THE EFFECT OF BIONIC BIOELECTRICAL TECHNOLOGY IN THE COMBINED TREATMENT OF POSTPARTUM PUBIC SYMPHYSIS SEPARATION AND ITS INFLUENCE ON POSTPARTUM PAIN AND QUALITY OF LIFE

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ABSTRACT

Objective: *To investigate the effect of bionic bioelectrical technology in the combined treatment of postpartum pubic symphysis separation on postpartum pain and quality of life.*

Methods: *102 cases of postpartum pubic symphysis separation in our hospital were selected from October 2018 to December 2019 and divided into the observation group (53 cases) and control group (49 cases) according to different treatment methods. The control group was given routine postpartum care, hard bed, and pelvic belt restraint treatment, while the observation group was treated with bionic bioelectrical technology. After one month of treatment, the curative effect in the two groups was compared, and the scores of visual analog scale (VAS), pubic symphysis separation distance, and activity of daily living (ADL) were evaluated before the treatment and 1 day and 1 month after the treatment.*

Results: *After the treatment, the total effective rate of the observation group was 100.00%, which was higher than 77.55% of the control group (χ^2=13.336, P<0.001). Besides, with the prolongation of time after the treatment, the VAS scores of the two groups showed a downward trend. However, the VAS score of the observation group 1 day and 1 month after the treatment was lower than that of the control group, with a statistically significant difference (P<0.05 or P<0.01). after the treatment Moreover, the separation distances of pubic symphysis of the two groups showed a downward trend in the follow-up stage. Moreover, the pubic symphysis separation distance of the observation group after the treatmentwas shorter 1 day and 1 month after the treatment than that of the control group (P<0.05 or P<0.01). After the treatment, the ADL scores of the two groups showed an increasing trend, and the ADL scores of the observation group 1 day and 1 month after the treatment were higher than those of the control group at the same time, showing a statistically significant difference (P<0.05 or P<0.01).*

Conclusion: *Bionic bioelectrical technology in the combined treatment of postpartum pubic symphysis separation could effectively improve clinical efficacy, reduce maternal pain, shorten the pubic symphysis separation distance, and improve the postpartum quality of life.*

Keywords: *Pubic symphysis separation, postpartum, bionic bioelectrical technology, clinical efficacy, postpartum pain, quality of life.*

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Introduction

Separation of pubic symphysis refers to a soft tissue injury disease with slight dislocation of pubic fibrocartilage symphysis on both sides of the pelvis due to an external force, which is characterized by widening distance of pubic symphysis or dysfunction such as local pain and difficulty in lifting lower limbs due to dislocation[1]. The pathogenesis of pubic symphysis separation is that the relaxation and rupture of pubic symphysis ligament lead to local blood disorder, finally leading to aseptic necrosis of the pubic bone[2]. Studies have shown that postpartum pubic symphysis separation of pregnant women is one of the pregnancy complications, and the incidence rate in China is 1: 1300[3].

Studies have confirmed that this disease is related to the exuberant secretion of progesterone in

the perinatal period, the increase of pelvic volume, and the ligament strain during childbirth[4]. Postpartum pubic symphysis separation is characterized by obvious local tenderness and percussion pain at the pubic symphysis, limited abduction and rotation function of the hip joint, frequent severe pain in the lumbosacral region, and difficulty in turning over and walking, which seriously affect the health and quality of life of pregnant women[5]. At present, non-surgical symptomatic treatment is adopted, including bed braking and pelvic external fixation to relieve postpartum pain symptoms, restore functional activities as soon as possible and improve maternal quality of life[6].

However, the above-mentioned conventional treatment methods have some shortcomings, and the clinical application effect is not satisfactory. Bionic bioelectrical technology is a kind of electrotherapy that inputs specific low-frequency pulse current into the human body through the skin to stimulate nerves and muscles, which is helpful to compensatory hyperplasia of muscle fibers, improves the blood circulation of damaged tissues, relieves congestion and edema around damaged tissues, and alleviates patients' pain in a short time[7]. Therefore, the purpose of this study is to apply bionic bioelectrical technology to the treatment of postpartum pubic symphysis separation and to compare and observe the effect of combining bionic bioelectrical technology with conventional treatment on postpartum pubic symphysis separation. The study is as follow.

Methods

Inclusion and exclusion criteria

Inclusion criteria:

• After delivery, local tenderness at pubic symphysis is obvious, and is aggravated during body position changes, weight-bearing, and walking, which may be accompanied by local swelling, and low back and groin pain;

• The pubic symphysis is widened (>5mm) according to obstetric examination, and the pelvic separation test shows positive results;

• The delivery process is smooth;

• Having single pregnancy;

• The puerperae and their families signed informed consent in this study;

• Accessing to complete clinical data.

