


Updated Evidence of Acupuncture for Trigeminal Neuralgia: A Systematic Review and Meta-Analysis with GRADE Assessment

Yaxuan Xu^{1,*}, Lingyu Zhang^{1,*}, Yurong Jiang¹, Jing Sun^{1,2}, Jianqiao Fang^{1,2}, Rongrong Li^{1,2} 

¹The Third Clinical Medical College of Zhejiang Chinese Medical University, Hangzhou, Zhejiang, People's Republic of China; ²Acupuncture and Moxibustion Department, The Third Affiliated Hospital of Zhejiang Chinese Medical University, Hangzhou, Zhejiang, People's Republic of China

*These authors contributed equally to this work

Correspondence: Jianqiao Fang; Rongrong Li, The Third Affiliated Hospital of Zhejiang Chinese Medical University, 219 Moganshan Road, Hangzhou, Zhejiang, 310000, People's Republic of China, Email fangjianqiao7532@163.com; 425671918@qq.com

Background: Trigeminal neuralgia (TN) is a clinically intractable disorder characterized by episodes of severe pain that often significantly impairs patients' quality of life. Although previous studies suggest that acupuncture may alleviate pain, it is particularly important to conduct an updated meta-analysis to confirm the effectiveness and safety of acupuncture in light of updated clinical evidence in recent years.

Methods: A systematic search was conducted across eight databases: four English-language (PubMed, Cochrane Library, Embase, and Web of Science) and four Chinese-language (Wanfang Data, China National Knowledge Infrastructure, China Science and Technology Journal Database, and China Biomedical Literature Service System). The search period for each database spans from its inception to 19 December 2025. Meta-analysis was conducted by using Stata 17.0.

Results: A total of 38 randomized controlled trials involving 2836 patients with TN were included. Meta-analysis results showed that compared with the control group, the acupuncture group demonstrated significant differences in the following indicators: higher overall response rate (RR = 1.14, 95% CI 1.11–1.18), and lower visual analog scale scores (SMD = -1.19, 95% CI -1.62 to -0.76), frequency of pain episodes (SMD = -1.31, 95% CI -2.18 to -0.44), adverse events (RR 0.28, 95% CI: 0.16–0.50), and BPI-facial pain score (SMD = -0.53, 95% CI -0.96 to -0.09) were reduced.

Conclusion: Acupuncture combined with medication may improve efficacy and reduce adverse events compared with monotherapy. However, the quality of existing evidence is low due to methodological limitations. Rigorous, multicenter randomized controlled trials with standardized protocols are needed to confirm the role of acupuncture for TN management.

Keywords: trigeminal neuralgia, acupuncture, efficacy, meta-analysis, pain, grade

Introduction

Trigeminal neuralgia (TN) is a disorder characterized by recurrent episodes of unilateral, electric shock-like pain within the distribution of the trigeminal nerve,^{1,2} with an overall prevalence of approximately 0.03% to 0.3%.³ The incidence rate in women is approximately twice that in men.⁴ Approximately 90% of cases occur after the age of 40, with the incidence gradually increasing with age.⁵ The frequency and intensity of TN attacks progressively worsen with disease progression, ultimately evolving into a chronic course,⁶ severely impairing patients' quality of daily life.⁷ It frequently induces comorbid emotional disorders such as anxiety and depression,⁸ with their severity showing a significant positive correlation with pain scores and disease duration.^{9,10}

Carbamazepine (CBZ) as a first-line treatment for TN provides some analgesic effect.^{11,12} However, it often leads to adverse reactions such as cognitive impairment, drowsiness, dizziness, gastrointestinal discomfort, and mood swings.^{13,14} Surgical interventions such as microvascular decompression (MVD), pulsed radiofrequency, gamma knife, and balloon

compression may either preserve neural function through decompression or achieve pain relief by controllably disrupting trigeminal sensory function.^{15–17} However, these approaches carry risks of high recurrence rates, sensory deficits, and severe complications including hearing loss and intracranial hemorrhage.^{18–20} Against this backdrop, acupuncture—as a well-established non-pharmacological analgesic therapy—offers a new potential avenue for addressing this clinical challenge. Research indicates that acupuncture not only significantly reduces pain intensity and NRS scores in TN patients,^{21–23} decreases attack frequency²⁴ but also lowers the risk of developing psychiatric disorders.²⁵

Systematic synthesis of high-quality evidence for acupuncture in treating TN remains insufficient. Previous systematic reviews have been constrained by both methodological limitations (eg, narrow inclusion criteria focusing primarily on manual acupuncture) and incomplete outcome assessment (often excluding important endpoints like quality of life or long-term effects). Consequently, the existing evidence base has not been fully utilized to inform clinical practice. Although previous studies have suggested that acupuncture may have analgesic effects on TN, such as Hu et al indicating that acupuncture has some positive effects on PTN, the quality of evidence remains low;²⁵ Yin et al found that multiple acupuncture techniques outperformed CBZ in alleviating pain, though the assessment metrics were relatively limited.²³ Lin et al and Li et al both indicated that acupuncture demonstrated superior efficacy compared to CBZ. However, the types of controls included in these studies were limited, resulting in a narrow reference range.^{22,26} Recent methodological advancements have yielded an expanding body of high-quality randomized controlled trials (RCTs) investigating acupuncture for TN. While existing evidence suggests potential analgesic benefits, the recent availability of more rigorous RCTs—featuring improved blinding techniques, standardized pain assessment protocols, and longer-term follow-ups—necessitates an updated systematic evaluation. This study will employ the GRADE framework to conduct a comprehensive meta-analysis that specifically addresses three critical knowledge gaps: (1) quantifying the strength of evidence amidst heterogeneity in study methodologies, (2) determining the precision and consistency of therapeutic outcomes across different acupuncture modalities, and (3) evaluating comparative efficacy relative to first-line pharmacological treatments. By synthesizing this contemporary evidence base, our findings will provide clinicians and policy-makers with a current, methodologically robust assessment of acupuncture’s therapeutic profile in TN management.

