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Research on the Different Frequencies of Transcutaneous Electrical Acupoint Stimulation for Postpartum Pelvic Girdle Pain

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Abstract: *Objective:* To observe the clinical effect of different frequencies of transcutaneous electrical acupoint stimulation in treating postpartum pelvic girdle pain and promoting postpartum rehabilitation. *Methods:* From January to September 2022, 300 patients with pelvic girdle pain after spontaneous delivery in a hospital in Shaanxi Province were selected and randomly divided into three groups, low frequency, high frequency, and alternating frequency, with 100 cases in each group. In addition to routine postpartum care and psychological counseling, the three groups received transcutaneous electrical acupoint stimulation at low-frequency (2 Hz,) high-frequency (100 Hz), and alternating frequency (2/100 Hz), respectively. The differences in initial pain, pain scores before and after treatment, satisfaction with analgesic effect, and postpartum rehabilitation effect were evaluated among the three groups of patients. *Results:* There was a significant correlation between maternal age and postpartum pelvic girdle pain ($P < 0.001$), but no correlation was observed between newborn birth weight and postpartum pelvic girdle pain ($P > 0.05$). After 1d/2d of treatment, the pain scores and rehabilitation effect of patients in the alternating-frequency group and low-frequency group were significantly better than those in the high-frequency group, and the postpartum curative effect of patients in the alternating-frequency group was the best, followed by the low-frequency group, and the high-frequency group; the differences were statistically significant ($P < 0.001$). Among the three groups, the alternating-frequency group had the highest satisfaction with the analgesic effect and the highest rate of selecting the same analgesic regimen the next time; the differences were statistically significant ($P < 0.001$). *Conclusion:* Transcutaneous electrical acupoint stimulation at different frequencies is safe and effective in treating postpartum pelvic girdle pain and beneficial to postpartum rehabilitation. Sparse-dense wave stimulation is effective in treating postpartum pelvic girdle pain. It has the best effect in promoting postpartum rehabilitation and the highest patient satisfaction. Therefore, its application in clinical practice is highly recommended.

Keywords: Transcutaneous electrical acupoint stimulation; Pelvic girdle pain; Postpartum rehabilitation; Frequency

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1. Introduction

The pelvic-floor tissue is an important part supporting the stability of the pelvic floor structure. Childbirth, which causes serious damage to the pelvic-floor tissue, may lead to postpartum pelvic girdle pain. The latter can lead to weakening of pelvic floor muscle strength, stress urinary incontinence, and female sexual dysfunction. It carries risk of complications such as postpartum depression and may involve other tissues and organs, which will seriously affect their life, work, and family, if not treated in time [1,2]. At present, there are two main methods of analgesia that are routinely used in clinical practice for the treatment of postpartum pelvic girdle pain: pharmacological and non-pharmacological analgesia. Parturients are less

likely to accept pharmacological analgesia due to breastfeeding, the side effects, and other reasons. Among the non-pharmacological analgesia, acupuncture, moxibustion, traditional Chinese medicine (TCM) application, and low-frequency electrical stimulation are the main methods for treating postpartum pelvic girdle pain, among which the first three are highly specialized and cumbersome [3], and the effect of low-frequency electrical stimulation is rather insignificant [4]. Therefore, seeking a treatment that is safer, better, and more acceptable to patients is a widespread clinical concern. Transcutaneous electrical acupoint stimulation (TEAS) is a new technology that combines traditional Chinese acupuncture and transcutaneous electrical nerve stimulation (TENS) [5], which uses pulse currents of specific frequencies to stimulate the surface of acupuncture points to achieve the purpose of treating pain. In recent years, low-frequency TEAS has been widely used in clinical settings to treat postpartum pelvic girdle pain. After reviewing numerous literatures, only several reports on high-frequency and alternating-frequency TEAS for postpartum pelvic girdle pain were found. Therefore, in the present study, we compared the effect and user satisfaction of low-frequency TEAS therapy with high-frequency and alternating-frequency TEAS therapy in terms of analgesia and rehabilitation so as to provide reference for its clinical application.

2. Materials and methods

2.1. General information

We selected 300 cases of parturients with pelvic girdle pain after delivery in a tertiary hospital in Shaanxi Province between January 2022 and September 2022. After gaining approval from the hospital ethics committee, the parturients were randomly divided into three groups (low-frequency control group, high-frequency group, and alternating-frequency group) according to the control principle, with 100 cases in each group. Inclusion criteria: (i) women who had delivered; (ii) women who had natural childbirth; (iii) women who had breastfed after childbirth; (iv) women without complications during pregnancy and childbirth; (v) women who voluntarily participated in the experiment and signed the informed consent. Exclusion criteria: (i) women who used analgesics or other analgesic measures; (ii) women with severe acute and chronic low back pain; (iii) women with cardiac pacemaker; (iv) women with a history of pelvic surgery or trauma, inflammation, or scars.; (v) women with mental disorders or communication disorders.

