Journal of Pain Research

Dovepress
Taylor & Francis Group

Open Access Full Text Article

REVIEW

Comparative Efficacy of Pulsed Radiofrequency-Based and Related Interventions for Postherpetic Neuralgia: A Network Meta-Analysis of Randomized Controlled Trials

Lin Li, Xin Yang, Shuhua Chen, Chaoqi Xuan, Mengjun Zhou, Yujuan Zhang, Xiaojun Wang

Department of Anesthesiology, The Affiliated Yangming Hospital of Ningbo University (Yuyao People's Hospital), Yuyao, Zhejiang, People's Republic of China

Correspondence: Xiaojun Wang, Email wxj3037377@163.com

Objective: This study aimed to assess the effectiveness of 12 interventions for postherpetic neuralgia (PHN) through direct and indirect comparisons using a network meta-analysis. These interventions included pulsed radiofrequency (PRF), high-voltage pulsed radiofrequency (HPRF), Long-Term PRF (LPRF), selective nerve block (SVB), PRF combined with Nerve Block Therapy (PRF +SVB), spinal cord stimulation (SCS), PRF combined with drug therapy (PRF+drug), and other minimally invasive treatments.

Design: A systematic search was conducted across PubMed, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science, and China National Knowledge Infrastructure (CNKI) to identify randomized controlled trials (RCTs) from inception to January 2026. Methodological quality was assessed using the Cochrane Risk of Bias tool, and data analysis was performed with Stata 15.1.

Results: A total of 27 RCTs involving 1996 patients were included. Network meta-analysis showed that SCS significantly reduced Visual Analog Scale (VAS) scores (SUCRA: 77.3%, MD=3.17, 95% CI=1.74,4.60). PRF+drug ranked first in improving General Health (GH, SUCRA: 92.9%), Mental Health (MH, SUCRA: 100.0%), vitality (VT, SUCRA: 100.0%) scale scores, and reducing pregabalin dosage (SUCRA: 90.5%, MD=−387.08, 95% CI=−540.05,-234.10).

Conclusion: SCS is the optimal intervention for pain relief in PHN, while PRF+drug effectively improves quality of life and reduces medication burden. These findings provide evidence-based support for individualized PHN treatment.

Keywords: postherpetic neuralgia, pulsed radiofrequency, network meta-analysis, spinal cord stimulation, quality of life

Introduction

Postherpetic Neuralgia (PHN) is characterized by persistent and severe pain in the area innervated by the affected nerve, continuing for more than three months after the resolution of herpes zoster.[1] Clinically, PHN is often marked by paroxysmal, burning, electric shock-like, or needle-like pain, frequently accompanied by hyperalgesia and sensory abnormalities.[2] This condition not only causes persistent distress but also leads to reduced work productivity, sleep disturbances, and emotional disorders, severely impairing patients' overall quality of life. The incidence of PHN ranges from approximately 5% to 30%, with advanced age, immunosuppressive conditions, and chronic diseases such as diabetes being the primary risk factors.[3] Current treatment strategies encompass pharmacological therapies (including anticonvulsants and antidepressants), minimally invasive interventional therapies (such as Selective Nerve Block [SVB], Pulsed Radiofrequency [PRF], and Spinal Cord Stimulation [SCS]), physical therapies (including Transcutaneous Nerve Stimulation [TENS] and laser treatment), and psychological interventions.[4]

PRF has emerged as a novel approach for treating neuropathic pain, utilizing short pulses of high-frequency, low-energy current to modulate nerve impulse conduction without causing neural damage, thus providing analgesic effects.[5]

https://doi.org/10.2147/JPR.S607566
Received: 13 March 2026
Accepted: 24 June 2026
Published: 29 June 2026

Multiple treatment modalities, including PRF, SCS, SVB, BoNT-A, and oral analgesics, have been used for PHN, but their relative merits remain unclear. Some studies have reported favorable effects of PRF on pain relief and quality of life[6,7] while others have shown that PRF provides similar efficacy compared with SVB[8] and BoNT-A.[9] Combined interventions such as PRF plus methylene blue have also been investigated,[10] but findings remain inconsistent across different populations and protocols. Accordingly, the comparative efficacy of PRF, related interventions, and other widely used therapies remains incompletely understood. Variability in study results may stem from differences in PHN stage, anatomical location, treatment parameters, concurrent interventions, and follow-up duration. Spinal cord stimulation (SCS) is used for refractory PHN but is limited by invasiveness and cost.[11–14] Oral analgesics are first-line treatments but are often limited by incomplete efficacy and side effects.[15–18] SVB provides rapid pain relief but has variable long-term outcomes.[8,19,20] BoNT-A is safe and convenient, yet supporting evidence remains limited.[9]

Although previous systematic reviews and meta-analyses have evaluated various interventions for postherpetic neuralgia, most were limited to pairwise comparisons of only 2–3 treatments or focused on single pain-related outcomes. Few network meta-analyses have included the majority of clinically common interventions, and none have comprehensively compared analgesic efficacy, quality of life, and medication dosage reduction within a unified analytic framework. This study was designed to address this evidence gap and provide a comprehensive efficacy ranking to support clinical decision-making.

Notably, the existing clinical evidence for PHN interventions is compromised by unbalanced trial numbers across different therapies, geographic concentration of study populations, relatively short follow-up durations, and inadequate blinding design, which further necessitates a comprehensive and rigorous network meta-analysis.

All interventions included in this network represent widely used clinical strategies for PHN, including minimally invasive procedures, interventional therapies, and medical treatments. A unified network comparison enables indirect comparisons and head-to-head efficacy ranking across interventions, even when no direct head-to-head trials exist.

While safety and invasiveness are important clinical considerations, the present study focuses primarily on comparative efficacy, as all included interventions are well-established in clinical practice with documented safety profiles.

Materials and Methods

Search Strategy

This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 27-item checklist[21] and the PRISMA extension statement for network meta-analyses (PRISMA-NMA). The protocol was registered in PROSPERO (registration number: CRD420261278879). In this study, the researchers conducted a comprehensive search of five electronic databases—PubMed, EMBASE, the Cochrane Central Register of Controlled Trials, CNKI and Web of Science—covering the period from their inception to January 2026. The search strategy was designed using the PICOS framework: (P) Population: Postherpetic Neuralgia; (I) Intervention: Pulsed Radiofrequency; (C) Comparator: Control group receiving common minimally invasive interventional treatments; and (S) study type: RCTs. A detailed description of the search strategy is provided in Table 1, with PubMed as an example.

Inclusion Criteria

(1) The intervention in the experimental group involved PRF treatment; (2) the control group received different PRF modalities, including PRF combined with various therapeutic approaches and other minimally invasive interventional treatments; (3) only clinical RCTs were included; and (4) outcome measures included at least one of the following: the Numerical Rating Scale or Visual Analog Scale (NRS/VAS), the 36-Item Short Form Health Survey (SF-36), and medication dosage.

Table 1 Search Strategy for the PubMed Database

#1	"Neuralgia, Postherpetic"[MeSH Terms]
#2	(Neuralgia, Postherpetic[Title/Abstract]) OR (Postherpetic Neuralgia[Title/Abstract])
#3	(#1) OR (#2)
#4	((Radiofrequency Therapy[MeSH Terms]) OR (Pulsed Radiofrequency Treatment[MeSH Terms])) OR (clinical trial[MeSH Terms])
#5	((((((((((((((((((((Pulsed Radiofrequency Treatment[Title/Abstract]) OR (Radiofrequency Therapy[Title/Abstract])) OR (Pulsed Radiofrequency Treatments[Title/Abstract])) OR (Radiofrequency Treatment, Pulsed[Title/Abstract])) OR (Radiofrequency Treatments, Pulsed[Title/Abstract])) OR (Treatment, Pulsed Radiofrequency[Title/Abstract])) OR (Treatments, Pulsed Radiofrequency[Title/Abstract])) OR (Pulsed Radio Frequency Treatment[Title/Abstract])) OR (Radiofrequency Therapies[Title/Abstract])) OR (Therapies, Radiofrequency [Title/Abstract])) OR (Therapy, Radiofrequency[Title/Abstract])) OR (Radio-Frequency Therapy[Title/Abstract])) OR (Radio Frequency Therapy[Title/Abstract])) OR (Radio-Frequency Therapies[Title/Abstract])) OR (Therapies, Radio-Frequency[Title/Abstract])) OR (Therapy, Radio-Frequency[Title/Abstract])) OR (clinical trial[Title/Abstract])) OR (Intervention Study[Title/Abstract])) OR (Controlled Clinical Trial [Title/Abstract])) OR (Randomized Controlled Trial[Title/Abstract])) OR (Equivalence Trial[Title/Abstract])) OR (Pragmatic Clinical Trial [Title/Abstract])
#6	(#4) OR (#5)
#7	(#3) AND (#6)

Notes: This search strategy was used to identify randomized controlled trials on interventions for postherpetic neuralgia, covering the period from database inception to January 2026.

Exclusion Criteria

(1) Studies with incomplete or unreported data were excluded; (2) Studies that were not RCTs, including quasi-RCTs, animal studies, protocols, conference abstracts, case reports, and editorials, were also excluded.

Study Selection

The literature was screened and managed using the EndNote reference management software. Initially, two researchers independently reviewed the titles of the studies to identify and exclude duplicates, non-RCTs, review articles, conference abstracts, protocols, and correspondence articles. Subsequently, the abstracts of the remaining studies were evaluated to determine their eligibility for inclusion. Finally, the full texts of the selected studies were thoroughly reviewed by both researchers. Throughout this process, the researchers independently screened the literature, and any discrepancies between their selections were resolved through discussions with a third researcher. Studies deemed identical by both researchers were included, while those with differing evaluations were reviewed and resolved collaboratively.

