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Clinical Efficacy of Different Parameter Modes of Electrophysiological Therapy in Chronic Pelvic Pain Syndrome

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Abstract: *Objective*: To investigate the clinical efficacy of electrophysiological therapy under different parameter modes in chronic pelvic pain syndrome (CPPS). Methods: A total of 95patients with CPPS from the Department of Urology, First Affiliated Hospital of Jinan University, were selected and treated with electrophysiological therapy. They were randomly divided into three groups: the fixed-parameter AA7 treatment group, the P2 + P4 treatment group, and the precision treatment group (individualized parameter treatment). Pain scores of patients in each group were compared before and after treatment, with a pain score of 0 indicating cure. The cure rate of each group was observed. *Results:* The average ages of the AA7 group, P2 + P4 group, and precision treatment group were 34 ± 14.17 years, 35.58 ± 12.57 years, and 35.5 ± 11.27 years, respectively. There was no significant difference in age among the three groups ($p > 0.05$). Before treatment, the pain scores of the AA7 group, P2 + P4 group, and precision treatment group were 4.14 ± 1.74, 4.64 ± 1.72, and 3.50 ± 1.89, respectively, with no significant differences among the groups ($p > 0.05$). After treatment, the pain scores were 0.71 ± 0.99 for the AA7 group (cure rate: 57%), 0.49 ± 0.79 for the P2 + P4 group (cure rate: 67%), and 0.50 ± 0.77 for the precision treatment group (cure rate: 64%), with no significant differences among the groups ($p > 0.05$). The cure rates for different pain locations were as follows: 83% for lower abdominal pain, 74% for perineal pain, 62% for dysuria, 49% for testicular pain, and 75% for inguinal pain. *Conclusion:* The pathogenesis of CPPS is complex and diverse, with numerous treatment options and uncertain efficacy, posing significant challenges to clinical practice. This study showed that electrophysiological therapy under different parameter modes significantly reduced pain scores before and after treatment, indicating significant therapeutic effects on CPPS. All three modes demonstrated good cure rates. Individualized precision treatment and fixed-mode P2 + P4 or AA7 treatment were safe and effective in CPPS treatment and are worth promoting. Fixed-mode P2 + P4 and AA7, due to their easier standardization of parameters and patch modes, reduced the learning curve and had better potential for widespread application.

Keywords: Electrophysiological therapy; Chronic pelvic pain syndrome; Biofeedback; Efficacy evaluation

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1. Introduction

Chronic Pelvic Pain Syndrome (CPPS) is a disorder of the urinary system characterized primarily by pelvic pain, urinary symptoms, and sexual dysfunction [1,2]. The etiology of CPPS is complex and multifactorial, involving infectious, immunological, neurological, and psychological factors [3]. As a result, CPPS has a substantial negative impact on the quality of life of affected patients. Conventional treatment strategies for CPPS include pharmacological therapy, psychological intervention, and physical therapy [4]. However, the clinical effectiveness of these treatments is often limited, and some approaches are associated with adverse effects. In recent years, electrophysiological therapy has gained increasing attention as a noninvasive physical treatment modality for chronic pain management [5]. By applying electrical stimulation with specific parameter settings, electrophysiological therapy can modulate neural transmission, alleviate pain, improve local blood circulation, and promote tissue repair processes [6]. Despite these potential benefits, current evidence regarding the use of electrophysiological therapy in CPPS remains limited, particularly with respect to comparisons of different parameter modes [7,8]. Variations in stimulation parameters may lead to significant differences in therapeutic outcomes. Therefore, identifying optimal electrophysiological therapy parameter modes for patients with CPPS is of considerable clinical importance.

2. Materials and methods

2.1. Clinical data

A total of 95 patients diagnosed with Chronic Pelvic Pain Syndrome (CPPS) who visited the Department of Urology at the First Affiliated Hospital of Jinan University between January 2023 and July 2024 were enrolled in this study. The patients were aged between 26 and 59 years, with a median age of 36 years. All patients were diagnosed with CP/CPPS based on medical history, physical examination including digital rectal examination, routine laboratory tests, NIH Chronic Prostatitis Symptom Index (NIH-CPSI) score, bacterial culture, and ultrasonography [9]. There were no statistically significant differences among the groups in terms of age, NIH-CPSI scores, maximum urinary flow rate, or average urinary flow rate (Qavg) ($p > 0.05$), indicating good comparability [10,11].