Exclusion criteria:

• Postpartum hemorrhage and vaginal tearing;

• Obstetrics and internal medicine complications;

• Complicated with puerperal infection;

• Mental illness;

• Complicated with puerperal pelvic dysplasia, pubic symphysis inflammation, pelvic tumor, and other diseases;

• A history of pelvic trauma and surgery;

• Lack of clinical data.

Subjects and grouping

A total 102 patients with postpartum pubic symphysis separation who met the above inclusion and exclusion criteria and received the treatment in our hospital from October 2017 to December 2019 were selected.

They were aged 21 to 37 with an average age of (26.7±1.6); their gestational ages ranged from 37 to 41 weeks, with an average of (39.0±2.8) weeks; delivery situation: 79 cases of primiparity (77.45%), 23 cases of multiparity (22.55%); delivery mode: 87 cases of normal delivery (85.29%), and 15 cases of cesarean delivery (14.71%); fetal body mass ranged from 2940 to 4150 g, with an average of 3688.7±572.1 g; and the maternal body mass of puerperal ranged from 63 to 71 kg, with an average of 68.5±4.1 kg.

According to different treatment methods, all puerperae were divided into the observation group (53 cases) and the control group (49 cases). There was no significant difference in the general data between the two groups (P>0.05), and they were comparable, as shown in Table 1. This study was approved by the ethics committee of the hospital.

Group	Case	Age (X±S)	Gestational weeks (X±S weeks)	Delivery situation[case (%)]	
				Primiparity	Multiparity
Observation Group	53	26.9±1.5	39.2±3.1	40 (75.47)	13 (24.53)
Control Group	49	26.8±1.4	39.1±3.0	39 (79.59)	10 (20.41)
T/X^2		1.283	1.149	0.247	
P		0.750	0.864	0.619	
Group	Case	Delivery mode[case (%)]		Fetal body mass (X±S, g)	Puerperae body mass (X±S, kg)
		Normal delivery	Cesarean delivery		
Observation Group	53	46 (86.79)	7 (13.21)	3624.5±523.4	68.9±4.6
Control Group	49	41 (83.67)	8 (16.33)	3702.7±614.9	68.2±4.7
T/X^2		0.197		0.722	0.972
P		0.657		0.495	0.566

Table 1: Comparison of general data of two groups of postpartum pubic symphysis separation treated by different methods.

Treatment method

The control group

After delivery, the participants in the control group received routine postpartum care. The subjects laid on the hard bed and kept the left lateral position and local braking. Those with dysuria were placed with a urinary catheter. Moreover, they were bound with a pelvic belt (about 25mm wide) 48 h after delivery, with the leveling of iliac ridges on both sides as the upper limit. The tightness was due the activities of lower limbs and blood supply were not affected. At the same time, the puerpera took high-calcium and high-protein foods and were guided to take exercises such as postpartum abdominal breathing, exercising pelvic floor muscles, and contraction of levator to increase abdominal muscle strength and promote uterine recovery.

The observation group

Compared to the members of the control group, the participants in the observation group received treatment in combination with bionic bioelectrical technology. Before the treatment, the puerpera were instructed to empty urine and take the supine position. PHENIX USB4, a neuromuscular electrical stimulation therapeutic instrument produced by a French company, was used to start the treatment from the first day after delivery once a day, 30 minutes each time, for five consecutive days. Eight 5×9 mm disposable electrode pads were used, and the current was a rectangular bidirectional pulse.

The electrical stimulation parameters

The first day and the second day: frequency 80Hz/120Hz/80Hz, pulse width 120us/80us/120us, 10min; frequency 1Hz/4Hz/1Hz, pulse width230us/270us/230us, 20min. The electrode patches were attached to bilateral gluteus medius, gluteus maximus, erector spinae, and adductor muscles. From the 3rd day to the 5th day: frequency 1Hz/4Hz/1Hz, pulse width 230us/270us/230us, 20 minutes; frequency 1Hz/pulse width 500us, frequency 15Hz/pulse width 500us, and frequency 30Hz/pulse width 500us, alternately for 10min. The electrode patches were applied as follows: On the third day, for the first 20 minutes, the electrode patches were applied to bilateral rectus femoris, bilateral semitendinosus, bilateral erector spinae, and bilateral gluteus medius.