Data Extraction

A standardized eight-item data extraction form was used to record the relevant information for inclusion in the study. The following headings were used to guide data collection: (1) author, (2) country, (3) year of publication, (4) mean age, (5) population, (6) sample size, and (7) details of the intervention (frequency, duration, dosage), (8) outcome data (mean, standard deviation, sample size for VAS/GH/MH/VT scores and pregabalin dosage).

Risk of Bias of Individual Studies

Two researchers independently assessed the risk of bias (ROB) using the Cochrane Handbook version 5.1.0 tool for evaluating ROB in RCTs. The assessment considered the following seven domains: (1) random sequence generation, (2) treatment allocation concealment, (3) blinding of participants, (4) blinding of personnel, (5) incomplete outcome data, (6) selective reporting, and (7) other sources of bias. Trials were categorized into three levels of risk based on the number of domains in which a high ROB was identified: high risk (five or more domains), moderate risk (three or four domains), and low risk (two or fewer domains).

Data Analysis

In studies where PRF is the intervention, all variables were treated as continuous and are expressed as means with standard deviations (SD). The continuous variables in the study were reported as either mean difference (MD), defined as

the absolute difference between the means of the two groups (calculated as the difference between the treatment and control groups using the same scale), or standardized mean difference (SMD), which is the mean difference in outcome between groups divided by the standard deviation of the outcome between subjects. SMD is used when combining data from trials with different outcome scales. Both MD and SMD were presented with 95% confidence intervals (CI). Given the potential variability across studies, a random effects model was chosen for the analysis, rather than a fixed effects model.

We utilized Stata software (version 15.1) to perform the network meta-analysis (NMA) aggregation and analysis, as outlined in the PRISMA NMA manual.[22] This was a frequentist network meta-analysis. Multi-arm studies were handled appropriately within the frequentist framework to avoid correlated bias. Heterogeneity was evaluated using the tau statistic and I^2 index. Model consistency and adequacy were assessed using node-splitting analysis. The nodal method was applied to quantify and assess the agreement between indirect and direct comparisons using Stata software. A consistency test was conducted, and if the *P*-value exceeded 0.05, the consistency test was considered to have passed.[23]

Stata software was used to generate and illustrate the network diagrams for PRF combined with different interventions. In these network diagrams, each node represents a distinct PRF combined intervention, and the lines connecting the nodes indicate direct head-to-head comparisons between the interventions. The size of each node and the width of the connecting lines are proportional to the number of studies included in each intervention.[24]

The intervention hierarchy was summarized and reported using the surface under the cumulative ranking curve (SUCRA). This metric, the frequentist analog to the Bayesian ranking probability, quantifies the certainty that one treatment is superior to another, on average across all competing treatments. SUCRA ranges from 0% to 100%, where a value of 100% represents the best treatment with absolute certainty and 0% indicates the worst treatment with absolute certainty. Although the SUCRA can be reinterpreted as the relative effectiveness or acceptability percentile of pulsed radiofrequency (PRF) combined with various interventions, these values require cautious interpretation unless clinically meaningful differences between the interventions are established. To assess potential bias arising from small-scale studies, which may contribute to publication bias in the network meta-analysis (NMA), a network funnel plot was generated and visually inspected for symmetry.

We assessed the confidence in the network meta-analysis findings using the CINeMA framework (Confidence in Network Meta-Analysis; https://cinema.ispm.unibe.ch/), which evaluates six domains: within-study bias, reporting bias, indirectness, imprecision, heterogeneity, and incoherence. Owing to the lack of PICO descriptors in the dataset, the software was unable to automatically summarize the indirectness domain. For the incoherence domain, node-splitting analysis was performed for comparisons via the common reference (PRF). Although the star-shaped network structure resulted in large standard errors for indirect estimates due to the lack of closed loops, all direct comparisons were estimable and showed no significant inconsistency (all $P > 0.05$). Therefore, we judged incoherence as no concern for all comparisons.

Results

Study and Identification and Selection

A total of 329 records were retrieved from electronic databases, and one additional document was identified through a manual search (CNKI). After eliminating duplicates, 98 documents were reviewed based on their titles and abstracts, resulting in the exclusion of 9 documents. The remaining 89 documents were reviewed in full, and 62 were further excluded for reasons such as being non-RCTs, having incomplete data, being conference papers, or failing to meet the inclusion criteria for interventions in this review. Finally, 27 eligible RCTs were included in the network meta-analysis, with the detailed screening process shown in Figure 1 (PRISMA flow diagram).

Quality Assessment of the Included Studies

As shown in Figure 2, most studies had a low risk of bias across the majority of domains; however, blinding of participants and personnel was rated as high risk in approximately 50% of studies due to the difficulty of achieving

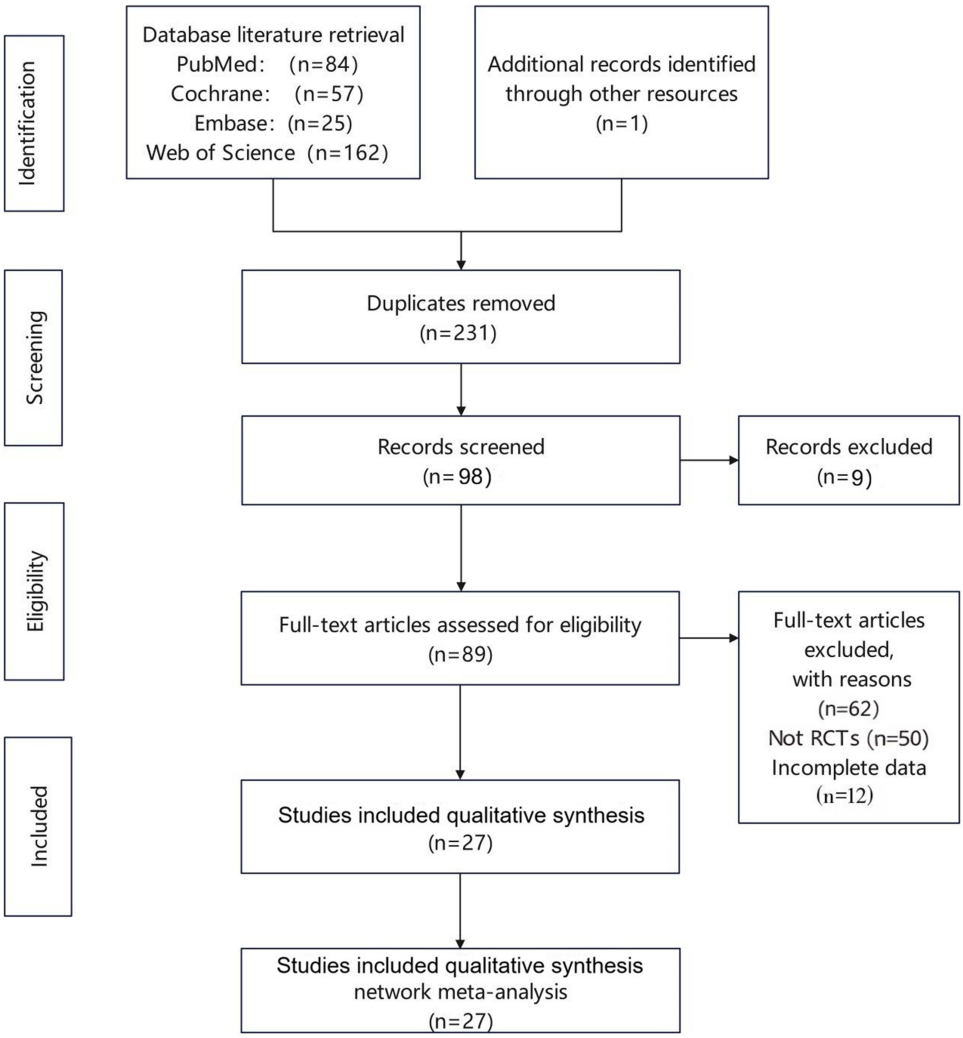

Figure 1 PRISMA[21] flow diagram of study selection. A total of 329 records were identified from electronic databases, with 1 additional record identified manually. After screening, 27 randomized controlled trials were finally included in this network meta-analysis.

double-blinding in interventional trials. Overall, most studies were classified as having a low risk of bias, with none categorized as moderate risk.

Characteristics of the Included Studies

In total, we included studies from 27 randomized controlled trials, which included 1,996 patients diagnosed with Postherpetic Neuralgia. Interventions in the control group included PRF with sham treatment (Sham) (5 studies),[6,7,25–27] High-Voltage PRF (HPRF) (3 studies),[28–30] PRF combined with nerve block therapy (PRF+SVB) (1 study),[31] selective nerve block (SVB) (3 studies),[8,19,20] long-term PRF (LPRF) (1 study),[32] spinal cord stimulation (SCS) (4 studies),[11–14] Oral-drug (4 studies),[15–18] PRF combined with drug (PRF+drug) (3 studies),[33–35] PRF combined with methylene blue paravertebral nerve block (PRF +MB) (1 study),[10] injection of BoNT-A in the lesion area (1 study)[9] and PRF combined with platelet rich plasma injection on the dorsal root ganglion (PRF+PRP) (1 study).[36] VAS scores were reported in all 27 studies, while GH (n=7), MH (n=8), VT (n=6), and pregabalin dosage (n=8) were reported in a subset of studies. There were twenty-four studies from China, two studies from India, and one study from Egypt. The characteristics of the included studies are shown in Table 2.

Network Meta-Analysis

The full NMA figure is shown in Figure 3. The other NMA figures will be shown in Supplementary Figures 1–4.

