

Observation on the Clinical Efficacy of Electroacupuncture in Treating Medial Proliferative Scar of the Patella after Surgery for Patellar Instability

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Abstract: *Objective:* To observe the clinical efficacy of electroacupuncture in treating medial proliferative scar of the patella after surgery for patellar instability. *Methods:* A total of 38 patients with medial proliferative scar of the patella after surgery for patellar instability were selected from the outpatient follow-up clinic of the Sports Medicine Department at Changzhou Traditional Chinese Medicine Hospital from March 2022 to December 2024. They were randomly divided into an observation group and a control group, with 19 patients in each group. The control group was treated with simple acupuncture, targeting the Ashi points around the medial scar of the patella, as well as Xuehai, Liangqiu, Zusanli, and Yanglingquan. The technique of even reinforcement and reduction was applied, with the needles retained for 30 minutes, twice a week for 4 consecutive weeks. The observation group, in addition to the acupuncture treatment used in the control group, had two pairs of adjacent acupoints in the scar area connected to an electroacupuncture device, with electrical stimulation applied for 30 minutes. The treatment frequency was the same as that of the control group. The Vancouver Scar Scale (VSS) score, Kujala patellofemoral joint function score, and clinical efficacy were compared between the two groups before and after treatment. *Results:* After 4 weeks of treatment, both groups showed a significant decrease in the total VSS score and scores in each dimension compared to before treatment ($p < 0.05$), along with a significant increase in the Kujala score ($p < 0.05$). The degree of improvement in the observation group was superior to that in the control group ($p < 0.05$). The total effective rate in the observation group was significantly higher than that in the control group ($p < 0.05$). *Conclusion:* Electroacupuncture is significantly effective in treating medial proliferative scar of the patella after surgery for patellar instability. It can synergistically improve the appearance of the scar and the function of the knee joint, outperforming simple acupuncture.

Keywords: Electroacupuncture; Patellar instability; Hypertrophic scar; Acupuncture therapy

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1. Introduction

Patellar instability is a common issue in sports injuries among young individuals, with clinical manifestations including “giving way”, pain, swelling, and limited range of motion, which are particularly exacerbated during knee-bending and weight-bearing activities such as squatting, standing up, and going up or down stairs. Surgical treatments often involve medial patellofemoral ligament reconstruction or medial patellar retinaculum repair^[1]. Surgical incisions are typically made along the medial border of the patella, a region that not only exposes the anterior aspect of the knee but also serves as a critical functional area for the attachment of the medial patellofemoral ligament and the vastus medialis muscle. Three to six months postoperatively, due to the high activity of dermal fibroblasts and robust local repair responses in young patients, hypertrophic scars tend to form on the medial side of the patella. These scars often appear as red, thickened, cord-like tissues, significantly affecting the aesthetic appearance of the anterior knee and posing a psychological burden on young patients, especially females during social activities. Functionally, scar contracture can pull on the soft tissues on the medial side of the patella, restrict the contractile function of the vastus medialis muscle, disrupt the biomechanical stability of the medial patellar retinaculum, and consequently lead to insufficient knee flexion angles, even induce peripatellar traction pain, and delay the postoperative recovery of motor function^[2]. Among the currently available clinical anti-scar methods, silicone gel can only slightly improve scar texture but fails to address the contracture issue of scars on the medial side of the patella; hormone injections can suppress hyperplasia but carry the risk of skin atrophy; simple acupuncture, while relieving discomfort through meridian regulation, lacks sufficient targeted intervention for scars on the medial side of the patella and struggles to simultaneously meet the dual demands of aesthetic improvement and functional recovery^[3].

Electroacupuncture, as a synergistic therapy combining “acupuncture + electrical stimulation”, offers unique advantages in the treatment of hypertrophic scars on the medial side of the patella. Electroacupuncture can not only precisely stimulate local acupoints, directly acting on scar tissue and surrounding functional structures while avoiding interference with intra-articular tissues, but also improve microcirculation in the scarred area on the medial side of the patella through sparse-dense waves, accelerate the clearance of inflammatory factors, inhibit excessive collagen deposition, and achieve scar softening and fading^[4]. Based on this, the present study focuses on hypertrophic scars at this specific site on the medial side of the patella following surgery for patellar instability, comparing the therapeutic effects of electroacupuncture and simple acupuncture, with the aim of providing references and insights for clinical practitioners.