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

Patients who met the diagnostic criteria for chronic pelvic pain were included. Chronic pelvic pain was defined as pain located in the pelvic region or surrounding tissues caused by functional and or organic factors and lasting for more than six months [12,13].

2.2.2. Exclusion criteria

Patients were excluded if they met any of the following conditions:

(1) Diagnosis of prostate cancer or having undergone prostate biopsy within the previous one month
(2) History of pelvic radiotherapy, transurethral surgery, or urethral trauma
(3) Presence of skin allergy, neurological disorders, or severe systemic diseases
(4) Diagnosis of acute or chronic urethritis, epididymitis, varicocele, perianal or rectal diseases, or sexually transmitted diseases

(5) Use of antibiotics, nonsteroidal anti-inflammatory drugs, or medications affecting the genitourinary system within one month before enrollment, including diuretics, alpha receptor blockers, or 5 alpha reductase inhibitors
(6) Receipt of investigational drug treatment within the past six months [14,15]

2.3. Grouping of patients

Patients were randomly assigned into three groups: Group A included 14 patients receiving fixed parameter AA7 (analgesic mode) treatment. Group B included 45 patients receiving combined P2 and P4 treatment (analgesia plus arterial circulation mode). Group C included 36 patients receiving precision treatment with individualized parameter settings. The mean ages were 34 ± 14.17 years in Group A, 35.58 ± 12.57 years in Group B, and 35.5 ± 11.27 years in Group C. No significant differences were found among the three groups regarding baseline characteristics (all $p > 0.05$). All patients and their family members voluntarily participated in the study and signed written informed consent forms. Pain intensity was evaluated before and after treatment using the visual analogue scale (VAS). A VAS score of 0 was considered complete pain relief. Cure rates were compared among the groups.

2.4. Treatment methods

2.4.1. Stimulation method

All patients received transcutaneous electrical nerve stimulation (TENS). TENS is a noninvasive method that delivers electrical stimulation through surface electrodes placed on the skin to activate nerve fibers and relieve pain.

2.4.2. Electrode placement

Electrodes were placed at treatment sites such as the pelvic floor muscles and lower abdomen. Proper contact between electrodes and skin was ensured, and electrode positions were adjusted according to body contour and treatment area to optimize stimulation effectiveness and patient comfort.

2.4.3. Parameter settings

Electrical stimulation parameters were adjusted according to patient tolerance and therapeutic goals, including current intensity, frequency, and waveform. Current intensity was initiated at a low level and gradually increased to a comfortable and effective range. Stimulation frequency was adjusted based on treatment mode and patient response, generally ranging from 1 to 150 Hz. Waveforms included square, triangular, and sinusoidal waves, which have different effects on neural and muscular stimulation.

2.4.4. Stimulation procedure

Electrical stimulation was initiated after parameter adjustment. Patient responses were continuously observed to ensure safety and effectiveness. Medical staff monitored facial expression and body movement during treatment and adjusted parameters when necessary to manage discomfort.

2.4.5. Electrode positions for different treatment modes

(1) Group A precision parameter treatment: Parameters were individualized based on infrared detection results. Electrode placement included: (a) Sensory, neural, and muscular stimulation at pain points and

sacral region. (b) Circulation stimulation at the Qugu acupoint and bilateral dorsum of the feet. (c) Bladder meridian stimulation along the lumbosacral bladder meridian pathway

(2) Group B fixed parameter treatment (AA7 Mode): Electrode placement: pain points and sacral region. Parameters: 80, 120, and 80 Hz with pulse widths of 20, 80, and 120 microseconds, and 1, 4, and 1 Hz with pulse widths of 270, 230, and 270 microseconds

(3) Group C P2 plus P4 treatment: P2 analgesic mode: electrodes placed at the Baliao points, Zhongji, and Guanyuan acupoints with parameters of 100, 150, and 100 Hz and pulse widths of 150, 100, and 150 microseconds. P4 arterial circulation mode: electrodes placed at Shenque, Mingmen, and Yongquan acupoints with parameters of 10 Hz and pulse width of 300 microseconds

2.5. Outcome measures

Pain intensity was assessed using the visual analogue scale (VAS). A reduction of 2 points or more on the 0 to 10 scale was considered clinically meaningful. The VAS is a simple and widely used tool for pain assessment. Patients marked their pain level on a 10 cm horizontal line, where 0 represented no pain and 10 represented the most severe pain imaginable. Changes in VAS scores before and after treatment were used to evaluate pain relief.