Figure 2 Risk of bias summary of included studies. (**A**) Risk of bias summary graph, showing the percentage of studies with low, unclear, and high risk of bias across all domains. (**B**) Risk of bias graph for individual studies. Green circles represent low risk of bias, yellow circles represent unclear risk, and red circles represent high risk of bias.

Unified Postherpetic Neuralgia VAS Score Scale

All *P*-values for indirect and direct comparisons between the studies were tested for consistency and inconsistency, with all *P*-values exceeding 0.05, indicating that the consistency of the effects between the studies was acceptable The details are provided in Table 3. The results of the network meta-analysis revealed that, compared to the sham control group, all 11 active treatments were superior in reducing VAS scores, with statistically significant differences observed in most comparisons (95% *CIs* did not cross 0).

Specifically, SCS [MD=3.17, 95% CI=(1.74, 4.60)], HPRF [MD=3.11, 95% CI=(1.58, 4.64)], and PRF combined with SVB (PRF+SVB) [MD=3.12, 95% CI=(0.84, 5.41)] exhibited the most significant analgesic effects compared to the sham group (95% CIs did not cross 0, $P < 0.05$). SCS was superior to PRF [MD=1.25, 95% CI=(0.16, 2.33)], and PRF was superior to SVB [MD=1.35, 95% CI=(0.11, 2.60)]. Additionally, PRF+drug, HPRF, and SCS were superior to Oral-drug therapy [MD=1.60, 95% CI=(0.01, 3.20)], [MD=1.98, 95% CI=(0.38, 3.58)], and [MD=2.04, 95% CI=(0.53, 3.55)], respectively. The details are shown in Table 4.

The probability ranking of the different interventions in terms of reducing VAS scores indicated that SCS ranked first in the SUCRA analysis (SUCRA: 77.3%). A comparison between the two interventions is presented in Figure 4.

To assess the robustness of these findings, we evaluated the certainty of evidence for the primary outcome using the CINeMA framework. The summary of judgments across the six domains is presented in Table 5.

https://doi.org/10.2147/JPR.S607566

Table 2 Characteristics of the Studies Included in the Meta-Analysis

Author	Country	Year	Population	Age (Mean±SD)	Total/Male/ Female	Intervention	Control	Outcome
Bo Wang[28]	China	2021	Herpes zoster neuralgia	T:71.42(5.43) C:72.81(5.92)	T:32/13/19 C:32/15/17	PRF Length of Intervention: 480s Freq: once Duration (days): 23.20 (4.61)	HPRF	NRS Doses of gabapentin Doses of tramadol
Wanyun Zhang[33]	China	2022	Herpes zoster neuralgia	T: 66.5(2.08) C: 63.7(2.94)	T: 32/15/17 C: 32/18/14	PRF Length of Intervention: 120s Freq: once Duration (days): 51.46 (8.46)	PRF+drug Duration (days): 50.10 (9.86)	VAS Doses of Morphine
Chang-Fu Wan[29]	China	2022	Postherpetic neuralgia	T: 69.96(13.66) C: 70.54(14.02)	T: 58/23/35 C: 57/21/36	PRF Length of Intervention: 120s Freq: once Duration (days): 65.14 (18.53)	HPRF Length of Intervention: 900s Freq: once Duration (days): 67.28 (19.64)	VAS GH MH VT Doses of Pregabalin
Chang-Fu Wan[25]	China	2019	Postherpetic neuralgia	T: 66.01(12.28) C: 64.87(15.21)	T: 48/23/25 C: 48/20/28	PRF Length of Intervention: 900s Freq: once Duration (days): 59.95 (21.72)	Sham Duration (days): 62.88 (18.21)	VAS GH MH VT Doses of Pregabalin
Qing Sun[32]	China	2023	Herpes zoster neuralgia	T: 64(9.62) C: 65(9.84)	T:60/32/28 T:60/30/30	PRF Length of Intervention: 180s Freq: once	LPRF Length of Intervention: 600s	VAS Doses of Pregabalin Doses of gabapentin Doses of tramadol Doses of Morphine
Sheng Lei[11]	China	2022	Postherpetic neuralgia	T: 68.29(12.25) C: 70.10(10.24)	T: 38/19/19 C: 29/15/14	PRF Length of Intervention: 600s Freq: once Duration (months): 3.19 (2.16)	SCS Length of Intervention: 2 weeks Freq: once Duration (months): 59.95 (21.72)	VAS Doses of Pregabalin
Ashok Kumar Saxena[15]	India	2022	Postherpetic neuralgia	NA	T: 20 C:20	PRF Length of Intervention: 240s Freq: 1–2times	Oral-drug Freq: at 4th week if vas>3,done once	VAS
Ashok Kumar Saxena[26]	India	2016	Postherpetic neuralgia	T: 61.33(7.96) C: 59(7.6)	T: 30/17/13 C: 30/17/13	PRF Length of Intervention: 180s Freq: once Duration (months): 4.02 (1.44)	Sham Duration (months): 3.80 (1.52)	VAS

(*Continued*)

https://doi.org/10.2147/JPR.S607566

https://doi.org/10.2147/JPR.S607566

Table 2 (Continued).

Author	Country	Year	Population	Age (Mean±SD)	Total/Male/ Female	Intervention	Control	Outcome
Zhibing Pi[16]	China	2018	Herpes zoster neuralgia	NA	T: 64 C:64	PRF Length of Intervention: 240s Freq: once	Oral-drug	VAS Doses of Morphine
Mohamed Y. Makharita[6]	Egypt	2018	Postherpetic neuralgia	T: 59.1(4.1) C: 58.4(4.1)	T: 21/12/9 C: 22/12/10	PRF Length of Intervention: 120s Freq: once Duration (months): 13.4 (4.4)	Sham Duration (months): 15.1 (3.4)	VAS GH MH VT Doses of Pregabalin
Ke Ma[7]	China	2013	Postherpetic neuralgia	T: 73.04(6.52) C: 71.14(7.2)	T: 46/24/22 C: 46/22/24	PRF Length of Intervention: 120s Freq: twice Duration (months): 23.28 (15.41)	Sham Freq: twice Duration (months): 25.59 (14.49)	VAS GH MH Doses of tramadol
Yan-zhi Xia[19]	China	2018	Postherpetic neuralgia	T: 67.10(3.30) C1: 65.80(3.70) C2: 66.50(3.50)	T: 20/12/8 C1: 20/10/10 C2: 20/8/12	PRF Length of Intervention: 600s Freq: once Duration (months): 14.10 (1.60)	SVB/Acupuncture Length of Intervention: 6 days/9days Freq: once/thrice Duration (months): 13.50 (3.70)/12.90 (2.20)	VAS
Zhen-Wu Zhang[8]	China	2023	Herpes zoster neuralgia	T: 65.70(6.18) C1: 63.60(5.94) C2:65.58(4.18)	T: 30/14/16 C1:30/18/12 C2:30/13/17	PRF Length of Intervention: 600s Freq: once Duration (days): 51.46 (6.46)	SVB Length of Intervention: NA Freq: once Duration (days): 52.10 (9.86)/55.46 (7.12)	NRS
Wen Song[34]	China	2021	Postherpetic neuralgia	T: 64.0(5.10) C: 63.7(6.3)	T: 15/7/8 C: 15/6/9	PRF+drug Length of Intervention: 600s Freq: once Duration (months): 6.3 (4.8)	PRF Length of Intervention: 600s Freq: once Duration (months): 6.6 (5.1)	NRS
Botao Liu[12]	China	2020	Postherpetic neuralgia	T: 65.33(9.10) C: 66.53(10.81)	T: 32/18/14 C: 31/13/18	PRF Length of Intervention: 360s Freq: once Duration (months): 2.31 (1.54)	SCS Length of Intervention: 2 weeks Freq: once Duration (months): 3.27 (1.80)	NRS
Shenshen Lin[27]	China	2023	Postherpetic neuralgia	T: 66.8(8.4) C: 67.6(10.6)	T: 30/18/12 C: 30/16/14	PRF Length of Intervention: 900s Freq: once Duration (days): 15.2 (7.3)	Sham Duration (days): 16.0 (8.7)	VAS GH MH VT

Xiaohong Li[13]	China	2022	Postherpetic neuralgia	T: 63.5(17.8) C: 65.5(13.2)	T: 20/10/10 C: 20/11/9	PRF Length of Intervention: 240s Freq: once Duration (days): 47.5 (37.5)	SCS Length of Intervention: 1 week Freq: once Duration (months): 3.27 (1.80)	VAS
Min Li[35]	China	2022	Postherpetic neuralgia	T: 63,47(13.24) C: 62.85(14.52)	T: 51/25/28 C: 52/27/26	PRF+drug Length of Intervention: 600s Freq: once Duration (days): NA	PRF Length of Intervention: 600s Freq: once Duration (days): NA	VAS GH MH VT Doses of Pregabalin
Dan Li[31]	China	2018	Postherpetic neuralgia	T: 69(5) C1: 68(7) C2:65(6)	T:15 C:15	PRF Length of Intervention: 120s Freq: once Duration (days): NA	PRF+SVB Length of Intervention: 120s Freq: once Duration (days): NA	VAS
Meiduan Ji[10]	China	2022	Postherpetic neuralgia	T: 69.22(6.97) C:71.55(9.13)	T: 36/18/18 C: 36/20/16	PRF Length of Intervention: 600s Freq: once Duration (months): 7.86(4.24)	PRF+MB Length of Intervention: 600s Freq: once Duration (months): 9.02(5.71)	VAS Doses of Pregabalin
ZhenKai Han[30]	China	2022	Postherpetic neuralgia	T: 67.67 (6.77) C1:68.19(10.42) C2:68.35(9.47)	T:40/19/21 C1:39/18/21 C2:39/20/19	PRF (45V) Length of Intervention: 600s Freq: once Duration (months): 3.08(1.07)	HPRF Length of Intervention: 600s Freq: once Duration (months): 3.38(0.93)	VAS MH
Hui-Hui Gu[20]	China	2015	Postherpetic neuralgia	NA	NA	PRF Length of Intervention: 120s Freq: once	SVB/sham Length of Intervention: 120s Freq: once	VAS
Lipingn Chen[9]	China	2022	Postherpetic neuralgia	T:72.28(7.43) C: 72.20(6.57)	T: 50/26/24 C:50/26/24	PRF Length of Intervention: 360s Freq: once Duration (days): NA	BoNT-A Length of Intervention: NA Freq: once Duration (days): NA	NRS
Yuanli Gang[36]	China	2022	Postherpetic neuralgia	T: 69.34(10.32) C: 70.11(12.15)	T: 25/11/14 C: 27/12/15	PRF Length of Intervention: 900s Freq: once Duration (months): 2.21(1.07)	PRF+PRP Length of Intervention: 900s Freq: once Duration (months): 2.07(0.93)	VAS

(*Continued*)

https://doi.org/10.2147/JPR.S607566

Table 2 (Continued).