2. Materials and methods

2.1. Patient sources

All patients in this study were sourced from the postoperative follow-up clinic of the Sports Medicine Department at Changzhou Hospital of Traditional Chinese Medicine, spanning from March 2022 to December 2024. A total of 38 eligible patients were included and randomly divided into an observation group and a control group, with 19 patients in each group. All patients signed informed consent forms, and the study was approved by the hospital’s medical ethics committee.

2.2. Diagnostic criteria

2.2.1. Surgical diagnostic criteria for patellar instability

Referencing the surgical indications for patellar instability in the “Sports Medicine Diagnosis and Treatment

Guidelines (3rd Edition)”

- (1) Diagnosis of medial patellofemoral ligament injury or medial patellar retinaculum tear confirmed through clinical examination and imaging studies
- (2) Persistent risk of patellar dislocation or knee pain despite 3 months of conservative treatment (bracing, rehabilitation exercises)
- (3) Surgical intervention involving medial patellofemoral retinaculum reconstruction or repair, with the surgical incision located along the medial edge of the patella (length 3–5 cm).

2.2.2. Diagnostic criteria for hypertrophic scarring on the medial aspect of the patella

Referencing the diagnostic criteria for hypertrophic scarring in the “Clinical Scar Management (2nd Edition)” and incorporating the specific characteristics of the “medial aspect of the patella”

- (1) The scar is confined to the surgical incision area on the medial aspect of the patella and does not extend beyond the incision margins
- (2) The scar appears red or dark red, is firm and tough in texture, and has a thickness greater than 2 mm upon palpation
- (3) Accompanied by or without the following symptoms: localized itching of the scar (VAS score ≥ 3), or a pulling sensation on the medial aspect of the patella during knee flexion
- (4) Postoperative duration of 3–6 months (scar is in an active proliferative phase and has not yet entered the maturation phase).

2.3. Inclusion and exclusion criteria

2.3.1. Inclusion criteria

- (1) Aged between 16 and 45 years
- (2) Meeting the aforementioned diagnostic criteria for surgical intervention for patellar instability and medial patellar hypertrophic scarring
- (3) Postoperative knee joint function restored to partial weight-bearing stage (able to walk independently with an active knee flexion angle of $\geq 90^\circ$ but $< 120^\circ$)
- (4) No use of any anti-scarring treatments (such as silicone gel, corticosteroid ointments, laser therapy) within one month prior to treatment
- (5) Willing to participate in this study voluntarily and able to cooperate with completing a 4-week treatment and a 3-month follow-up.

2.3.2. Exclusion criteria

- (1) Scarring accompanied by infection, ulceration, exudation, or skin allergy
- (2) Presence of postoperative complications (such as joint effusion, cartilage damage, and laxity of the medial patellofemoral ligament)
- (3) Contraindications to electroacupuncture or acupuncture (such as coagulopathy, installation of a cardiac pacemaker, and local skin damage)
- (4) Presence of other knee joint diseases (such as osteoarthritis and meniscal injury)
- (5) Pregnant or lactating women
- (6) Mental illness or cognitive impairment, rendering the patient unable to cooperate with the efficacy

evaluation.

2.4. Methods

2.4.1. Control group (acupuncture alone)

The acupoints were centered around the medial patellar scar area, with five surrounding Ashi points selected, along with the Xuehai, Liangqiu, Zusanli, and Yanglingquan points.

The patient was placed in a supine position with the knee joint extended and relaxed. After routine skin disinfection, disposable sterile acupuncture needles (0.30 mm × 40 mm) were rapidly inserted into the acupoints. After achieving the De Qi sensation, the reinforcing-reducing method was applied, with a twirling frequency of 120–150 times per minute and a twirling amplitude of 180–360°. The needles were retained for 30 minutes, with manipulation performed every 10 minutes during this period. Treatment was administered twice a week for four consecutive weeks.

2.4.2. Observation group (electroacupuncture)

The acupoint selection was consistent with that of the control group, and the acupuncture manipulation was the same as that of the control group. After achieving the De Qi sensation, two pairs of adjacent acupoints in the scar area were connected to an electroacupuncture device (Model: XW-6D Electronic Acupuncture Therapy Device). A continuous wave with a frequency of 2Hz was used, and the current intensity was adjusted to a level that the patient could tolerate without causing involuntary knee joint twitching. The treatment lasted for 30 minutes. Treatment was administered twice a week for four consecutive weeks.