Methods

This study protocol is registered with PROSPERO (registration number: CRD420251269307). This systematic review was conducted according to the Cochrane Handbook and reported in accordance with the PRISMA 2020 statement ([Appendix 1](#)).^{27,28}

Literature Search Strategy

We performed a systematic literature search across eight databases from their inception to December 19, 2025, with no restrictions on language: PubMed, the Cochrane Library, Embase, Web of Science, Wanfang Data, China National Knowledge Infrastructure (CNKI), Chinese Scientific Journal Database (VIP), and China Biomedical Literature Service System (SinoMed). The search strategy comprehensively employs Medical Subject Headings (MeSH) and free-text terms, covering acupuncture, TN, and RCTs. Additionally, studies potentially meeting the inclusion criteria were identified by tracing the references cited in the included studies and consulting subject matter experts. The specific search strategies for each database are detailed in [eTable 1](#).

Inclusion and Exclusion Criteria

Inclusion Criteria

We included studies that met the following criteria:

1. Study design: RCTs;
2. Participants: Patients clinically diagnosed with TN, with no restrictions on age, gender, ethnicity, or disease duration;
3. Interventions: The intervention for the experimental group consists of acupuncture therapy (including manual acupuncture (MA), electroacupuncture (EA), fire acupuncture (FA), acupuncture and moxibustion (AM), etc.), which may be combined with or without other therapies identical to those in the control group. Specific restrictions

are not imposed on acupuncture techniques, point selection, or treatment duration. The control group may include patients receiving Western medication, those awaiting consultation, sham acupuncture/placebo acupuncture or other treatment modalities.

4. Outcome measures:

1. Visual Analogue Scale (VAS);
2. Frequency of pain episodes;
3. Response rate:

Cured: pain absent, normal facial sensorimotor function, no trigger point pain, no recurrence ≥ 1 month;

Markedly effective: pain reduced $\geq 50\%$ in frequency or VAS, facial function basically normal, daily life unaffected;

Effective: pain reduced 25–50% in frequency or VAS, partial facial function improvement, occasional induced pain;

Ineffective: pain unchanged/worsened, reduction $< 25\%$, no functional improvement; Total response rate = (Cured + Markedly effective + Effective)/Total $\times 100\%$;

1. Brief Pain Inventory (BPI);
2. Incidence of adverse events (AEs).

Exclusion Criteria

This study excluded relevant literature based on the following criteria:

1. Studies that could not be retrieved in full text after systematic searching;
2. Research where key data cannot be obtained through means such as contacting the author;
3. Non-RCTs, as well as non-clinical research types such as reviews, conference abstracts, and animal studies;
4. For duplicated studies, only the version with the most complete data should be retained.
5. Research that struggles to distinguish the individual effects of acupuncture from those of other medical combination therapies.

Research Screening and Data Extraction

Two reviewers independently conducted literature searches and screening based on the retrieval strategy. After importing the retrieved documents into EndNote X9 (Clarivate Analytics) and removing duplicate records, they first performed an initial screening based on titles and abstracts, followed by a further evaluation through reading the full texts. For studies meeting the inclusion criteria, both parties independently extracted relevant information, including authors, publication year, number of RCTs, sample size, intervention measures, outcome measures, risk assessment tools, adverse reactions, and conclusions, and recorded these using standardized forms. After extraction is complete, cross-check the data. Any discrepancies shall be resolved by a third reviewer.

Risk of Bias Assessment

This study employed the Cochrane risk of bias assessment tool ROB 2.0 to evaluate the methodological quality of the included RCTs. The assessment encompassed five domains: randomization process, deviation from the specified intervention, missing outcome data, outcome measurement, and selection of outcome reporting. Each area is classified as “low risk,” “some concerns,” or “high risk” based on the clarity and appropriateness of the method description and implementation. All assessments were conducted independently by two researchers. In cases of disagreement, a third researcher was consulted to facilitate discussion and reach a consensus.

Statistical Analysis Methods

This study employed Stata 17.0 (StataCorp LLC) for the meta-analysis. For binary outcomes, effect sizes are expressed as relative risk or odds ratio. For continuous outcomes, the mean difference is used when measurement tools are identical

across studies; otherwise, the standardized mean difference is employed. All effect sizes are reported as point estimates with 95% confidence intervals.

Heterogeneity among studies was assessed using the I^2 statistic and interpreted in conjunction with the P -value. If $I^2 < 50\%$ and $P > 0.1$, indicating low heterogeneity, the analysis was performed using a fixed-effects model. If $I^2 \geq 50\%$ or $P \leq 0.1$, indicating significant heterogeneity, then a random-effects model is used. Simultaneously, subgroup analyses will be conducted to explore sources of heterogeneity. When ≥ 10 studies are included for a specific outcome, funnel plots will be generated to assess potential publication bias. Additionally, sensitivity analyses will be conducted by sequentially excluding individual studies to assess the impact of each study on the stability of the pooled results. The significance level for all analyses is set at $\alpha=0.05$.