2.2. Research methods

In addition to routine postpartum care and psychological counseling, patients in the low-frequency, high-frequency, and alternating-frequency groups were all treated with TEAS. An electronic diagnosis and treatment instrument (SDZ-II) manufactured by Suzhou Medical Supplies Factory Co., Ltd. was used. Electrodes were placed on each patient's uterine point and Sanyinjiao point, respectively. The electrical stimulation frequencies used were 2 Hz, 100 Hz, and 2/100 Hz, respectively. The maximum electrical stimulation intensity acceptable to the patients, between 0.5 mA and 10 mA, was used, once a day for 30 min each time, over two days.

2.3. Observation indicators

(1) Pain score

Visual analogue scale (VAS) was used to record the degree of pain at first diagnosis and 1 day/2 days after treatment. The higher the VAS score, the more severe the pain (**Table 1**).

(2) Correlation

The correlation between both maternal age and newborn birth weight and initial pain before treatment was analyzed.

(3) Rehabilitation effect

The fundal height and amount of lochia during the first visit and at 48 h after delivery were measured and evaluated by the same senior physician.

(4) Satisfaction

A curative effect satisfaction survey form, designed by the department, was used to record the satisfaction status of patients after treatment (very satisfied, satisfied, generally satisfied, and dissatisfied; whether the same analgesic regimen will be chosen the next time). Curative effect satisfaction = (very satisfied + satisfied)/(very satisfied + satisfied + general + dissatisfied) × 100%.

Table 1. Postpartum pelvic girdle pain scores

Score	Content
0	No pain
1–3	Mild pain, which is tolerable, and sleep is not affected
4–6	Moderate pain, which is tolerable, but sleep and activities are affected
7–10	Severe pain, which is unbearable and affects appetite and sleep

2.4. Statistical analysis

SPSS 26.0 was used for statistical analysis of data. The measurement data conforming to normal distribution were represented by mean ± standard deviation, while the count data were represented by the number of cases (n) and rate (%). The comparison within groups before and after treatment was carried out by paired *t*-test, while the comparison between groups was carried out by *F*-test or χ^2 test. $P < 0.05$ indicates statistically significant difference.

3. Results

3.1. Comparison of general data

There was no statistically significant difference among the three groups in terms of age, height, weight, body mass index (BMI), gestational week of delivery, and newborn weight ($P > 0.05$). See **Table 2** for more details.

Table 2. Comparison of general data among the three groups

Group	Number of cases (n)	Average age (years)	Height (cm)	Weight (kg)	BMI	Gestational week	Newborn birth weight (g)
Low-frequency group	100	30.96 ± 4.51	160.62 ± 3.31	73.22 ± 3.51	21.73 ± 1.95	39.24 ± 1.02	3,373.91 ± 421.12
High-frequency group	100	31.23 ± 6.77	161.32 ± 4.87	74.16 ± 3.17	22.13 ± 2.10	38.92 ± 1.81	3,295.83 ± 439.31
Alternating-frequency group	100	29.95 ± 4.02	160.59 ± 2.97	73.43 ± 4.68	21.36 ± 3.32	39.16 ± 0.74	3,284.61 ± 308.34
F		1.6587	1.1769	1.6496	2.3130	1.7105	1.5252
P		0.1921	0.3097	1.6939	0.1007	0.1826	0.2193

Abbreviation: BMI, body mass index.

3.2. Correlation between both maternal age and newborn weight and pain score at first visit after delivery

There was a significant correlation between maternal age and pain score at first visit after delivery ($P < 0.001$), but there was no correlation between newborn birth weight and pain score at first visit after delivery ($P > 0.05$). See **Table 3** for more details.

Table 3. Correlation between both maternal age and newborn weight and pain score at first visit after delivery

Group	Maternal age and pain score at first visit after delivery		Newborn birth weight and pain score at first visit after delivery	
	r	***P***	***r***	***P***
Low-frequency group	0.6829	0.0000	0.0779	0.4411
High-frequency group	0.6714	0.0000	0.0371	0.7140
Alternating-frequency group	0.6943	0.0000	0.0182	0.8574

3.3. Comparison of pain scores before and after treatment

Before treatment, the pain scores of all three groups followed a normal distribution, and the difference was not statistically significant ($P > 0.05$). However, after 1 day and 2 days of treatment, the difference in pain scores of all three groups was statistically significant ($P < 0.001$); compared with the pain scores before treatment, the pain scores of all three groups after 2 days of treatment significantly improved ($P < 0.001$). The alternating-frequency group showed the best curative effect, followed by the low-frequency group and the high-frequency group. See **Table 4** for more details.