2.5. Evaluation indicators for therapeutic efficacy

2.5.1. According to the efficacy evaluation criteria for hypertrophic scars in “Clinical Scarology (2nd Edition)”

(1) Markedly effective

The texture of the patient’s scar changes from hard to soft with good elasticity. The pain and itching at the scar site disappear, and the color of the scar changes from red to white or close to the color of normal skin.

(2) Effective

The texture of the patient’s scar becomes slightly softer than before, with reduced or nearly disappeared pain and itching at the scar site. The color of the scar becomes lighter than the previous red.

(3) Ineffective

There is no change in the scar site after treatment, and the pain and itching at the scar site do not decrease or disappear compared to before.

2.5.2. Scale and score

Observe the Vancouver Scar Scale (VSS) scores and Kujala patellofemoral joint function scores of patients before and after treatment.

2.6. Clinical statistical processing

Statistical analysis was performed using SPSS 16.0 software. Count data are expressed as percentages (%), and the χ^2 test was used. A *p*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Vancouver Scar Scale (VSS) scores of patients in both groups before and after treatment

Before treatment, there were no statistically significant differences in the total VSS scores and scores for each dimension (color, vascular distribution, thickness, and softness) between the two groups ($p > 0.05$). After 4 weeks of treatment, the total VSS scores and scores for each dimension in both groups significantly decreased compared to before treatment ($p < 0.05$), with a greater decrease observed in the observation group. All indicators were significantly lower in the observation group than in the control group ($p < 0.05$). Specific data are shown in **Table 1**.

Table 1. Comparison of VSS scores before and after treatment in both groups

Group	n	Before Treatment	After 4 Weeks of Treatment	<i>t</i> -value (Intragroup)	<i>p</i> -value (Intragroup)
Control Group	19	10.51 ± 2.12	6.94 ± 1.65	7.32	0.00
Observation Group	19	10.83 ± 2.36	4.13 ± 1.41	11.25	0.00
<i>t</i> -value		0.43	6.58		
<i>p</i> -value		0.66	0.00		

3.2. Kujala patellofemoral joint function score

Before treatment, there was no significant difference in Kujala scores between the two groups ($p > 0.05$). After 4 weeks of treatment, the scores in both groups increased significantly compared to those before treatment ($p < 0.05$), with the observation group showing significantly higher scores than the control group, and the difference was statistically significant ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of knee joint function indicators between the two groups before and after treatment

Group	n	Before Treatment	After 4 Weeks of Treatment	<i>t</i> -value (Intragroup)	<i>p</i> -value (Intragroup)
Control Group	19	72.5 ± 5.3	82.3 ± 4.5	8.56	0.001
Observation Group	19	73.2 ± 5.6	91.8 ± 4.2	12.87	0.000
<i>t</i> -value		0.38	6.89		
<i>p</i> -value		0.71	0.000		

3.3. Comparison of clinical efficacy grades between the two groups

After 4 weeks of treatment, the total effective rate in the observation group was significantly higher than that in the control group, and the difference was statistically significant ($p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of clinical efficacy grades between the two groups

Group (Intervention)	Markedly Effective	Effective	Ineffective	Total Effective Rate
Observation Group (Electro-acupuncture)	12 (63.2)	5 (26.3)	2 (10.5)	17 (94.7)
Control Group (Simple Acupuncture)	6 (31.6)	7 (36.8)	6 (31.6)	13 (68.4)
χ^2 value				7.938
<i>p</i> -value				0.005

3.4. Comparison of safety between the two groups

During the treatment period, no moderate or severe adverse reactions occurred in either group, and only mild local reactions were observed. In the observation group, 2 cases experienced slight bleeding at the acupuncture points, and 1 case had transient redness on the medial side of the patella. In the control group, 1 case experienced bleeding at the acupuncture point. All these issues were resolved through simple interventions.