Grading of Evidence Quality

We will use the GRADE approach to systematically assess the quality of evidence for each outcome measure. Evidence quality will be categorized into four levels: high, medium, low, or extremely low. The assessment process is based on consideration of the following five factors that may reduce the quality of evidence: risk of bias, inconsistency of results, indirect evidence, imprecise data, and publication bias. The initial quality of evidence from RCTs is rated as “high.” It is downgraded by one level if serious concerns exist, and by two levels if very serious concerns exist. The final GRADE assessment results and specific downgrade reasons will be summarized and presented in a table.

Results

Study Selection

Through systematic retrieval of eight databases, we initially obtained 937 literature records. After removing duplicate references using EndNote X9, 545 articles remained. Based on the titles and abstracts, an initial screening was conducted to exclude 400 papers that were clearly irrelevant to the topic. Ultimately, 145 full-text papers were obtained for further evaluation. During the full-text assessment phase, the following studies were excluded for failing to meet the inclusion criteria: 8 non-randomized controlled trial designs, 2 conference abstracts or unpublished reports, 30 studies lacking randomized procedures, 11 studies with inadequately defined control groups, 54 studies failing to clearly describe randomization methods, and 2 studies for which full-text access was unavailable. A total of 38 RCTs were ultimately included for data analysis. The specific literature screening process is shown in [Figure 1](#).

Study Characteristics

This study included a total of 38 RCTs, of which 37 were published in Chinese and 1 in English.^{21,29–65} These studies, published between 2009 and 2024, involved a total of 2836 patients with TN. In studies reporting gender, 1196 participants were male and 1517 were female (two additional studies did not report gender). The age range of patients was broad, with a mean age of approximately 53.4 years (distribution range approximately 42 to 62 years). Treatment regimens ranged from 7 to 90 days. Regarding intervention methods, the acupuncture techniques employed in the experimental groups across 38 studies included: MA (28 studies), EA (7 studies), AM (2 studies), and FA (1 study). Fourteen studies reported AEs, with a cumulative total of 160 cases: 32 in the acupuncture group and 128 in the control group. The baseline characteristics of the included studies are detailed in [Table 1](#).

Assessment of Methodological Quality

We assessed the risk of bias of the included RCTs using the RoB 2 tool. Of the 38 included studies, 34 studies (89.5%) were rated as having some concerns or high risk of bias for the randomization process, while only 4 studies (10.5%) met the criteria for low risk. Regarding deviations from intended interventions, only one study (2.6%) adequately documented blinding implementation and adherence and was rated as low risk. The remaining 37 studies (97.4%) were rated as having some concerns or high risk of bias. Regarding missing outcome data, the majority of studies (31/38, 81.6%) were rated as low risk due to low dropout rates or appropriate handling of missing data. However, 7 studies (18.4%) raised concerns because they failed to report dropout information and were rated as having some concerns. Regarding outcome

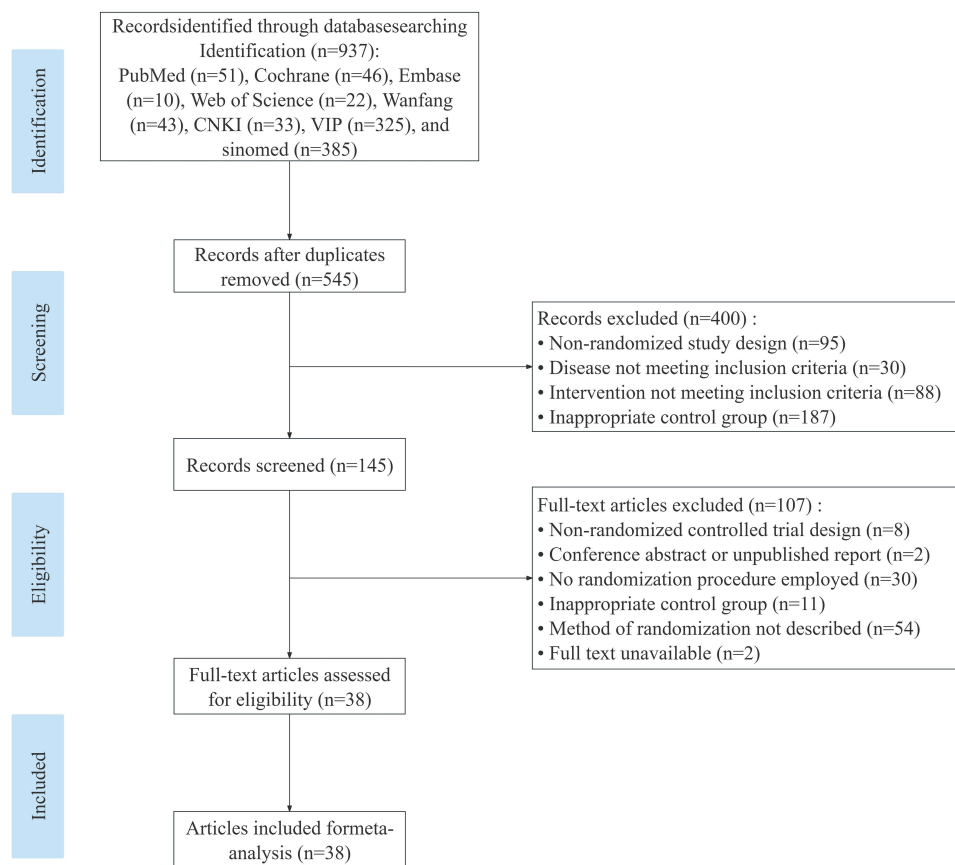


Figure 1 Experimental Selection Flowchart.

measurement, only one study (2.6%) was rated as low risk due to the use of objective measurements or assessor blinding. The remaining 37 studies (97.4%) were rated as having some concerns or high risk of bias due to the use of subjective pain scales and unclear assessor blinding. Of the 38 studies, 37 studies (97.4%) with non-pre-registered protocols were judged to have some concerns for selective reporting, while one registered study was assessed as low risk. Overall, the included RCTs had notable methodological limitations, particularly in randomization, blinding, and selective reporting. Only a few trials were rated as having a low risk of bias. This raises concerns that the pooled effect estimate may be overestimated. Detailed risk of bias assessments are presented in Figures 2 and 3.