3. Results

3.1. Comparison of pain scores among treatment groups

There were no significant differences in baseline VAS scores among the three groups before treatment ($p > 0.05$). After treatment, the mean VAS score was 0.71 ± 0.99 in the AA7 group, with a cure rate of 57 percent. The P2 plus P4 group had a mean VAS score of 0.49 ± 0.79 and a cure rate of 67 percent. The precision treatment group showed a mean VAS score of 0.50 ± 0.77, with a cure rate of 64 percent. Pain scores were significantly reduced in all three groups after treatment, while no statistically significant differences were observed among the groups ($p > 0.05$). During the treatment period, patients in the AA7 group experienced relatively slower pain relief during the first one to two weeks, followed by gradual improvement. The P2 plus P4 group showed more rapid pain relief in the early treatment stage with a stable overall improvement trend.

In the precision treatment group, some patients achieved marked pain relief at an early stage due to individualized parameter settings, while a small number of patients required parameter adjustment because of variability in treatment response. The results are summarized in **Table 1** and **Figure 1**.

Table 1. Comparison of pre- and post-treatment VAS scores among three electrophysiological treatment modalities

	AA7 group mean VAS score	P2 + P4 group mean VAS score	Precision treatment group mean VAS score
Pre treatment	4.14 ± 1.74 points	4.64 ± 1.72 points	3.50 ± 1.89 points
Post treatment	0.71 ± 0.99 points	0.49 ± 0.79 points	0.50 ± 0.77 points
Cure rate	57%	67%	64%

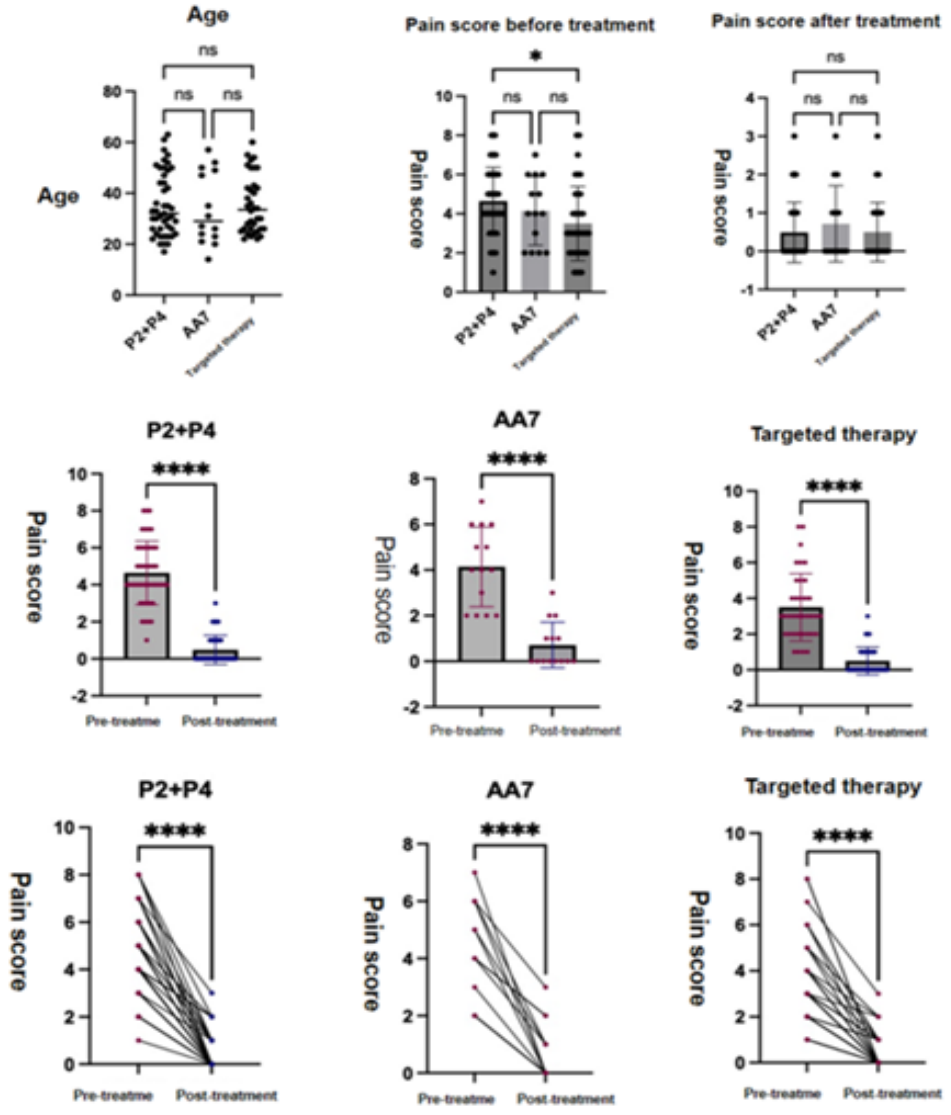

Figure 1. Comparison of pain scores among different treatment modalities.