Author	Country	Year	Population	Age (Mean±SD)	Total/Male/ Female	Intervention	Control	Outcome
Chang-Fu Wan[14]	China	2021	Postherpetic neuralgia	T: 69.59(14.68) C: 71.16(12.88)	T: 46/20/26 C: 45/21/24	PRF Length of Intervention: 900s Freq: once Duration (days): 68.75(19.57)	SCS Length of Intervention: 10 days Freq: once Duration (days): 71.1(17.65)	NRS GH MH VT Doses of Pregabalin
Youqing Huang[17]	China	2018	Postherpetic neuralgia	T: 46.7(12.3) C: 48.5(14.7)	T: 58/29/29 C: 58/32/26	PRF Length of Intervention: 240s Freq: once Duration (days): 41.2(8.5)	Oral-drug Length of Intervention: NA Freq: NA Duration (days): 45.6(9.7)	VAS
Zhi-Hong Xiong[18]	China	2020	Postherpetic neuralgia	T: 71.4(10.3) C:50.1(12.2)	T: 39/17/22 C: 39/19/20	PRF Length of Intervention: 180s Freq: once Duration (days): NA	Oral-drug Length of Intervention: NA Freq: NA Duration (days): NA	NRS

Notes: NA indicates that the corresponding data were not reported in the original studies.

Abbreviations: T, test group, C, control group, PRF, Pulsed radiofrequency, HPRF, High-Voltage PRF, LPRF, long-term PRF; SVB, selective nerve block; PRF+SVB, PRF combined with nerve block therapy; SCS, spinal cord stimulation; Oral-drug, only oral drug; PRF+MB, PRF combined with methylene blue paravertebral nerve block; BoNT-A, injection of BoNT-A in the lesion area; PRF+PRP, PRF combined with platelet-rich plasma injection on the dorsal root ganglion; Sham, without radiofrequency energy output; PRF+drug, PRF combined with intravenous injection of drugs.

https://doi.org/10.2147/JPR.S607566

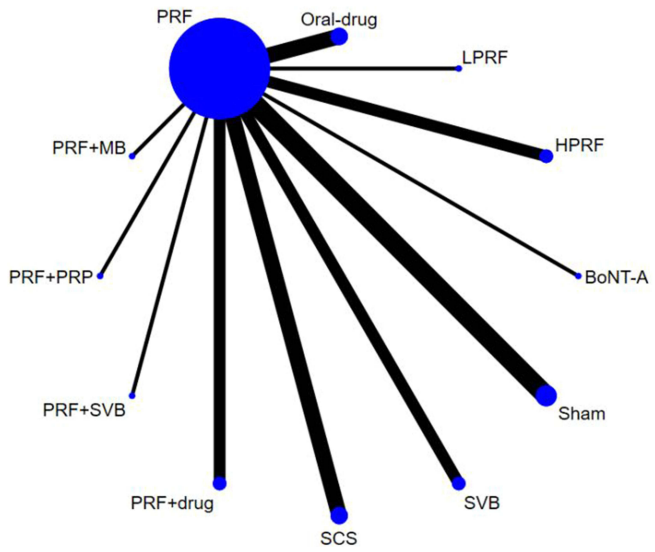

Figure 3 Network evidence structure of included interventions for the primary outcome (VAS pain score). The network plot displays the direct comparisons between all included interventions. Nodes (blue circles) represent each intervention, with size proportional to the total number of studies evaluating that intervention. Lines (edges) represent direct head-to-head comparisons between two interventions, with line width proportional to the number of studies included in that comparison.
Abbreviations: PRF, pulsed radiofrequency; HPRF, high-voltage pulsed radiofrequency; LPRF, long-term pulsed radiofrequency; SVB, selective nerve block; SCS, spinal cord stimulation; BoNT-A, botulinum toxin type A; PRF+SVB, pulsed radiofrequency combined with selective nerve block; PRF+drug, pulsed radiofrequency combined with drug therapy; PRF+MB, pulsed radiofrequency combined with methylene blue; PRF+PRP, pulsed radiofrequency combined with platelet-rich plasma; Oral-drug, oral medication; Sham, sham control.

Unified Postherpetic Neuralgia GH Score Scale

All *P*-values for indirect and direct comparisons between the studies were tested for consistency and inconsistency, with all *P*-values exceeding 0.05, indicating that the consistency of the effects between the studies was acceptable The details are provided in Supplementary Table 1.

The results of the network meta-analysis for GH scores indicated that PRF+drug [MD=33.99, 95% CI=(19.61, 48.36)], HPRF [MD=24.93, 95% CI=(10.95, 38.91)], SCS [MD=22.03, 95% CI=(7.98, 36.07)], and PRF [MD=21.42,

Table 3 Node-Splitting Analysis for Consistency Test of VAS Pain Score

Side	Direct		Indirect		Difference		*P* > |z|	Tau
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.		
A E *	−0.310	1.099	0.038	62.023	−0.348	62.033	0.996	1.043
B E *	1.185	0.616	−1.805	365.066	2.991	365.066	0.993	1.043
C E *	0.600	1.048	−1.220	632.578	1.820	632.579	0.998	1.043
D E *	−0.794	0.535	0.174	316.419	−0.968	316.419	0.998	1.043
E F *	−1.040	1.061	−0.422	632.961	−0.618	632.962	0.999	1.043
E G *	−0970	1.076	−0.350	630.837	−0.620	630.838	0.999	1.043
E H *	−1.200	1.063	−0.580	631.870	−0.620	631.871	0.999	1.043
E I *	−0.810	0.613	−0.194	365.776	−0.617	365.777	0.999	1.043
E J *	−1.246	0.554	−0.626	314.450	−0.620	314.451	0.998	1.043
E K *	1.351	0.635	1.970	365.542	−0.620	365.543	0.999	1.043
E L *	1.925	0.476	2.545	283.580	−0.620	283.581	0.998	1.043

Notes: Data were obtained from node-splitting analysis for consistency test.[23] *Indicates the node-splitting comparison between two interventions.
Abbreviations: A, botulinum toxin type A (BoNT-A); B, high-voltage pulsed radiofrequency (HPRF); C, long-term pulsed radiofrequency (LPRF); D, oral medication (Oral-drug); E, pulsed radiofrequency (PRF); F, pulsed radiofrequency combined with methylene blue (PRF+MB); G, pulsed radiofrequency combined with platelet-rich plasma (PRF+PRP); H, pulsed radiofrequency combined with selective nerve block (PRF+SVB); I, pulsed radiofrequency combined with drug therapy (PRF+drug); J, spinal cord stimulation (SCS); K, selective nerve block (SVB); L, sham control (Sham).