Meta-Analysis Results

Effective Rate

According to the results of a meta-analysis of thirty-five studies. The inclusion of acupuncture increased the overall treatment efficacy rate (RR = 1.14, 95% CI: 1.11–1.18, $P < 0.001$), with low heterogeneity among the included studies ($I^2 = 16.6\%$, $P = 0.197$) (Figure 4A). In comparisons of different acupuncture techniques, MA demonstrated positive effects (RR = 1.16, 95% CI: 1.12–1.19) (Figure 4B). Subgroup analysis further revealed that acupuncture in combination with CBZ (RR = 1.17, 95% CI: 1.06–1.29) and acupuncture combined with Traditional Chinese Medicine (TCM) (RR = 1.24, 95% CI: 1.11–1.37) both demonstrated higher efficacy rates compared to the respective monotherapies (Figure 4C and D). Sensitivity analyses conducted by sequentially excluding individual studies demonstrated that the pooled effect size remained stable and was not significantly influenced by any single study (eFigure 1).

VAS

Twenty-four studies reported changes in VAS among patients with TN treated with acupuncture. The pooled analysis showed that the VAS reduction in the acupuncture group was greater than that in the control group (SMD = -1.19, 95%

Table I Main Characteristics of Included RCTs

Study	Country	Sample Size	Age	Gender M: F	A Treatment Group	B Control Group I	C Control Group II	D Control Group III	Duration of Treatment	Adverse Effects (No. of Cases)	Conclusion Summary
Xiao 2016 ²⁹	China	A:50 B:50	A:54.4 ± 10.8 B:54.2 ± 11.5	A:13/37 B:15/35	MA	CBZ	—	—	28 Days	A:1 B:12	Stasis-resolving acupuncture is superior to CBZ in alleviating pain and comorbidities in TN (blood stasis type), with enhanced safety
Ye 2020 ³⁰	China	A:34 B:34	A:62.34 ± 5.49 B:61.22 ± 5.38	A:20/14 B:19/15	MA	CBZ	—	—	—	Not reported	Acupuncture demonstrated superior efficacy and greater pain reduction than CBZ for PTN
Yi 2015 ³¹	China	A:60 B:60	A:45.54 ± 3.11 B:45.98 ± 4.10	A:33/27 B:31/29	MA+CBZ+TCM	CBZ+TCM	—	—	7 Days	A:6 B:4	Acupuncture combined with herbs effectively treats recurrent TN with good safety
Liu 2015 ³²	China	A:42 B:42	A:54.27 ± 3.15 B:53.71 ± 3.40	A:20/22 B:17/25	MA	CBZ	—	—	28 Days	A:3 B:11	Acupuncture yielded significantly higher efficacy and symptom improvement than CBZ
Li 2016 ³³	China	A:25 B:25	Total: 60.1 ± 3.4	Total:31/19	MA	CBZ	—	—	30 Days	A:1 B:5	Acupuncture demonstrates significant efficacy and favorable safety for PTN
Jin 2015 ³⁴	China	A:37 B:36 C:36 D:37	Total:51.8 ± 4.2	Total:63/83	MA	CBZ	TCM	MA+TCM	30 Days	Not reported	Combined acupuncture and medication yields superior efficacy to monotherapies for PTN
Huang 2018 ³⁵	China	A:32 B:31	A:43.64 ± 5.47 B:44.86 ± 6.39	A:12/20 B:11/20	MA	CBZ	—	—	30 Days	A:1 B:6	Acupuncture yields superior efficacy and favorable safety in PTN
Huang 2018 ³⁶	China	A:43 B:43	A:42.5 ± 2.3 B:41.9 ± 2.2	A:24/19 B:26/17	MA	CBZ	—	—	30 Days	A:0 B:6	Syndrome-differentiated acupuncture demonstrates superior efficacy and safety to conventional drugs for TN
Wang 2019 ³⁷	China	A:15 B:15	A:45.8 ± 7.9 B:44.8 ± 7.7	A: 7/8 B:8/7	MA	CBZ	—	—	90 Days	Not reported	Acupuncture shows higher total efficacy and better safety than western medicine in PTN
Chen 2021 ³⁸	China	A:40 B:40	A:43.75 ± 5.89 B:43.28 ± 6.43	A:16/24 B:18/22	MA	CBZ	—	—	28 Days	A:1 B:6	Acupuncture provides significant efficacy with favorable safety for PTN
Wang 2013 ³⁹	China	A:20 B:20	A:54.54 ± 2.3 B:53.92 ± 2.8	A:3/17 B:5/15	MA	CBZ	—	—	42 Days	Not reported	Temple-through and trigger point surrounding needling shows superior efficacy to drugs for PTN