3.2. Cure rates according to different pain locations

The cure rate for lower abdominal pain was 83%, followed by inguinal pain (75%), perineal pain (74%), dysuria-related pain (62%), and testicular pain (49%). During treatment, patients with lower abdominal and inguinal pain showed relatively better responses to electrophysiological therapy. This may be attributed to the more concentrated neural distribution and richer blood supply in these regions. In contrast, patients with testicular pain demonstrated a relatively lower cure rate, which may be related to the unique characteristics of testicular tissue, including highly sensitive and complex nerve endings, as well as a relatively independent blood supply, resulting in a weaker response to electrical stimulation. The cure rates for perineal pain and dysuria-related pain were at an intermediate level, which may be associated with interactions between nerves and muscles in the perineal and periurethral regions, as well as inflammatory responses. See **Table 2**.

Table 2. Cure rates according to different pain locations

Pain location	Lower abdominal pain	Perineal pain	Urinary pain	Testicular pain	Groin pain
Cure rate (%)	83	74	62	49	75

4. Discussion

The pathogenesis of CP/CPPS is complex and multifactorial, involving infectious, immunological, neurological, and psychological factors. Traditional treatment approaches, including pharmacological therapy, psychological intervention, and physical therapy, often show limited efficacy and may be associated with adverse effects. In recent years, electrophysiological therapy, as a non-invasive and non-traumatic physical treatment modality, has attracted increasing attention in the management of chronic pain. By delivering electrical stimulation with specific parameters, electrophysiological therapy can modulate neural transmission, alleviate pain, improve local blood circulation, and promote tissue repair.

In the present study, VAS scores were significantly reduced after electrophysiological treatment under different parameter modes, indicating that electrophysiological therapy is effective for CP/CPPS across various treatment modes. All three treatment modes demonstrated favorable cure rates. Both individualized precision therapy and fixed modes (P2 + P4 and AA7) were shown to be safe and effective in the treatment of CP/CPPS and therefore merit wider clinical application. Notably, the fixed P2 + P4 and AA7 modes allow easier standardization of parameters and electrode placement, which may reduce the learning curve and make them particularly suitable for implementation in primary healthcare settings.

Furthermore, analysis based on pain location revealed that the cure rates for lower abdominal pain and inguinal pain were relatively high (83% and 75%, respectively), whereas the cure rate for testicular pain was comparatively low (49%). These differences may be related to variations in neural distribution, blood supply, and underlying pathophysiological characteristics among different anatomical sites. This finding suggests that treatment strategies may be optimized by tailoring electrophysiological therapy according to pain location or by combining it with other therapeutic modalities to improve overall efficacy. For example, patients with lower abdominal or inguinal pain may preferentially benefit from the P2 + P4 or AA7 modes, whereas patients with testicular pain may require adjunctive treatments, such as pharmacotherapy or physical rehabilitation, in addition to electrophysiological therapy, to enhance treatment outcomes.

Although the overall cure rate of the individualized precision therapy group was comparable to those of the other two groups, this approach demonstrated advantages in addressing individual patient needs during treatment. It is particularly suitable for patients with complex clinical conditions, multiple pain locations, or poor responses to conventional therapies. By performing detailed physiological parameter assessments and designing personalized treatment protocols, precision therapy enables more targeted modulation of neural transmission and blood circulation, thereby improving treatment specificity and effectiveness.

However, individualized precision therapy requires higher technical expertise and specialized equipment, as well as experienced healthcare professionals for parameter adjustment and operation. These requirements may limit its widespread application in primary medical institutions. Therefore, in clinical practice, the choice of electrophysiological treatment mode should be based on institutional resources, patient characteristics, and economic considerations to achieve optimal therapeutic outcomes and patient satisfaction. Future large-scale, multicenter clinical studies are warranted to further explore the optimal parameter settings, treatment duration, and long-term

efficacy of electrophysiological therapy in CP/CPPS, thereby providing stronger evidence for its clinical application.

Disclosure statement

The authors declare no conflict of interest.

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