https://doi.org/10.2147/JPR.S607566

https://doi.org/10.2147/JPR.S607566

Table 4 League Table on VAS

SCS	HPRF	PRF+SVB	PRF+MB	PRF+PRP	PRF+drug	LPRF	PRF	BoNT-A	Oral-Drug	SVB	Sham
SCS	0.06 (−1.56,1.68)	0.05 (−2.30,2.39)	0.21 (−2.14,2.55)	0.28 (−2.10,2.65)	0.44 (−1.18,2.05)	0.65 (−1.68,2.97)	1.25 (0.16,2.33)	1.56 (−0.86,3.97)	**2.04 (0.53,3.55)**	**2.60 (0.94,4.25)**	**3.17 (1.74,4.60)**
−0.06 (−1.68,1.56)	HPRF	−0.01 (−2.42,2.39)	0.15 (−2.26,2.55)	0.22 (−2.21,2.65)	0.37 (−1.33,2.08)	0.59 (−1.80,2.97)	1.19 (−0.02,2.39)	1.50 (−0.97,3.96)	**1.98 (0.38,3.58)**	**2.54 (0.80,4.27)**	**3.11 (1.58,4.64)**
−0.05 (−2.39,2.30)	0.01 (−2.39,2.42)	PRF+SVB	0.16 (−2.78,3.10)	0.23 (−2.73,3.19)	0.39 (−2.02,2.79)	0.60 (−2.33,3.53)	1.20 (−0.88,3.28)	1.51 (−1.49,4.51)	1.99 (−0.34,4.33)	**2.55 (0.12,4.98)**	**3.12 (0.84,5.41)**
−0.21 (−2.55,2.14)	−0.15 (−2.55,2.26)	−0.16 (−3.10,2.78)	PRF+MB	0.07 (−2.89,3.03)	0.23 (−2.17,2.63)	0.44 (−2.48,3.36)	1.04 (−1.04,3.12)	1.35 (−1.64,4.34)	1.83 (−0.49,4.16)	2.39 (−0.03,4.81)	**2.96 (0.69,5.24)**
−0.28 (−2.65,2.10)	−0.22 (−2.65,2.21)	−0.23 (−3.19,2.73)	−0.07 (−3.03,2.89)	PRF+PRP	0.16 (−2.27,2.59)	0.37 (−2.57,3.31)	0.97 (−1.14,3.08)	1.28 (−1.73,4.29)	1.76 (−0.59,4.12)	2.32 (−0.13,4.77)	**2.89 (0.59,5.20)**
−0.44 (−2.05,1.18)	−0.37 (−2.08,1.33)	−0.39 (−2.79,2.02)	−0.23 (−2.63,2.17)	−0.16 (−2.59,2.27)	PRF+drug	0.21 (−2.17,2.59)	0.81 (−0.39,2.01)	1.12 (−1.35,3.59)	**1.60 (0.01,3.20)**	**2.16 (0.43,3.89)**	**2.74 (1.21,4.26)**
−0.65 (−2.97,1.68)	−0.59 (−2.97,1.80)	−0.60 (−3.53,2.33)	−0.44 (−3.36,2.48)	−0.37 (−3.31,2.57)	−0.21 (−2.59,2.17)	LPRF	0.60 (−1.45,2.65)	0.91 (−2.07,3.89)	1.39 (−0.91,3.70)	1.95 (−0.45,4.35)	**2.52 (0.27,4.78)**
−1.25 (−2.33,-0.16)	−1.19 (−2.39,0.02)	−1.20 (−3.28,0.88)	−1.04 (−3.12,1.04)	−0.97 (−3.08,1.14)	−0.81 (−2.01,0.39)	−0.60 (−2.65,1.45)	PRF	0.31 (−1.84,2.46)	0.79 (−0.25,1.84)	**1.35 (0.11,2.60)**	**1.92 (0.99,2.86)**
−1.56 (−3.97,0.86)	−1.50 (−3.96,0.97)	−1.51 (−4.51,1.49)	−1.35 (−4.34,1.64)	−1.28 (−4.29,1.73)	−1.12 (−3.59,1.35)	−0.91 (−3.89,2.07)	−0.31 (−2.46,1.84)	BoNT-A	0.48 (−1.91,2.88)	1.04 (−1.45,3.53)	1.61 (−0.73,3.96)
−2.04 (−3.55,-0.53)	**−1.98 (−3.58,-0.38)**	−1.99 (−4.33,0.34)	−1.83 (−4.16,0.49)	−1.76 (−4.12,0.59)	**−1.60 (−3.20,-0.01)**	−1.39 (−3.70,0.91)	−0.79 (−1.84,0.25)	−0.48 (−2.88,1.91)	Oral-drug	0.56 (−1.07,2.18)	1.13 (−0.27,2.53)
−2.60 (−4.25,-0.94)	**−2.54 (−4.27,-0.80)**	**−2.55 (−4.98,-0.12)**	−2.39 (−4.81,0.03)	−2.32 (−4.77,0.13)	**−2.16 (−3.89,-0.43)**	−1.95 (−4.35,0.45)	**−1.35 (−2.60,-0.11)**	−1.04 (−3.53,1.45)	−0.56 (−2.18,1.07)	SVB	0.57 (−0.98,2.13)
−3.17 (−4.60,-1.74)	**−3.11 (−4.64,-1.58)**	**−3.12 (−5.41,-0.84)**	**−2.96 (−5.24,-0.69)**	**−2.89 (−5.20,-0.59)**	**−2.74 (−4.26,-1.21)**	**−2.52 (−4.78,-0.27)**	**−1.92 (−2.86,-0.99)**	−1.61 (−3.96,0.73)	−1.13 (−2.53,0.27)	−0.57 (−2.13,0.98)	Sham

Notes: Data are presented as mean difference (MD, 95% confidence interval [CI]).[23,24] Bold values denote statistically significant comparisons (95% CI does not cross zero).

Abbreviations: PRF, Pulsed radiofrequency; HPRF, High-Voltage PRF; LPRF, long-term PRF; SVB, selective nerve block; PRF+SVB,PRF combined with nerve block therapy; SCS, spinal cord stimulation; Oral-drug, only oral-drug; PRF+MB, PRF combined with methylene blue paravertebral nerve block; BoNT-A, injection of BoNT-A in the lesion area; PRF+PRP, PRF combined with platelet rich plasma injection on the dorsal root ganglion; Sham, without radiofrequency energy output; PRF+drug, PRF combined with intravenous injection of drugs.

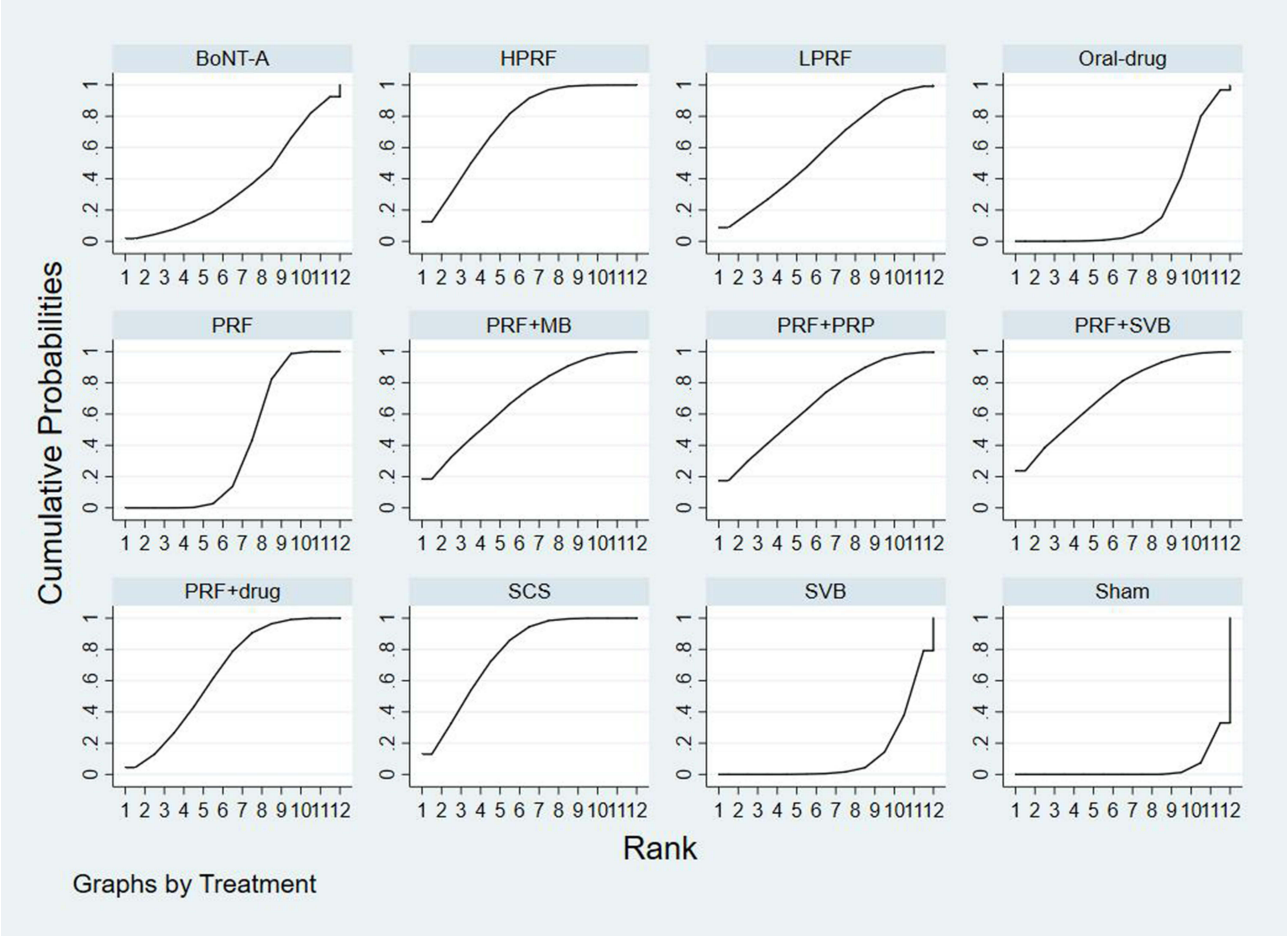

Figure 4 Surface under the cumulative ranking curve (SUCRA) probabilities for VAS pain score. Curves show the cumulative ranking probabilities of included interventions. A higher SUCRA value indicates a higher probability of being among the most effective treatments.
Abbreviations: BoNT-A, botulinum toxin type A; HPRF, high-voltage pulsed radiofrequency; LPRF, long-term pulsed radiofrequency; Oral-drug, oral medication; PRF, pulsed radiofrequency; PRF+MB, pulsed radiofrequency combined with methylene blue; PRF+PRP, pulsed radiofrequency combined with platelet-rich plasma; PRF+SVB, pulsed radiofrequency combined with selective nerve block; PRF+drug, pulsed radiofrequency combined with drug therapy; SCS, spinal cord stimulation; SVB, selective nerve block; Sham, sham control.

95% CI=(15.14, 27.70)] were superior in improving GH scores compared to the sham control group. The details are provided in Supplementary Table 2.