Dong 2019 ⁴⁰	China	A:44 B:44	A:54.2 B:53.8	A:29/15 B:30/14	MA	CBZ	—	—	30 Days	A:1 B:8	Acupuncture for TN demonstrates high efficacy and safety, effectively improving quality of life
Zhao 2017 ⁴¹	China	A:34 B:34	A:58.21 ± 10.06 B:58.13 ± 10.26	A:12/22 B:13/21	MA+CoA	CBZ+CoA	—	—	60 Days	A:5 B:12	For qi stagnation-blood stasis TN, acupuncture outperforms western medicine in symptom and psychosocial improvement
Fan 2019 ⁴²	China	A:38 B:38	A:58.14 ± 10.36 B:57.46 ± 10.25	A:15/23 B:16/22	MA+CBZ+MEC	CBZ+MEC	—	—	A:60 Days B:30 Days	Not reported	Adjuvant acupuncture significantly enhanced analgesic efficacy and sleep quality with favorable safety
Guo 2012 ⁴³	China	A:30 B:30	A:45.2±11.7 B:46.4±11.2	A:15/15 B:15/15	MA+CBZ	CBZ	—	—	45 Days	Not reported	Adjunctive acupuncture to CBZ/doxepin shows superior efficacy over pharmacotherapy alone
Si 2016 ⁴⁴	China	A:40 B:35	A:57.5±4.1 B:57.3±4.3	A:24/16 B:20/15	MA+TCM	TCM	—	—	30 Days	Not reported	Acupuncture-drug combination yields superior efficacy and greater pain relief
Pan 2017 ⁴⁵	China	A:31 B:30	A:54±11 B:59±11	A:13/18 B:12/18	MA+CBZ	CBZ	—	—	28 Days	Not reported	Spirit-regulating acupuncture notably improves pain, reduces frequency, and enhances quality of life in PTN
Shen 2016 ⁴⁶	China	A:40 B:40	A:59.57±6.27 B:59.82±6.82	A:23/17 B:22/18	MA+CBZ	CBZ	—	—	30 Days	A:2 B:7	Acupuncture plus CBZ yields superior efficacy and tolerability for TN
Yao 2017 ⁴⁷	China	A:48 B:48	A:58.84±4.47 B:59.44±4.26	A:19/29 B:20/28	MA+TCM	TCM	—	—	21 Days	Not reported	Acupuncture combined with herbal formula significantly relieves TN pain
Wang 2021 ⁴⁸	China	A:30 B:30	A:50.80±8.10 B:50.30±7.80	Not reported	MA+CBZ	CBZ	—	—	56 Days	Not reported	Acupuncture plus CBZ yields better pain control and neural recovery
Cao 2024 ⁴⁹	China	A:25 B:25	A:51.67±6.21 B:52.17±5.19	A:12/13 B:10/15	MA+CBZ	CBZ	—	—	30 Days	Not reported	Acupuncture at Yifeng (SJ17) and Xia Guan (ST7) acupoints improves efficacy and alleviates pain in TN
Ti 2021 ⁵⁰	China	A:30 B:30	A:57.27±6.28 B:58.37±6.67	A:13/17 B:12/18	MA	CBZ	—	—	28 Days	Not reported	Acupuncture demonstrates superior efficacy to CBZ for TN
Luo 2018 ⁵¹	China	A:42 B:42	A:57.15±11.26 B:57.39±11.58	A:22/20 B:23/19	MA+TCM	TCM	—	—	28 Days	A:7 B:9	Acupuncture effectively relieves pain and emotional symptoms in recurrent TN with comorbid anxiety-depression

(Continued)

Table I (Continued).

Study	Country	Sample Size	Age	Gender M: F	A Treatment Group	B Control Group I	C Control Group II	D Control Group III	Duration of Treatment	Adverse Effects (No. of Cases)	Conclusion Summary
Wu 2019 ⁵²	China	A:14 B:14	A:45.24±10.78 B:47.06±11.02	A:5/9 B:4/10	AM	CBZ	—	—	33 Days	Not reported	Moxibustion at Xia Guan (ST7) provides superior immediate analgesia versus CBZ for TN
Zhang 2022 ⁵³	China	A:30 B:30	A:49±16 B:46±15	A:18/12 B:13/17	MA	CBZ	—	—	14 Days	Not reported	Xia Guan (ST 7) surrounding-needling outperforms CBZ in alleviating pain and negative emotions
Long 2017 ⁵⁴	China	A:30 B:30	A:50 B:52	A:12/18 B:13/17	AM	CBZ	—	—	21 Days	Not reported	Warm needling with penetrating technique outperforms pharmacotherapy for PTN
Hong 2020 ⁵⁵	China	A:60 B:60	A:55.42 ± 8.12 B:55.64 ± 9.05	A:28/32 B:29/31	MA	CBZ	—	—	14 Days	A:0 B:14	Liver-soothing acupuncture offers comparable efficacy but fewer side effects than CBZ for Liver-Stomach Heat TN
Zheng 2010 ⁵⁶	China	A:60 B:60	A:52 B:56	A:28/32 B:27/33	MA	CBZ	—	—	30 Days	Not reported	Deep needling at Renying (ST 9) provides superior analgesia and reduced recurrence versus CBZ with favorable safety
Yin 2018 ⁵⁷	China	A:62 B:62	A:62.37±5.41 B:62.11±5.28	A:25/37 B:27/35	EA+CBZ	CBZ	—	—	28 Days	Not reported	Adjuvant EA offers superior pain relief and symptom improvement over CBZ alone
Hao 2019 ⁵⁸	China	A:27 B:27	A:45.6±3.4 B:47.2±3.8	A:12/15 B:13/14	MA+CBZ	CBZ	—	—	30 Days	Not reported	MA combination therapy outperforms CBZ monotherapy for TN
Yu 2022 ⁵⁹	China	A:30 B:30	A:57.4±5.2 B:57.3±5.1	Not reported	FA+TCM+MEC	TCM+MEC	—	—	56 Days	Not reported	Filiform-FA combined with Fuzheng Yangyin decoction demonstrates superior efficacy to decoction alone
Li 2018 ⁶⁰	China	A:20 B:20 C:20	A:56.13±4.02 B:56.88±3.49 C:57.18±3.62	A:6/14 B:7/13 C:5/15	MA+CBZ	CBZ+PBO	CBZ+CoQ10	—	60 Days	Not reported	Both adjuvants enhance analgesia, yet only CoQ10 reduces oxidative stress
Zheng 2011 ⁶¹	China	A:12 B:12	Total:52.2±17.5	Total:8/16	EA	CBZ	—	—	30 Days	Not reported	Lectroacupuncture demonstrates superior efficacy, lower recurrence, and fewer adverse effects versus CBZ
Han 2009 ⁶²	China	A:30 B:30	A:Range:48–75 B:Range:45–70	A:18/12 B:14/16	EA	CBZ	—	—	90 Days	Not reported	EA demonstrates superior efficacy to oral CBZ for PTN