Table 4. Comparison of pain scores before and after treatment

Group	Number of cases (n)	Pain score			*t*	*P*
		Before treatment	After 1 day of treatment	After 2 days of treatment		
Low-frequency group	100	8.12 ± 1.33	5.23 ± 1.31	3.15 ± 1.13	28.4778	0.0000
High-frequency group	100	8.23 ± 1.16	5.56 ± 1.37	3.19 ± 1.32	28.6808	0.0000
Alternating-frequency group	100	8.17 ± 1.26	5.09 ± 1.27	2.23 ± 0.86	38.9376	0.0000
F		0.1935	3.3395	23.5388		
P		0.8241	0.0368	0.0000		

3.4. Comparison of satisfaction with analgesic effect

From the χ^2 test, there was a statistically significant difference in the satisfaction with analgesic effect among the three groups ($P < 0.001$); the difference in the rate of selecting the same analgesic regimen for the next delivery among the three groups was also statistically significant ($P < 0.001$); the alternating-frequency group had the highest satisfaction with the analgesic effect and the highest rate of selecting the same analgesic regimen for the next delivery. See **Table 5** for more details.

Table 5. Comparison of satisfaction with analgesic effect

Group	Number of cases (n)	Satisfaction (%)	χ^2	*P*	Will still choose the same analgesic regimen (%)	χ^2	*P*
Low-frequency group	100	30 (30)	120.5268	0.0000	23 (30)	131.2963	0.0000
High-frequency group	100	78 (78)			70 (70)		
Alternating-frequency group	100	100 (100)			100 (100)		

3.5. Comparison of postpartum rehabilitation effect

From the *F*-test, there was no statistically significant difference in the fundal height and total amount of lochia among the three groups during the first visit after delivery ($P > 0.05$). The differences in fundal height and amount of lochia between the first visit and 48-h postpartum were statistically different in all three groups ($P < 0.0\ 01$), but the alternating-frequency group had the best rehabilitation effect, followed by the low-frequency group and the high-frequency group. See **Table 6** for details.

Table 6. Comparison of postpartum rehabilitation effect

Group	Number of cases (n)	Fundal height (cm)		*t*	*P*	Amount of lochia (mL)		*t*	*P*
		Postpartum first visit	48-h postpartum			Postpartum first visit	48-h postpartum		
Low-frequency group	100	19.97 ± 1.55	14.73 ± 1.36	25.4115	0.0000	292.37 ± 72.38	321.95 ± 55.70	2.6913	0.0000
High-frequency group	100	19.74 ± 1.48	15.57 ± 1.62	19.0041	0.0000	280.17 ± 64.29	310.40 ± 51.43	4.8169	0.0000
Alternating-frequency group	100	19.98 ± 1.39	13.96 ± 1.21	32.6663	0.0000	287.54 ± 67.21	331.03 ± 60.05	5.7813	0.0000
F		0.8475	32.7596			0.8153	3.4289		
P		0.4295	0.0000			0.4435	0.0337		

4. Discussion

Postpartum pelvic girdle pain refers to persistent muscle and bone pain at the anterior and posterior pelvic rings after childbirth [6]. In Chinese medicine, it is categorized under "postpartum abdominal pain." As mentioned in *Key Tips in Gynecology-Abdominal Pain Syndrome*, if postpartum blood loss is excessive, the pain is primarily caused by blood deficiency; if there is blood stasis and little postpartum lochia discharge, the pain is primarily caused by the residual. It can be seen that the pain is caused by deficiency and stasis of qi and blood,, which leads to blockage of qi and blood flow as well as the inability to nourish the meridians. This embodies the idea "pain if it is blocked, and pain if it is not nourished." The focus of the treatment should be on nourishing blood and replenishing qi, mainly promoting blood circulation and removing blood stasis. The belief that uterine acupoints store blood vessels and are extra meridian acupoints that pass through the uterus, remove stasis, and regulate qi movement has long been founded in TCM [7]. In modern anatomy, the lower nerve distribution segments are mainly T12–L1, which innervate the uterus and ovary. The same or similar distribution of nerve segments in other organs, stimulating this acupoint, have a definite curative effect on uterine lesions [8]. Sanyinjiao is the acupoint where the three meridians (Foot Taiyin, Foot Jueyin, and Foot Shaoyin) meet; these three meridians pass through the lower abdomen and are closely related to the uterus, thus rendering the expression "gynecological Sanyinjiao." Acupuncture at Sanyinjiao can relieve the meridians and collaterals, promote blood circulation, remove blood stasis and lochia, relieve excessive uterine contraction, and relieve pain [9]. According to ancient literature, Sanyinjiao acupoint is often used in combination with Gonggong acupoint to treat various

gynecological diseases with good curative effect [10]. "Where the acupoints are located, there the indications are; where the meridians pass, there lies the focus of treatment." Based on the theory of meridians and acupoints in TCM and the theory of the same spinal segment, we selected Gonggong and Sanyinjiao points for electrical stimulation to treat postpartum pelvic girdle pain in the present study.