For the last 10 minutes, the electrode patches were attached to bilateral transverse abdominal muscles, bilateral middle gluteal muscles, bilateral leiomyoma, and bilateral biceps femoris. On the 4th day: for the first 20 minutes, the electrode patches were attached to the lateral heads of bilateral rectus femoris, right semitendinosus, bilateral erector spinae, left biceps femoris, left gluteus maximus, and right gastrocnemius. For the last 10 minutes, the electrode patches were attached to bilateral gluteus medius muscle, left semitendinosus muscle, right biceps femoris muscle, bilateral transverse abdominal muscle, and bilateral leiomyoma.

On the 5th day: for the first 20 minutes, the electrode patches were attached to bilateral erector spinae, bilateral middle gluteus muscles, bilateral rectus femoris muscles, and bilateral biceps femoris. For the last 10 minutes, the electrode patches were attached to bilateral middle gluteal muscles, bilateral semitendinosus and semitendinosus muscles, bilateral transverse abdominal muscles, and bilateral leiomyoma, with the current of 50 Ma to 60 Ma and intensity of 0μV to 100 μV. The current intensity was adjusted in combination with puerperae, which was subject to obvious muscle contraction.

Observation indicators

Clinical efficacy

After one month of treatment, the puerperae came to the hospital for reexamination. The clinical efficacy was compared between the two groups.

• Cured: pelvic pain disappeared. Results of pelvic compression test were negative, and the pubic symphysis distance returned to normal;

• Effective: pelvic pain symptoms were obviously alleviated. The results of the pelvic compression test were negative. The pubic symphysis distance was shortened but still not returned to normal;

• Ineffective: The pelvic pain symptoms had not been improved significantly. The results of the pelvic compression test were positive, and the pubic symphysis distance had not been shortened [8]. Total effective rate = (cured + effective) cases/total cases ×100%.

Pelvic pain

The pelvic pains before the treatment and 1 day and 1 month after the treatment were compared by VAS. The scale has a total score of 10 points, which is directly proportional to the degree of pain, with 0 points indicating no pain and 10 points indicating unbearable severe pain.

In this way, pregnant women can express the

degree of pain according to their self-feeling. The higher the score is, the more severe the pain is[9].

The pubic symphysis separation distance

Before the treatment and one day and one month after the treatment, the pelvic X-ray measurement was carried out and the pubic symphysis separation distance was recorded.

Quality of life

The ADL rating scale was used to evaluate the quality of life of the two groups before the treatment and 1 day and 1 month after the treatment. The full score of the scale is 100, which is directly proportional to the quality of life. The higher the score is, the higher the quality of life of pregnant women is[10]. As for the statistical method, SPSS 12.0 software was applied to process the data. Counting data was expressed in rate (%), and χ^2 test was used for comparison; the measurement data was expressed by mean ± standard deviation (X±S), and the comparison was made by t-test, with α=0.05 as the test standard.

Results

• One month after the treatment, the total effective rate of the observation group was 100.00% higher than that of the control group (χ^2=13.336, p<0.001), as shown in Table 2.

Group	Case	Cured	Effective	Ineffective	Total effective rate
Observation group	53	30 (56.60)	23 (43.40)	0	53 (100.00)
Control group	49	24 (48.98)	14 (28.57)	11 (22.45)	38 (77.55)
χ^2					13.336
P					<0.001

Table 2: Comparison of clinical efficacy of the two groups of postpartum pubic symphysis separation treated by different methods [case (%)].

• A comparison of pelvic pain scores before and after the treatment showed no significant difference in the VAS scores between the two groups before the treatment (p>0.05).

After the treatment, over time, the VAS scores of the two groups showed a downward trend. The VAS scores before the treatment > that 1 day after the treatment > that 1 month after the treatment, with statistical significance (P<0.05 or P<0.01); the VAS scores of the observation group 1 day and 1 month after the treatment were lower than those of the control group (P<0.05) as shown in Table 3.

Group	Case	Before the treatment	1 d after the treatment	1 month after the treatment	F	P
Observation group	53	6.43±1.52	2.57±0.75[1)]	1.90±0.681[1) 2)]		<0.001
Control group	49	6.45±1.55	4.09±1.231[1)]	3.10±0.361[1) 2)]		<0.001
t		1.145	3.621	3.972		
P		0.732	0.034	0.030		

Table 3: A comparison of visual analog scores of the pelvic pain between the two groups before and after the treatment (X±S, points).

Note: [1)]Compared with that before the treatment, the observation group 1 day after the treatment: t=4.126, P=0.025; 1 month after the treatment: t=6.783, P<0.001; the control group 1 day after the treatment: t=3.524, p=0.031; 1 month after the treatment: t=5.712, P=0.018. [2)] compared with that 1 day after the treatment, the observation group: t=2.973, P=0.039; the control group: t=2.759, P=0.043.