Zhang 2013 ⁶³	China	A:30 B:30	Total:52.5	Total:24/29	EA	CBZ	—	—	30 Days	A:0 B:11	EA at scalp points plus CBZ yields superior efficacy and safety with reduced recurrence
Hu 2021 ⁶⁴	China	A:30 B:30 C:30 D:30	A:52.78±4.10 B:53.03±3.92 C:52.91±4.01 D:53.08±3.98	A:5/25 B:4/26 C:4/26 D:5/25	EA	CBZ	EA+rTMS	rTMS	28 Days	Not reported	Combined EA and rTMS improves pain, daily function, and sleep, outperforming all monotherapies and CBZ
Sun 2020 ⁶⁵	China	A:24 B:20	A:58±10 B:64±14	A:8/16 B: 7/13	EA	CBZ	—	—	28 Days	Not reported	Cluster-EA yields better pain relief and daily function than CBZ
Li and Sun 2024 ²¹	China	A:30 B:29 C:29 D:29	Total:58.5±15.3	Total:45/75	EA+CBZ	SEA+CBZ	EA+PBO	SEA+PBO	28 Days	EA:6 CBZ:15	EA or CBZ alone is effective, but their combination yields superior results with fewer adverse events associated with EA

Abbreviations: TN, Trigeminal neuralgia; PTN, Primary trigeminal neuralgia; MA, Manual acupuncture; EA, Electroacupuncture; FA, Fire acupuncture; AM, Acupuncture and moxibustion; SEA, Sham electroacupuncture; CBZ, Carbamazepine; MEC, Methylcobalamin; TCM, Traditional Chinese Medicine; CoA, Cyanocobalamin injection; PBO, Placebo; rTMS, Repetitive transcranial magnetic stimulation; CoQ10, Coenzyme Q10.

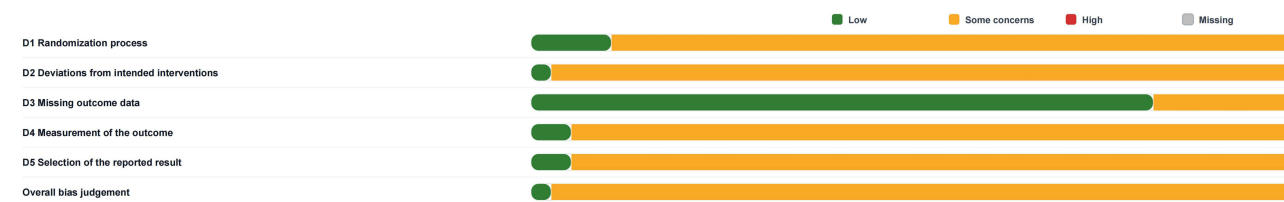


Figure 2 Summary of risk of bias in included randomized controlled trials.

CI: -1.62 to -0.76), but between-study heterogeneity was substantial ($I^2 = 93.6\%$, $P < 0.001$) (Figure 5A). Subgroup analysis revealed differences in efficacy among various acupuncture modalities: MA demonstrated significant effects (SMD = -1.22 , 95% CI -1.61 to -0.82). Other methods yielded inconclusive results due to high inter-study heterogeneity or inconsistent findings (Figure 5B). Additionally, subgroup analyses of combined therapies revealed that acupuncture combined with TCM (SMD = -1.00 , 95% CI -1.52 to -0.48) or in combination with CBZ (SMD = -0.75 , 95% CI -1.41 to -0.08) demonstrated greater pain reduction compared to the respective monotherapies (Figure 5C and D).

To explore potential sources of heterogeneity, further subgroup analyses were performed for direct comparison between MA and CBZ and by study year; however, heterogeneity was not reduced (eFigures 2 and 3). Sensitivity analyses showed that the pooled effect size remained stable around -1.19 when any single study was excluded, and no study reversed the direction or statistical significance of the effect (eFigure 4), suggesting that the results were robust.

Frequency of Pain Attacks

Seven studies reported changes in the frequency of pain episodes before and after treatment in patients with TN. Results showed that the acupuncture group had a significantly greater reduction in seizure frequency compared with the control group in reducing seizure frequency (SMD = -1.31 , 95% CI: -2.18 to -0.44 , $P < 0.05$) (Figure 6). Sensitivity analysis indicated that the pooled result was stable, as the effect direction remained consistently negative after the sequential exclusion of any single study (eFigure 5).