The probability ranking of the different interventions in terms of improvement in GH scores showed that PRF+drug ranked first in the SUCRA analysis (SUCRA: 92.9%). A comparison between the two interventions is presented in Supplementary Figure 5.

Unified Postherpetic Neuralgia MH Score Scale

All *P*-values for indirect and direct comparisons between the studies were tested for consistency and inconsistency, with all *P*-values exceeding 0.05, indicating that the consistency of the effects between the studies was acceptable The details are provided in Supplementary Table 3.

The results of the network meta-analysis for MH scores showed that, relative to the sham control group, PRF+drug [MD=46.70,95% CI=(39.16, 54.25)], HPRF [MD=26.30, 95% CI=(20.69, 31.91)], SCS [MD=23.29, 95% CI=(15.72, 30.87)], and PRF [MD=21.77, 95% CI=(18.48, 25.06)] were superior in improving the MH scores. The details are provided in Supplementary Table 4.

The probability ranking of the different interventions in terms of improvement in MH scores showed that PRF+drug ranked first in the SUCRA analysis (SUCRA: 100.0%). A comparison between the two interventions is presented in Supplementary Figure 6.

https://doi.org/10.2147/JPR.S607566

Table 5 CINeMA Assessment of Certainty of Evidence for VAS Pain Score (vs PRF)

Comparison	Within-Study Bias	Reporting Bias	Indirectness	Imprecision	Heterogeneity	Incoherence	Confidence
SCS vs PRF	Moderate	Low risk	No concern	Major concerns	No concerns	No concern	Moderate
HPRF vs PRF	High	Low risk	No concern	Some concerns	Some concerns	No concern	Moderate
PRF+SVB vs PRF	High	Low risk	No concern	Major concerns	No concerns	No concern	Low
PRF+MB vs PRF	Moderate	Low risk	No concern	Major concerns	No concerns	No concern	Moderate
PRF+PRP vs PRF	Moderate	Low risk	No concern	Major concerns	No concerns	No concern	Moderate
PRF+drug vs PRF	Moderate	Low risk	No concern	Major concerns	No concerns	No concern	Moderate
LPRF vs PRF	Moderate	Low risk	No concern	Major concerns	No concerns	No concern	Moderate
BoNT-A vs PRF	High	Low risk	No concern	Major concerns	No concerns	No concern	Low
Oral-drug vs PRF	High	Low risk	No concern	Major concerns	No concerns	No concern	Low
SVB vs PRF	High	Low risk	No concern	No concerns	Major concerns	No concern	Low
Sham vs PRF	Moderate	Low risk	No concern	No concerns	No concerns	No concern	High

Notes: The confidence in evidence was rated as moderate for SCS, HPRF, PRF+MB, PRF+PRP, PRF+drug, and LPRF compared with PRF, and low for PRF+SVB, BoNT-A, Oral-drug, and SVB. The comparison of Sham versus PRF yielded high confidence.

Unified Postherpetic Neuralgia VT Score Scale

All *P*-values for indirect and direct comparisons between the studies were tested for consistency and inconsistency, with all *P*-values exceeding 0.05, indicating that the consistency of the effects between the studies was acceptable The details are provided in Supplementary Table 5.

The results of the network meta-analysis for VT scores showed that, relative to the sham control group, PRF+drug [MD=36.06, 95% CI=(29.71, 42.41)], HPRF [MD=23.07, 95% CI=(17.53, 28.61)], SCS [MD=18.76, 95% CI=(13.60, 23.92)], and PRF [MD=18.77, 95% CI= (15.48, 22.06)] were superior in improving the VT scores. The details are provided in Supplementary Table 6.

The probability ranking of the different interventions in terms of improvement in VT scores showed that PRF+drug ranked first in the SUCRA analysis (SUCRA: 100.0%). A comparison between the two interventions is presented in Supplementary Figure 7.

Unified Post-Treatment Pregabalin Dosage in Postherpetic Neuralgia

All *P*-values for indirect and direct comparisons between the studies were tested for consistency and inconsistency, with all *P*-values exceeding 0.05, indicating that the consistency of the effects between the studies was acceptable The details are provided in Supplementary Table 7.

The results of the network meta-analysis for pregabalin dosage showed that, relative to the sham group, PRF+drug [MD=−387.08, 95% CI=(−540.05, −234.10)], PRF combined with Methylene Blue (PRF+MB) [MD=−310.52, 95% CI=(−465.72, −155.31)], SCS [MD=−298.60, 95% CI=(−423.33, −173.86)], Long-Term PRF (LPRF) [MD=−288.43, 95% CI=(−440.06, −136.81)], High-Voltage PRF (HPRF) [MD=−271.23, 95% CI=(−411.01, −131.45)], and PRF [MD=−246.74, 95% CI=(−335.58, −157.90)] were superior in reducing pregabalin doses. Details are provided in Supplementary Table 8.

The probability ranking of the different interventions in terms of reduction in the doses of pregabalin showed that PRF+drug ranked first in the SUCRA analysis (SUCRA: 90.5%). A comparison between the two interventions is presented in Supplementary Figure 8.

Publication Bias Test

We constructed separate funnel plots for all outcome indicators to assess the potential publication bias. Visual inspection of the funnel plots did not reveal any significant publication bias. The details are provided in Figure 5.

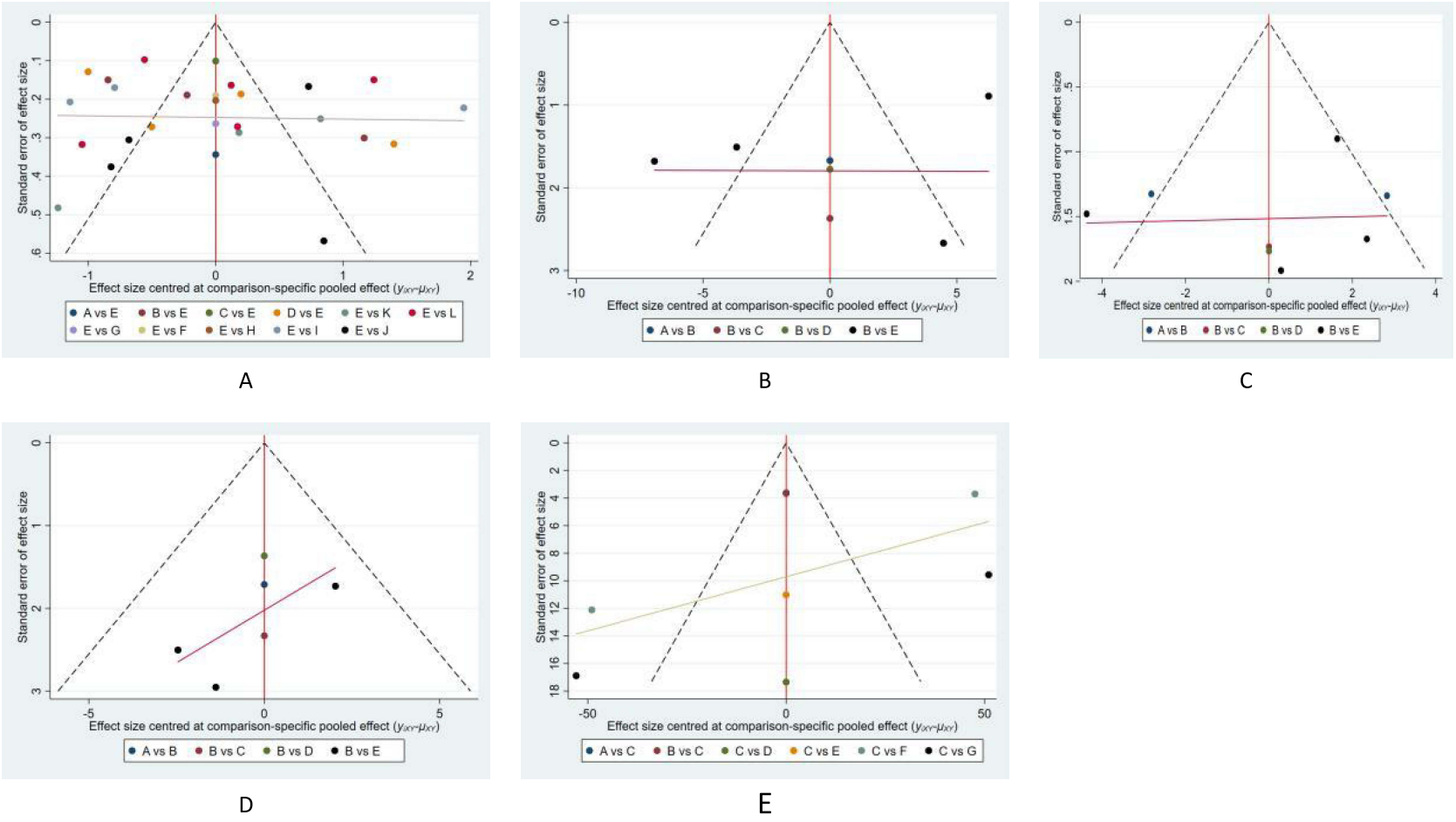

Figure 5 Funnel plots for publication bias assessment across all outcomes. (**A**) Visual Analog Scale (VAS) pain score. (**B**) SF-36 General Health (GH) score. (**C**) SF-36 Mental Health (MH) score. (**D**) SF-36 Vitality (VT) score. (**E**) Pregabalin dosage. Symmetrical distribution of points indicates low risk of publication bias.

https://doi.org/10.2147/JPR.S607566

Discussion

In this study, we compared the effectiveness of PRF combined with different interventions to improve the outcomes of patients with PHN. A total of 27 studies encompassing 12 different interventions and 1,996 patients diagnosed with PHN, were included, representing a relatively large sample size. Our findings indicated that SCS was the most effective intervention for reducing VAS scores, while PRF+drug proved to be the most effective intervention for improving MH, GH, VT scores, and reducing doses of pregabalin. These results confirm two optimal interventions for PHN with distinct advantages.