• A comparison of pubic symphysis separation distance before and after the treatment shoed no significant difference between the two groups before the treatment (P > 0.05). After the treatment, the pubic symphysis separation distance of the two groups showed a downward trend, showing a statistically significant difference (P<0.05 or P<0.01). The pubic symphysis separation distance in the observation group was shorter than that in the control group 1 day and 1 month after the treatment (P<0.05) as displayed in Table 4.

Group	Case	Before the treatment	1 d after the treatment	1 month after the treatment	F	P
Observation group	53	24.56±1.68	16.27±1.15[1)]	7.86±0.681[1) 2)]	12.903	<0.001
Control group	49	24.67±1.57	19.86±1.96[1)]	10.53±1.151[1) 2)]	8.624	<0.001
t		1.028	3.026	3.392		
P		0.714	0.039	0.036		

Table 4: A comparison of the pubic symphysis separation distance between two groups before and after the treatment (X±S, mm).

Note: [1)]Compared with that before the treatment, the observation group 1 day after the treatment: t=4.623, P=0.024; 1 month after the treatment: t=7.387, P<0.001; the control group1 day after the treatment: t=3.425, p=0.033; 1 month after the treatment, t=7.505, P=0.012 in control group. [2)]Compared with that 1 day after the treatment, the observation group: t=6.779, P<0.001; the control group: t=4.508, P=0.031.

• A comparison of quality of life before and after the treatment indicated no significant difference in the ADL scores between the two groups before the treatment (P>0.05). After the treatment, the ADL scores of the two groups increased, and the ADL

scores before the treatment were lower than the ADL scores 1 day after the treatment, showing statistically significant differences (P<0.05 or P<0.01). The ADL scores of the observation group were higher than those of the control group 1 day and 1 month after the treatment (P<0.05) as displayed in Table 5.

Group	Case	Before the treatment	1 d after the treatment	1 month after the treatment	F	P
Observation group	53	43.68±5.71	67.17±4.96[1)]	86.46±6.541[1) 2)]	5.027	0.022
Control group	49	42.19±4.52	55.22±3.26[1)]	74.25±3.921[1) 2)]	4.469	0.029
t		0.972	3.426	2.973		
P		0.705	0.035	0.040		

Table 5: A comparison of quality of life scores between two groups before and after the treatment (X±S, points).
Note: [1)]Compared with that before the treatment, the observation group 1 day after the treatment: t=4.975, P=0.019; 1 month after the treatment: t=10.262, P<0.001; the control group1 day after the treatment: t=3.728, p=0.032; 1 month after the treatment: t=8.727, p=<0.001. [2)]Compared with that 1 day after the treatment, the observation group: t=3.029, P = 0.034; the control group: t=2.984, P=0.037.

Discussion

The pubic symphysis is a synovial joint, which is mainly composed of the pubic symphysis surface, connected by the pubic fibrocartilage plate and reinforced by four ligaments. Female pubic symphysis has certain mobility. After pregnancy, due to increased hormone secretion and fetal development, the pelvis is generally stretched and widened, and the gravity of the uterus increases, resulting in the relaxation of pubic symphysis joints and ligaments. Moreover, strong traction during delivery also causes pain due to excessive separation of the pubic symphysis, limits the movement function, and makes it difficult for one or both lower limbs to walk with heavy load and turn over[(11)]. The etiology of pubic symphysis separation is not clear. Some scholars believe that ligament relaxation and pathological weakness of pubic symphysis caused by hormone changes during pregnancy are the fundamental causes[(12)].

It is reported that the incidence of postpartum pubic symphysis separation is 1:600-1:30000[(13)]. Generally, the symptoms of pubic symphysis separation of puerperae are relieved naturally in a short time, but the poor recovery of some postpartum pubic symphysis separation causes pubic pain, low back pain, abdominal pain and even uterine prolapse, vaginal relaxation, urinary incontinence, and body shape change, which directly affect the daily activities, sleep and even lactation of puerperae, increase the incidence of postpartum depression, bring great pain to puerperae's physiology and psychology, and seriously affect puerperae's quality of life[(14)]. At present, non-surgical treatment is the main clinical treatment for the poor recovery of postpartum pubic symphysis separation. The main methods are lying on a hard bed, pelvic girdle restraint, direct manual reduction, infrared irradiation, massage rehabilitation therapy of traditional Chinese medicine, etc.[(15)].