BPI

Three studies investigated the effect of acupuncture treatment on BPI scores for TN. Analysis revealed that the acupuncture group showed a significantly greater reduction in facial pain scores compared to the control group in reducing facial pain scores (SMD = -0.53 , 95% CI: -0.96 to -0.09 , $p < 0.05$) and low study heterogeneity ($I^2 = 46.3\%$, $P = 0.155$) (Figure 7A). Analysis of the BPI quality of life scores for acupuncture treatment of TN revealed very high heterogeneity ($I^2 = 97.0\%$, $P = 0.000$, SMD = -2.22 , 95% CI: -4.55 – 0.12), which did not reach statistical significance (Figure 7B). Sensitivity analysis suggested that the BPI facial pain score result was robust, with confidence intervals remaining entirely below zero across all omitted studies (eFigure 6). Concurrently, the BPI quality of life score results was unstable; excluding studies with extreme effect sizes may reverse the direction of the pooled effect size, rendering the current evidence insufficient to support firm conclusions (eFigure 7).

AEs

Thirteen of the studies included in the analysis reported treatment-related AEs. Analysis results indicate that the incidence of AEs in the acupuncture combination therapy group was significantly lower than that in the conventional drug control group primarily receiving CBZ (RR 0.28, 95% CI: 0.16–0.50) (Figure 8). However, given the known high incidence of AEs associated with CBZ, acupuncture is considered safer than drugs such as CBZ; however, this primarily reflects a comparative advantage. Acupuncture-related adverse reactions (9 cases) in 13 studies were predominantly mild, transient local symptoms (such as needle syncope) and neuropsychiatric reactions like drowsiness. In contrast, CBZ-related AEs (82 cases) were more common and relatively more severe, primarily including dizziness, abnormal liver function, rash or exfoliative dermatitis, as well as gastrointestinal symptoms such as nausea and vomiting. In the trials of MA in combination with CBZ, a total of 2 AEs were reported, primarily reflecting the combined effects of both



Figure 3 Risk of bias assessment for each included study.

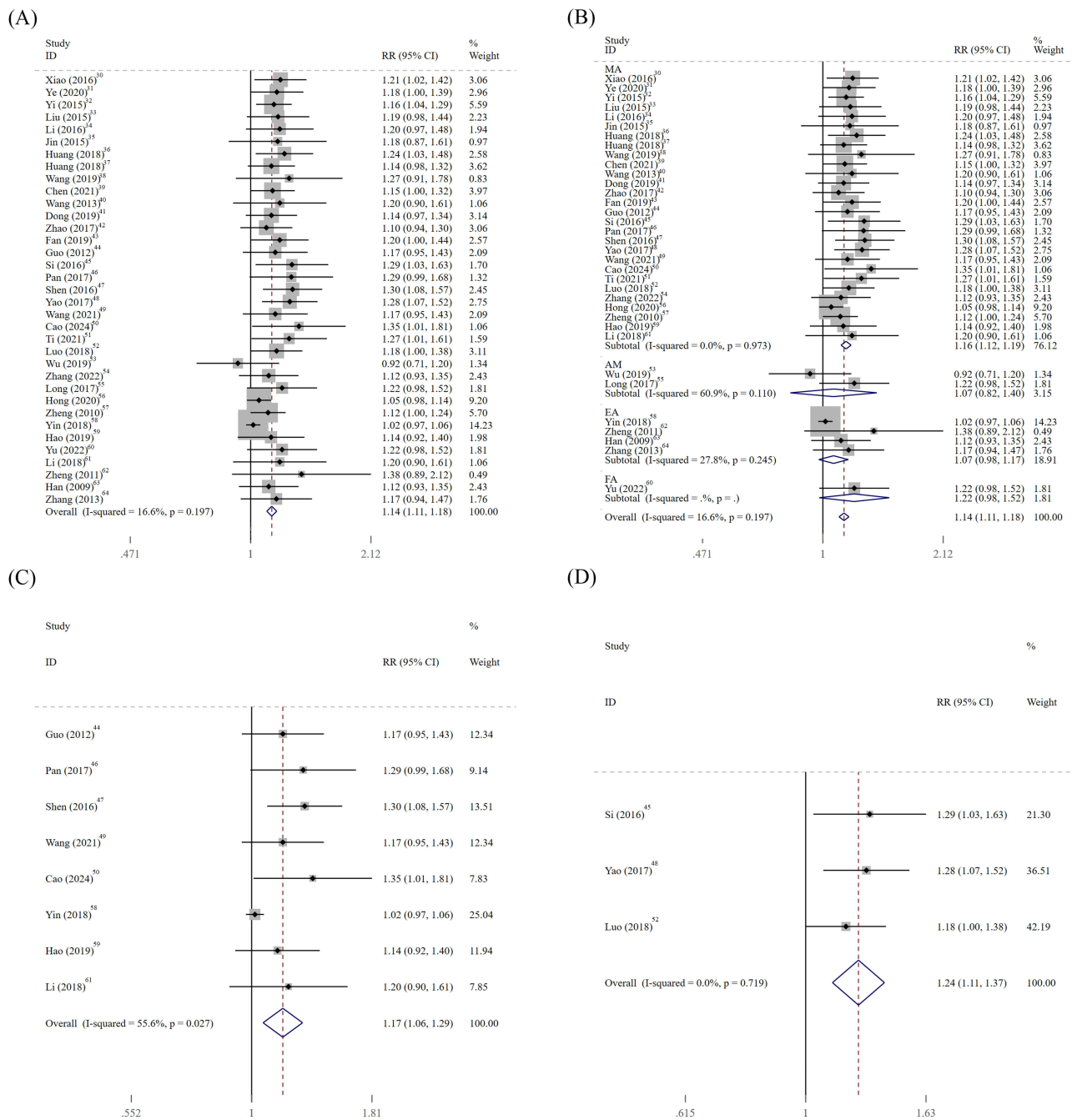


Figure 4 Forest plots for the experimental and control groups: Response rate. **(A)** Overall analysis; **(B)** Subgroup analysis by acupuncture method; **(C)** Acupuncture plus CBZ vs CBZ; **(D)** Acupuncture plus TCM vs TCM.

