle will lead to hypoxia and ischemia in local tissues, forming a vicious cycle of "pain-spasm-ischemia". Interfering electrotherapy

breaks this cycle by improving local blood supply, creating a good environment for muscle function recovery. If the conventional training group cannot break this cycle in time, even if the muscle group is trained, the training effect may be affected by continued muscle ischemia, and even muscle damage may be aggravated. From the perspective of hip joint function improvement, the Harris score covers multiple indicators such as pain, joint mobility, and walking ability, and can comprehensively reflect the functional status of the hip joint. Although the conventional training group can enhance muscle strength and improve joint stability through hip and core muscle training, due to slow pain relief, patients may reduce the range of joint motion due to fear of pain during training, affecting the training effect ^[4,5]. In the combined treatment group, with the assistance of interference electrotherapy, the pain was quickly relieved, and the patients could participate more actively in muscle group training. Interference electrotherapy can also promote muscle fiber repair and regeneration, enhance muscle contraction function, form a synergy with muscle group training, and further improve hip joint mobility and walking ability. Therefore, after treatment in the combined treatment group, Harris score is significantly higher. For example, in the gluteal bridge exercise, patients in the combined treatment group can complete the movements more easily due to reduced pain, and can maintain the correct posture for a longer period of time, thereby more effectively exercising the gluteus maximus, erector spinae and other related muscle groups. However, patients in the conventional training group may have deformed movements due to pain and cannot fully activate the target muscle groups, affecting the training effect. From the perspective of muscle biomechanics, the gluteal muscle group is the main external rotator muscle group of the hip joint. Insufficient strength or dysfunction will lead to mechanical imbalance of the hip joint, thereby increasing the burden on the piriformis muscle. The core muscle group, as the “central hub” of the human body, plays an important role in maintaining pelvic stability and reducing the load on the lower limbs ^[6]. The combined treatment group first relieves muscle spasms and improves muscle elasticity through interference electrotherapy, and then enhances muscle strength through targeted training to make muscle function recovery more systematic. However, the conventional training group directly performs strength training without relieving muscle spasms, which may lead to muscle compensation, such as over-reliance on the lower back muscles to complete glute bridge movements, which in turn increases the risk of waist injury. This is one of the reasons why some patients in the conventional training group experience worsening muscle soreness. In terms of adverse reactions, the aggravation of muscle soreness in the conventional training group was mostly due to the patient’s initial training intensity being too high or irregular movements, which led to muscle micro-damage, while skin redness and swelling were related to local friction during training. In the combined treatment group, only one case of skin redness and swelling occurred, and there was no worsening of muscle soreness. This is because interference electrotherapy can promote local blood circulation, provide sufficient nutrients for muscle repair, and reduce the occurrence of muscle soreness after training. At the same time, the electrode patch sticking position and current intensity are strictly controlled during treatment, reducing the risk of skin irritation. In addition, interference electrotherapy is simple to operate, non-invasive, has high patient acceptance, and can improve overall treatment compliance, which also provides guarantee for the improvement of treatment effects. However, some patients in the conventional training group may experience reduced training frequency or insufficient training intensity due to obvious muscle soreness in the early stages of training, which affects the final efficacy ^[7].

From the perspective of clinical application, the combined program of interference electrotherapy and strengthening training of the buttocks and core muscles is easy to operate and highly safe. It does not require complex equipment and professional technology and can also be carried out in primary hospitals. During the treatment process, the current intensity and training intensity that interfere with electrotherapy need to be adjusted according to the patient’s tolerance to avoid adverse reactions caused by excessive intensity. At the same time, patients are guided to master the correct training movements to ensure the training effect. For example, during clam opening and closing training, patients need to be reminded to maintain pelvic stability, avoid waist compensation, and prevent waist muscle damage; when interfering with electrotherapy, if the patient experiences skin itching or tingling, the position of the electrode pads needs to be adjusted in time or the current intensity must be reduced to ensure treatment safety. Controlling these details can further reduce the risk of adverse reactions and improve the safety and reliability of treatment. Compared with other rehabilitation programs,

such as acupuncture, massage and other traditional therapies, the advantage of interference electrotherapy combined with muscle group training is that the efficacy is more stable and highly reproducible. The efficacy of acupuncture and massage is greatly affected by the operator's technical level, while interference electrotherapy ensures the consistency of treatment through fixed parameter settings, and muscle group training ensures training quality through standardized action procedures^[8]. In addition, this combined regimen can also reduce the use of analgesic drugs and reduce the risk of adverse drug reactions, which is in line with the development trend of clinical "green treatment", because long-term use of non-steroidal analgesics may cause adverse reactions such as gastrointestinal damage, liver and kidney function damage, and combined treatment relieves symptoms through physical means and exercise therapy, avoiding drug-related risks. From the perspective of long-term recovery of patients, the combined treatment plan can not only improve the patient's current symptoms, but also improve the body's ability to prevent piriformis muscle injury by enhancing muscle strength and reduce the risk of recurrence. Clinical follow-up found that the recurrence of piriformis syndrome is mostly related to insufficient strength of the buttocks and core muscles and poor posture. After systematic training, patients in the combined treatment group significantly increased their muscle strength, which can better maintain the mechanical balance of the hip joint and reduce the probability of re-injury of the piriformis muscle^[9,10]. Although the conventional training group also performed muscle group training, due to initial pain affecting the quality of training, some patients did not see significant improvement in muscle group strength, and the risk of recurrence was relatively high. This also reflects the advantages of the combined treatment program in long-term rehabilitation.

It should be noted that this study did not conduct long-term follow-up of patients, so the preventive effect of the combined regimen on disease recurrence cannot be clarified, and the sample size is limited, which may have certain limitations. However, judging from the existing results, interference electrotherapy combined with hip and core muscle strengthening training is significantly more effective than single training in relieving pain and improving hip joint function. It is also highly safe and worthy of clinical promotion and application. In future clinical practice, the sample size can be further expanded, the follow-up time can be extended, the long-term efficacy and safety of this program can be studied in depth, and the impact of different treatment parameters on the efficacy, such as the effects of different current frequencies and training intensity on the treatment effect, can be explored to develop more individualized treatment plans for patients. In addition, stratified analysis can be conducted based on factors such as the patient's age, disease course, etc. to clarify the effectiveness of the program in different groups, further improve the treatment program, and provide high-quality rehabilitation services to more patients in the recovery period of piriformis syndrome.

In summary, the application of interference electrotherapy combined with intensive training of the hip and core muscles during the recovery period of piriformis syndrome can effectively reduce patients' pain, improve hip joint function, and reduce the risk of adverse reactions. It provides a reliable guarantee for the patient's recovery and has important clinical promotion value. In actual treatment, it is necessary to strengthen communication between doctors and patients, so that patients can fully understand the principles and precautions of treatment, improve treatment compliance, and at the same time regularly evaluate the treatment effect, adjust the treatment plan according to the patient's recovery situation, ensure the effectiveness and safety of the treatment, and help patients recover faster and return to normal life.

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Disclosure statement

The author declares no conflict of interest.

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