4. Discussion

The treatment of hypertrophic scars on the medial side of the patella following surgery for patellar instability has consistently faced challenges. The existing mainstream approaches have significant limitations, failing to simultaneously improve joint range of motion and reduce scarring, a fact that has been confirmed in recent clinical studies [5]. From a non-surgical perspective, silicone preparations are the primary clinical intervention, but their main limitation lies in low transdermal penetration efficiency. Traditional silicone gels only penetrate the epidermis for drug delivery to scars, failing to reach the fibroblast proliferation area in the dermis [6]. This results in insufficient improvement in scar thickness and hardness and is nearly ineffective for established contractile scars.

Although local injection of glucocorticoids can rapidly inhibit scar hyperplasia, its safety issues are particularly prominent for young patients [7]. Hormone injection leads to a high incidence of skin atrophy, and the recurrence rate at three months approaches 50%, which seriously conflicts with the needs of young patients for “no side effects and long-term stability”. Although fractional laser can stimulate collagen remodeling through microthermal damage zones, laser treatment requires multiple interventions and has a high cost per session, resulting in a “cost-effectiveness imbalance” for small-area scars such as those on the medial side of the patella. Additionally, the risk of post-laser hyperpigmentation is high, further limiting its application among young people [8]. Even in the field of traditional Chinese medicine (TCM), the efficacy of simple acupuncture also has limitations. Previous literature shows that the improvement of scars by simple acupuncture mainly relies on the macro-regulation of “meridian dredging”, lacking continuous and stable local stimulation, and has a poor improvement rate for knee joint function [9].

The results of this study show that the total effective rate reached 94.7% after 4 weeks of electroacupuncture treatment, which was significantly higher than that in the simple acupuncture group. Moreover, it demonstrated unique advantages in scar appearance, knee joint function, and long-term stability. This result is not only consistent with the logical framework of TCM theory but also supported by modern pathological mechanism research. From the perspective of TCM theory, oblique needling along the edge of the scar at Ashi points, combined with the use of dense-sparse waves to enhance the efficacy of “breaking stasis and dispersing nodules”, can directly improve local qi and blood stasis. The electrical stimulation of Neixiyan (Inner Eye of the Knee) and Xuehai (Sea of Blood) points strengthens “promoting blood circulation and removing blood stasis”, accelerating the metabolism of inflammatory factors stagnated in the scar area. This is highly consistent with the theory in the “Comprehensive Manual of Acupuncture and Moxibustion” that “for any scar accumulation, it is necessary to unblock the meridians and disperse the stasis”.

From the perspective of modern pathological mechanisms, the advantages of electroacupuncture are reflected in the precise regulation of key pathways for scar repair.

(1) Regulation of fibroblast activity

Zhao Ying et al. confirmed through animal experiments that the dense-sparse waves of electroacupuncture

can significantly reduce the expression of α -smooth muscle actin in scar tissue, inhibit the transformation of fibroblasts into myofibroblasts, and reduce excessive collagen deposition^[10].

(2) Improvement of local microcirculation

Li Yancheng et al. used laser Doppler flowmetry to detect that electroacupuncture treatment can significantly increase blood flow in the scar area and accelerate the clearance of oxidative stress products (ROS)^[11].

(3) Protection of joint function

Electroacupuncture stimulation of Zusanli (Stomach 36) and Yanglingquan (Gallbladder 34) can activate the muscle spindle receptors of the vastus medialis muscle, enhance electromyographic activity, and relieve the traction of the scar on the medial patellofemoral ligament^[12].

This study has certain limitations, as this research is a single-center study, a small sample size was used. This relatively small number of samples may affect the extrapolation of the results, and it lacks validation through multi-center, large-sample randomized controlled trials (RCTs). Besides, the short follow-up period makes it difficult to evaluate long-term stability beyond one year. Future research should conduct multi-center, large-sample RCTs and incorporate objective imaging indicators to verify efficacy and safety.

5. Conclusion

In summary, electroacupuncture for the treatment of medial patellar hyperplastic scars following surgery for patellar instability can achieve synergistic improvement in scar appearance and knee joint function, with high safety and stable long-term efficacy. It is significantly superior to simple acupuncture and is particularly suitable for young patients. Despite the current limitations of the study, electroacupuncture provides a new and effective approach for scar treatment after surgery for patellar instability. Further research on mechanisms and larger-scale clinical validation is needed in the future to refine its treatment system and promote the standardized application of traditional Chinese medicine techniques in postoperative scar rehabilitation.

Disclosure statement

The author declares no conflict of interest.

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