4.1. Significant analgesic effect of transcutaneous electrical acupoint stimulation

TEAS therapy can adjust the balance of yin and yang, promote unobstructed blood and qi, and produce good analgesic effect [10]. The present study showed that the *F*-test of the maternal pain scores in the three groups after 1 day and 2 days of treatment was statistically significant ($P < 0.001$), with the pain scores decreasing in trend and the mean value of VAS being mild or moderate pain after 2 days; the *t/F*-test also showed statistically significant differences ($P < 0.001$), indicating that TEAS has significant analgesic effect. Modern medical research believes that this analgesic effect is caused by electrical stimulation that promotes the release of maternal own endogenous analgesic substances, opioid peptides (such as endorphins, enkephalins, dynorphins, *etc*.), and the inhibition of pain sensitization. The results showed that $VAS_{\text{alternating-frequency group}} < VAS_{\text{low-frequency group}} < VAS_{\text{high-frequency group}}$, indicating that the analgesic effect is related to the frequency and waveform of the current, which is consistent with the research conclusion and may be related to the short treatment time of this study. In addition, the results showed a correlation between the curative effect of TEAS (pain score at first visit after delivery) and maternal age ($P < 0.001$). Analyzing the pain scores of all three groups at their first visit and after 1 day/2 days of treatment, it was found that the pain scores at the first visit and after 1 day/2 days of treatment were higher than the mean pain scores in the same period. The reason may be that as women age, their uterine muscle fibers and muscle activity gradually weaken and postpartum hypertonicity often occurs, resulting in more severe uterine contraction pain than in younger women.

4.2. Transcutaneous electrical acupoint stimulation promotes uterine involution and lochia discharge

TEAS therapy can strengthen uterine contractions and promote uterine involution and lochia discharge ($P < 0.001$). This is consistent with the meridian and acupoint theory in TCM [7,9]. Our research conclusions are as follows: percutaneous acupoint electrical stimulation can promote recovery after cesarean section; low-frequency electrical pulse stimulation can promote postpartum uterine involution; and electroacupuncture combined with uterine acupoint acupuncture can accelerate maternal recovery. After electrical stimulation treatment, the pain scores of all three groups gradually decreased from severe pain at first diagnosis after delivery to moderate and mild pain. Their pain was effectively relieved, their sleeping time and appetite increased, and there were improvements in qi and blood deficiency. By acupoint stimulation, the meridian qi and blood between the uterus and viscera can be dredged, nourished, and circulated; the muscle strength of the pelvic girdle region can be restored, and uterine contraction can be strengthened; the stagnant lochia can be discharged; and the uterus can regenerate. Consistent with the rehabilitation effect of the three groups in the present study, there were statistically significant differences in maternal satisfaction with analgesia and the rate of selecting the same analgesic regimen the next time ($P < 0.001$), indicating that most women would prefer to choose an analgesic method that suits them, while hoping that it relieves pain.

In conclusion, TEAS, as a new type of acupuncture and moxibustion therapy integrating the meridian and acupoint theory in TCM, the pain gate control theory, and modern electronic medical technology, has several advantages, such as non-invasive, painless, infection-free, easy to operate, no pharmacological side effects, and positive feedback from patients. TEAS can promote the release of endogenous opioid peptides via the sensing effect of meridians, increase the pain threshold of the body, and inhibit pain sensitization to exert analgesic effect. Compared with single-frequency stimulation, sparse-dense wave stimulation is more

effective in providing analgesia, preventing tolerance, promoting postpartum rehabilitation, and conferring the highest patient satisfaction. Therefore, it is worthy of clinical application and promotion. However, there are still some limitations in this study, such as the single source of data sample collection, short treatment duration, limited observation indicators and sample size; lack of unified clinical guidelines for TEAS parameter selection, acupoint compatibility, and rehabilitation indicators; insufficient clinical research data of high-frequency and alternating-frequency TEAS therapy for postpartum pelvic girdle pain; and the lack of consideration for the physical differences in individuals and their pain threshold. These limitations may have had a certain impact on this study. Therefore, it is necessary to expand the sample size and scale for more systematic and comprehensive observation and analysis so as to introduce more effective stimulation intervention programs and provide objective data support for postpartum pelvic girdle pain treatment and related clinical research based on TEAS.

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Disclosure statement

The authors declare no conflict of interest.

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