Lying on a hard bed requires a long period of rest treatment and a long time of self-healing. Long-term bed rest can cause pressure sores and increase the occurrence of complications such as skin necrosis, pulmonary dropsy pneumonia, urinary tract infection, and venous thrombosis of lower limbs. When the pelvis is bound, diamond-shaped straps are often used to balance the forces on all sides and maximize the help of the pelvis; when binding, the iliac crest on both sides of puerperae is taken as the level, which has little influence on the blood supply of lower limbs and can limit the force and activity function of the pubic symphysis, relieve pain, and promote the healing of cartilage and ligament. However, this therapy needs a long-term pelvic compression bandage, which affects the local blood supply to a certain extent. Besides, the puerperae have poor comfort and low compliance. Direct manual reduction is painful and is generally unbearable for puerperae.

Moreover, after the treatment, the puerperae shall avoid exercises and rest for two weeks, which requires a long period. Irradiating pubic symphysis with infrared rays can improve local blood circulation and relieve pain, but long-term irradiation can cause local skin damage. Traditional Chinese medicine rehabilitation massage can effectively harmonize qi, blood and viscera functions, dredge channels and collaterals, promote blood circulation, remove blood stasis, and relieve puerperae pain to a certain extent. However, due to different personal techniques (strength and orientation deviation), the effects are different, and the treatment period is long and the effect is slow. Thus, this therapy cannot be widely promoted. In conclusion, there is an urgent need for a rapid, non-invasive, low-impact, puerperae-tolerant combined treatment of postpartum pubic symphysis separation.

Recently, it has been pointed out that the treatment of postpartum pubic symphysis separation

using conventional treatment and combined with bionic bioelectrical technology is effective[16] Bionic bioelectrical technology therapy is to relax muscles by the stimulation of different frequencies, making the muscles contract passively with involuntary rhythm and delaying muscular atrophy. This treatment contributes to compensatory hyperplasia of muscle fibers, increases the blood flow velocity around the pelvic ring, improves blood circulation, promotes venous and lymphatic reflux, and relieves congestion and edema of postpartum pelvic tissues. Furthermore, it can stimulate the release of endogenous opioids, block the transmission of pain signals in the spinal cord, and release substance P, thus relieving the pain of puerperae in a short time. It is non-invasive, with simple operation, low price, and easy acceptance[17]. Studies have shown that the bionic bioelectrical technology therapy combined with physical fixation and rehabilitation massage of traditional Chinese medicine has a better effect in the treatment of postpartum pubic symphysis separation. The pain of puerperae is relieved and the time for getting out of bed and discharging is shortened so that the quality of life of puerperae is improved[18].

In this study, the symphysis pubis separation was treated with an intervention in maintaining the biomechanical balance of muscle tension between pelvis forward and pelvis backward. During pregnancy, the uterus is enlarged, and the gravity center of the human body moves forward. The pelvis leans forward excessively, leading to the strain of the pelvis backward muscles. Besides, the contraction force and tension of muscles that maintain pelvic declination decreases. After delivery, the puerperae get off the bed, and the mechanics is redistributed. The backward muscles keep the human biological force line perpendicular to the ground by shortening contraction. As a result, the pubic symphysis is stressed greatly, and the stress degree of the pubic symphysis is weakened by relaxing secretion and uterine gravity during pregnancy, which leads to the separation of the pubic symphysis. The observation group received treatment of postpartum pubic symphysis separation with bionic bioelectrical technology by resting on a hard bed with restraint on the pelvic girdle. It was compared with the control group receiving a treatment composed of resting on a hard bed and restraint on pelvic girdle only.

The results showed that the total effective rate of the observation group was 100.00% higher than that of the control group (χ^2=13.336, P<0.001). After the treatment, the VAS scores of the two groups showed a downward trend, and the VAS scores of the observation group were lower than those of the control group 1 day and 1 month after the treatment, showing statistically significant intergroup differences (P<0.05 or P<0.01). After the treatment, the pubic symphysis separation distance of the two groups showed a downward trend, and the pubic symphysis separation distance was shorter in the observation group compared to the control group 1 day and 1 month after the treatment, with statistically significant differences (P<0.05 or P<0.01). After the treatment, the ADL scores of the two groups increased, and the ADL scores of the observation group were higher than those of the control group 1 day and 1 month after the treatment, indicating statistically significant differences (P<0.05 or P<0.01). These are consistent with the above research results.

To sum up, the bionic bioelectrical technology in the combined treatment of postpartum pubic symphysis separation could effectively improve the clinical efficacy, reduce the pain of puerperae, shorten the distance of pubic symphysis separation, and improve the postoperative quality of life of puerperae. This treatment technique is worthy of popularization and application.

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