Our findings are consistent with previous meta-analyses,[37] while also providing meaningful extensions to current knowledge. In this network meta-analysis, SCS ranked highest in pain relief efficacy among all included interventions for PHN. Nevertheless, this finding should be interpreted with caution, considering the limited number of available trials for some interventions and the geographic concentration of the enrolled studies. However, prior systematic reviews[4] have focused mainly on single pain-related outcomes, often overlooking patient-reported quality of life and medication burden.

The present study addresses this research gap by showing that PRF+drug, rather than monotherapies, achieves the most favorable balance across mental health, general health, and vitality domains. Furthermore, the marked reduction in pregabalin dosage associated with PRF+drug adds a key safety dimension—an aspect rarely highlighted in previous comparative analyses of PHN interventions.[38] By including 12 interventions and a comprehensive set of outcomes, our analysis offers a more refined decision-making framework compared to earlier studies with narrower scopes.

The distinct advantages of SCS and PRF+drug observed in our study can be attributed to their targeted modulation of PHN pathophysiological pathways. For SCS, its potent analgesic effect is achieved by delivering low-frequency or high-frequency electrical stimulation to the spinal cord dorsal horn through electrodes, which activates inhibitory interneurons within the spinal cord and blocks the ascending transmission of nociceptive pain signals from the spinothalamic tract to the cerebral cortex.[39] Additionally, SCS stimulates the release of inhibitory neurotransmitters such as gamma-aminobutyric acid (GABA) and endogenous opioids, while reducing the secretion of pain-inducing neurotransmitters like glutamate and substance P, thereby lowering the excitability of sensory neurons.[40,41] Long-term regular electrical stimulation also enables SCS to reshape the neural circuitry of the spinal cord dorsal horn, reverse central sensitization, and inhibit the inflammatory response following peripheral nerve injury,[37] as well as modulate the inflammatory microenvironment by suppressing pro-inflammatory cytokines (eg., TNF-α, IL-6) and promoting anti-inflammatory cytokines (eg., IL-10).[42,43] These multi-target mechanisms collectively explain why SCS achieved the highest SUCRA ranking in VAS score reduction, consistent with its role as an established intervention for refractory PHN.[11,13]

For PRF+drug therapy, its comprehensive benefits in improving mental health, general health, and vitality are derived from the synergistic effects of PRF and combined medications. PRF exerts a neuromodulatory effect by reversibly inhibiting C-fiber excitability, reducing the transmission of pain signals to the central nervous system and alleviating the psychological burden of chronic pain.[44] Among the combined drugs, dexamethasone (a corticosteroid) inhibits immune responses and the release of pro-inflammatory cytokines (eg., TNF-α, IL-6),[35,45] reducing immune-mediated nerve damage and neurogenic edema; sedative-analgesic agents such as nalbuphine directly improve sleep quality and mitigate anxiety caused by pain-induced insomnia.[34] Lidocaine further blocks sodium channels in nerve fibers, reducing the physical stress response triggered by pain.[33] This multi-target synergistic effect achieves long-term stable pain control,[35] which in turn improves sleep structure, reduces physical exhaustion, relieves activity limitations, and ultimately enhances patients' vitality and general health perception.[46]

Despite the notable strengths of this study, several limitations should be acknowledged when interpreting the findings. First, the implementation of blinding was constrained in the included trials: only 8 out of 27 RCTs adopted a double-blind design. Given that patients and their family members were required to provide informed consent for PRF-based combined interventions, achieving complete blinding was methodologically challenging, which may have introduced potential performance bias and influenced the objectivity of outcome assessments. Second, there was a clear geographic imbalance in the included studies: 24 trials were conducted in China, with only 3 originating from other countries (2 from India and 1 from Egypt). This regional concentration may limit the generalizability of our results to more diverse ethnic

and healthcare settings. Third, the follow-up durations of some included studies were relatively short, with insufficient data on long-term efficacy and safety outcomes (eg., sustained pain relief beyond 6 months, long-term adverse events related to pregabalin or interventional procedures). Additionally, as highlighted by Chen et al[9] the efficacy of BoNT-A injection was comparable to PRF-related interventions in reducing VAS scores, but the small number of trials focusing on BoNT-A (only 1 RCT) limited the statistical power of our network meta-analysis for this intervention.

The findings of this network meta-analysis have important clinical implications for the individualized treatment of PHN patients. For patients with severe pain (VAS score ≥ 7) or refractory to conventional pharmacotherapy, spinal cord stimulation (SCS) should be prioritized, as it demonstrated the most significant analgesic effect (SUCRA=77.3%, MD=3.17, 95% CI=1.74,4.60) and targets multiple pain pathways through neurotransmitter modulation and inflammatory microenvironment regulation.[37,39,40,42,43] This is particularly applicable to younger patients with good surgical tolerance and no contraindications to minimally invasive procedures.

For elderly patients, those with comorbidities such as liver or kidney dysfunction, or those emphasizing quality of life improvement, PRF+drug therapy is a more appropriate choice. Its superior performance in improving mental health (SUCRA=100.0%), general health (SUCRA=92.9%), vitality (SUCRA=100.0%), and reducing pregabalin dosage (SUCRA=90.5%, MD=−387.08, 95% CI=−540.05,-234.10) addresses unmet clinical needs.[34,35,38] The synergistic effect of PRF and combined medications achieves long-term stable pain control while minimizing adverse drug reactions and metabolic burden, which is crucial for vulnerable populations.

The CINeMA assessment (Table 5) showed moderate to low confidence for most comparisons, mainly due to within-study bias (impaired blinding in interventional trials) and imprecision (small sample sizes and wide confidence intervals). These limitations are common in interventional pain management trials and do not invalidate our findings, but highlight the need for future high-quality RCTs.

Additionally, clinicians should avoid a uniform approach and integrate patient-specific factors (eg., pain severity, age, comorbidities, treatment preferences) into decision-making. For example, patients with mild to moderate pain may initially receive oral medications, but if pain persists or quality of life declines, PRF+drug therapy can be considered to enhance efficacy and reduce long-term medication reliance. These stratified recommendations provide a practical framework for optimizing PHN management and improving patient outcomes.

This study provides valuable evidence for the treatment of PHN, recommending the prioritization of SCS for potent analgesia or the use of PRF+drug therapy to achieve multiple goals, including pain relief, improvement in quality of life, and medication safety. Future research should focus on large-sample, multicenter RCTs with longer follow-up durations to verify the long-term efficacy and safety of SCS and PRF+drug. Additionally, more studies involving diverse ethnic populations are needed to improve the generalizability of the findings.

Conclusions

This network meta-analysis suggests that SCS may provide the greatest pain relief for PHN, while PRF combined with drug therapy may offer advantages in several quality-of-life domains and reduction in pregabalin use.

Importantly, these findings are derived from a network of both direct and indirect comparisons and should be interpreted cautiously, given the limited number of trials for some interventions, the risk of inconsistency and heterogeneity across studies, and the overall constraints of the available evidence.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare that there are no conflicts of interest regarding the publication of this article.

References

1. Gross GE, Eisert L, Doerr HW, et al. S2k guidelines for the diagnosis and treatment of herpes zoster and postherpetic neuralgia. *J Dtsch Dermatol Ges*. 2020;18(1):55–78.
2. Hüning S, Werner M, Susok L. Clinical presentation and treatment of herpes zoster and postherpetic neuralgia. *Dermatology*. 2024;75(9):733. doi:10.1007/s00105-024-05367-y
3. Wang J, Tao R, Jiang Y, Ma Z, Xia L. Risk factors for postherpetic neuralgia: a meta-analysis based on demographic, clinical features, and treatment characteristics. *Front Immunol*. 2025;16:1667364. doi:10.3389/fimmu.2025.1667364
4. Aggarwal A, Suresh V, Gupta B, Sonthalia S. Post-herpetic neuralgia: a systematic review of current interventional pain management strategies. *J Cutan Aesthet Surg*. 2020;13(4):265–274. doi:10.4103/JCAS.JCAS_45_20
5. Chen J, Lan L, Wang W, Xu X. Efficacy and safety of pulsed radiofrequency combined with pregabalin for herpetic neuralgia: a systematic review and meta-analysis. *Medicine*. 2023;102(23):e33932. doi:10.1097/MD.0000000000033932
6. Makharita MY, El Bendary HM, Sonbul ZM, Ahmed SES, Latif MA. Ultrasound-guided pulsed radiofrequency in the management of thoracic postherpetic neuralgia: a randomized, double-blinded, controlled trial. *Clin J Pain*. 2018;34(11):1017–1024. doi:10.1097/AJP.0000000000000629
7. Ke M, Yinghui F, Yi J, et al. Efficacy of pulsed radiofrequency in the treatment of thoracic postherpetic neuralgia from the angulus costae: a randomized, double-blinded, controlled trial. *Pain Physician*. 2013;16(1):15–25.
8. Zhang Z, Zhao Y, Du T, et al. A clinical study of C arm-guided selective spinal nerve block combined with low-temperature plasma radiofrequency ablation of dorsal root ganglion in the treatment of zoster-related neuralgia. *Front Neurol*. 2023;14:1122538. doi:10.3389/fneur.2023.1122538
9. Chen L, Zhang Y, Chen Y, et al. Efficacy and safety of botulinum toxin A and pulsed radiofrequency on postherpetic neuralgia: a randomized clinical trial. *Contrast Media Mol Imaging*. 2022;2022:1579937. doi:10.1155/2022/1579937
10. Ji M, Yao P, Han Z, Zhu D. Pulsed radiofrequency combined with methylene blue paravertebral nerve block effectively treats thoracic postherpetic neuralgia. *Front Neurol*. 2022;13:811298. doi:10.3389/fneur.2022.811298
11. Sheng L, Liu Z, Zhou W, et al. Short-term spinal cord stimulation or pulsed radiofrequency for elderly patients with postherpetic neuralgia: a prospective randomized controlled trial. *Neural Plast*. 2022;2022:7055697. doi:10.1155/2022/7055697
12. Liu B, Yang Y, Zhang Z, et al. Clinical study of spinal cord stimulation and pulsed radiofrequency for management of herpes zoster-related pain persisting beyond acute phase in elderly patients. *Pain Physician*. 2020;23(3):263–270.
13. Li X, Chen P, He J, et al. Comparison of the efficacy and safety of temporary spinal cord stimulation versus pulsed radiofrequency for postherpetic neuralgia: a prospective randomized controlled trial. *Pain Res Manag*. 2022;2022:3880424. doi:10.1155/2022/3880424
14. Wan C, Song T. Efficacy of pulsed radiofrequency or short-term spinal cord stimulation for acute/subacute zoster-related pain: a randomized, double-blinded, controlled trial. *Pain Physician*. 2021;24(3):215–222.
15. Saxena AK, Singh A, Chilkoti GT, et al. Modulation of signal transduction gene expression following pulsed radiofrequency in dorsal root ganglia and pregabalin therapy. *Pain Manag*. 2022;12(3):347–356. doi:10.2217/pmt-2021-0057
16. Pi ZB, Zhang JK, Peng Y, Jin Y, Lin H. Efficacy of ultrasound-guided spinal nerve posterior ramus pulsed radiofrequency treatment for elderly lower back post-herpetic neuralgia. *Chin Med*. 2018;98(10):733–737.
17. Huang Y, Luo F, He X. Clinical observations on selective dorsal root ganglion pulsed radiofrequency lesioning combined with gabapentin in the treatment of postherpetic neuralgia. *Neurol India*. 2018;66(6):1706–1710. doi:10.4103/0028-3886.246245
18. Xiong ZH, Tang XF, Huang LT, Yue LR. Clinical study on the treatment of postherpetic neuralgia with pulsed radiofrequency of the dorsal root ganglion with pain management. *Neurol Asia*. 2020;25(3):1–6.
19. Xia YZ, Zha J, Chen JM, et al. Comparative analysis of three treatment methods for postherpetic neuralgia. *Chin J Contemp Neurol Neurosurg*. 2018;18(9):674–677.
20. Gu HH, Lu PR, Pu LJ, Miao XH. Pulsed radiofrequency combined with nerve block for the treatment of eyelid herpes zoster neuralgia. *Int J Ophthalmol*. 2015;15(12):2123–2126.
21. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi:10.1136/bmj.n71
22. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev*. 2015;4(1):1. doi:10.1186/2046-4053-4-1
23. Salanti G, Ades AE, Ioannidis JPA. Graphical methods and numerical summaries for presenting results from multiple-treatment meta-analysis: an overview and tutorial. *J Clin Epidemiol*. 2011;64(2):163–171. doi:10.1016/j.jclinepi.2010.03.016
24. Chaimani A, Higgins JPT, Mavridis D, Spyridonos P, Salanti G. Graphical tools for network meta-analysis in STATA. *PLoS One*. 2013;8(10):e76654. doi:10.1371/journal.pone.0076654
25. Wan C, Dong D, Song T. High-voltage, long-duration pulsed radiofrequency on gasserian ganglion improves acute/subacute zoster-related trigeminal neuralgia: a randomized, double-blinded, controlled trial. *Pain Physician*. 2019;22(4):361–368.
26. Saxena AK, Lakshman K, Sharma T, et al. Modulation of serum BDNF levels in postherpetic neuralgia following pulsed radiofrequency of intercostal nerve and pregabalin. *Pain Manag*. 2016;6(3):217–227. doi:10.2217/pmt.16.3
27. Lin S, Lin M, Dai Z, et al. Novel bipolar high-voltage pulsed radiofrequency targeting the cervical sympathetic chain for treating acute herpetic neuralgia. *Neuromodulation*. 2023;26(8):1808–1816. doi:10.1016/j.neurom.2021.12.003
28. Wang B, Du Z, Xia J, Zhang H. Efficacy of high-voltage pulsed radiofrequency for the treatment of elderly patients with acute herpes zoster neuralgia. *Rev Assoc Med Bras*. 2021;67(4):585–589. doi:10.1590/1806-9282.20201124
29. Wan C, Song T. Comparison of two different pulsed radiofrequency modes for prevention of postherpetic neuralgia in elderly patients with acute/subacute trigeminal herpes zoster. *Neuromodulation*. 2022;25(8):1364–1371. doi:10.1111/ner.13457
30. Han ZK, Ji MD, Zhu DL, Yao P. Clinical efficacy of CT-guided pulsed radiofrequency with different voltages in the treatment of postherpetic neuralgia. *Chin J Med Univ*. 2022;51(4):356–360,369.

31. Li D, Sun G, Sun H, et al. Combined therapy of pulsed radiofrequency and nerve block in postherpetic neuralgia patients: a randomized clinical trial. *PeerJ*. 2018;6:e4852.
32. Sun Q, Yuan J, Yang J, Zou J. Efficacy of long-term spinal nerve posterior ramus pulsed radiofrequency in treating subacute herpetic neuralgia: a prospective randomized controlled trial. *J Integr Neurosci*. 2023;22(2):47. doi:10.31083/j.jin2202047
33. Zhang W, He C. Clinical efficacy of pulsed radiofrequency combined with intravenous lidocaine infusion in the treatment of subacute herpes zoster neuralgia. *Pain Res Manag*. 2022;2022:5299753. doi:10.1155/2022/5299753
34. Wen S, Xiao Q, Zhu Z, et al. Application of nalbuphine in trigeminal ganglion pulse radiofrequency in patients with postherpetic neuralgia. *Pain Res Manag*. 2021;2021:6623112. doi:10.1155/2021/6623112
35. Li M, Hu H, Tong S, et al. Therapeutic efficacy of pulsed radiofrequency alone versus pulsed radiofrequency combined with dexamethasone in patients with trigeminal postherpetic neuralgia: a double-blind, randomized controlled trial. *Pain Physician*. 2022;25(4):E543–E549.
36. Yuan LG, Wan CF. Clinical efficacy of dorsal root ganglion pulsed radiofrequency combined with platelet-rich plasma injection for acute/subacute postherpetic neuralgia. *Chin J Med Univ*. 2022;51(8):752–755.
37. Abbas A, Sabet H, El-Moslemani M, et al. From short-term relief to long-term management: a meta-analysis of temporary spinal cord stimulation and pulsed radiofrequency in postherpetic neuralgia. *Neuromodulation*. 2025;28(6):923–936. doi:10.1016/j.neurom.2025.03.076
38. Kataria R, Kadal KK, Shanmugam S, Setya P. Comparative study on the efficacy, safety and cost-effectiveness of gabapentin and pregabalin in the treatment of neuropathic Pain. *Cureus*. 2025;17(11):e95916. doi:10.7759/cureus.95916
39. Fang JY, Yamamoto H, Romman A, Koutrouvelis AP, Yamamoto S. Spinal mechanisms of pain modulation by spinal cord stimulation: a systematic review. *Cureus*. 2025;17(6):e85567. doi:10.7759/cureus.85567
40. Yousaf A, Yamamoto H, Fang JY, et al. Supraspinal mechanisms of spinal cord stimulation in pain mitigation: a systematic review. *Cureus*. 2025;17(6):e86756. doi:10.7759/cureus.86756
41. Cui X, Liu J, Uniyal A, et al. Enhancing spinal cord stimulation-induced pain inhibition by augmenting endogenous adenosine signalling after nerve injury in rats. *Br J Anaesth*. 2024;132(4):746–757. doi:10.1016/j.bja.2024.01.005
42. de Geus TJ, Franken G, Joosten EA. Conventional, high-frequency and differential targeted multiplexed spinal cord stimulation in experimental painful diabetic peripheral neuropathy: pain behavior and role of the central inflammatory balance. *Mol Pain*. 2023;19:17448069231193368. doi:10.1177/17448069231193368
43. Kogias SS, O'Brien JA, Robertson RV, et al. 10-kHz high-frequency spinal cord stimulation significantly reduces proinflammatory cytokines and distinct populations of T lymphocytes in patients with persistent spinal pain syndrome type 2. *Neuromodulation*. 2025;28(6):937–951. doi:10.1016/j.neurom.2025.02.010
44. Park D, Chang MC. Mechanism of action of pulsed radiofrequency in reducing pain: a narrative review. *J Yeungnam Med Sci*. 2022;39(3):200–205. doi:10.12701/jyms.2022.00101
45. Ramesh G, Meisner OC, Philipp MT. Anti-inflammatory effects of dexamethasone and meloxicam on Borrelia burgdorferi-induced inflammation in neuronal cultures of dorsal root ganglia and myelinating cells of the peripheral nervous system. *J Neuroinflammation*. 2015;12:240. doi:10.1186/s12974-015-0461-y
46. Liu Y, Liu H, Bian Q, Zhang S, Guan Y. Impact of herpes zoster and postherpetic neuralgia on the quality of life in China: a prospective study. *Clin Cosmet Investig Dermatol*. 2024;17:1905–1915. doi:10.2147/CCID.S471823