Abbreviations: CBZ, carbamazepine; TCM, traditional Chinese Medicine; MA, manual acupuncture; AM, acupuncture and moxibustion; EA, electroacupuncture; FA, fire acupuncture; CI, confidence interval.

treatment responses. This incidence rate was 71% lower than that observed with CBZ monotherapy; however, this downward trend should be interpreted with caution, as it may be partly attributable to the higher baseline incidence of AEs in the CBZ treatment group. It is worth noting that over one-third of the studies reported only the number of AEs without describing their specific manifestations, further highlighting the need for more comprehensive safety reporting. Detailed information on AEs between the acupuncture and control groups is presented in [Table 2](#).

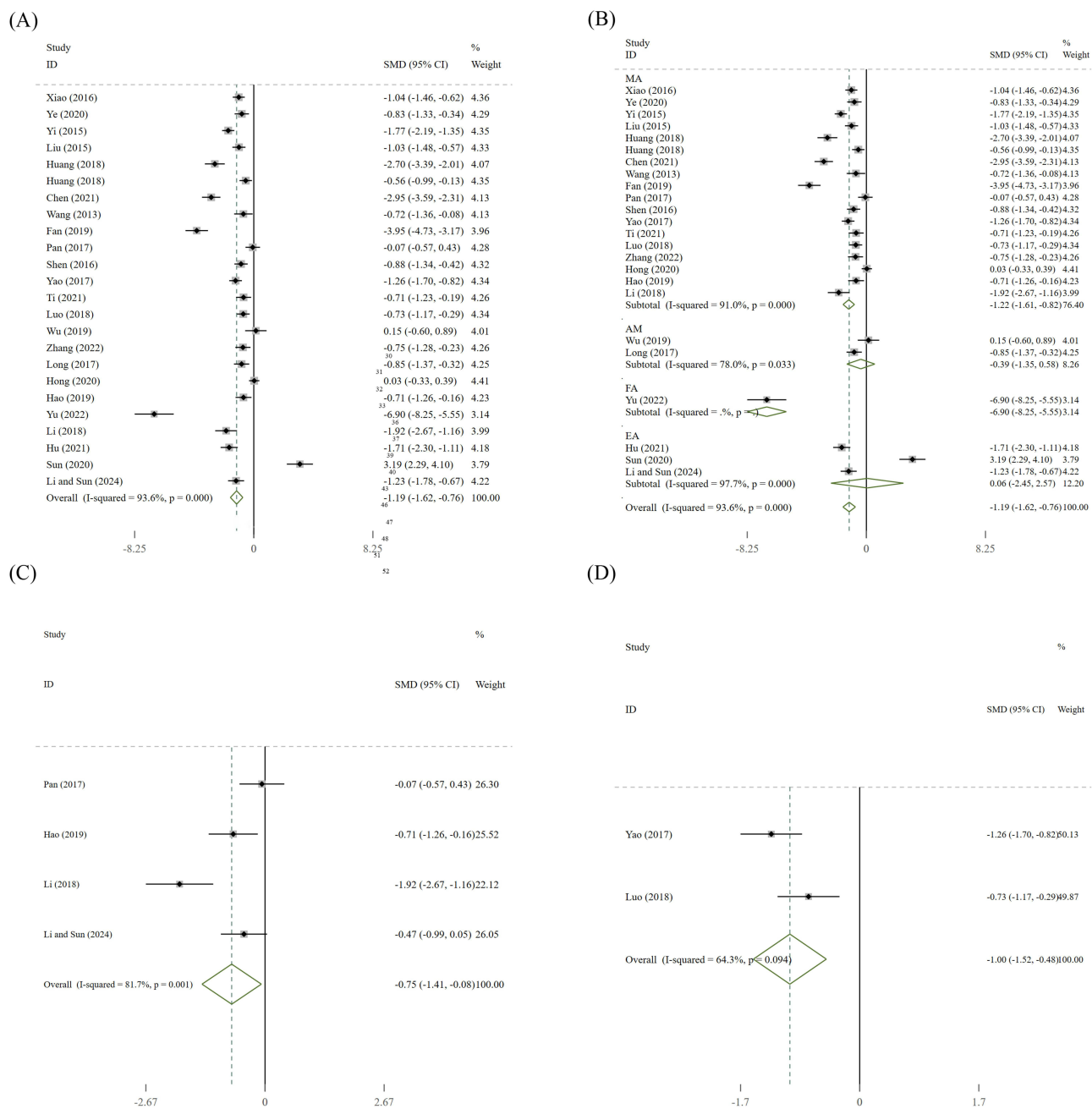


Figure 5 Forest plots for the experimental and control groups: Visual Analog Scale (VAS). **(A)** Overall analysis; **(B)** Subgroup analysis by acupuncture method; **(C)** Acupuncture plus CBZ vs CBZ; **(D)** Acupuncture plus TCM vs TCM.

Abbreviations: CBZ, carbamazepine; TCM, traditional Chinese Medicine; MA, manual acupuncture; AM, acupuncture and moxibustion; EA, electroacupuncture; FA, fire acupuncture; CI, confidence interval.

Publication Bias

Of the 38 included studies, 37 were published in Chinese, suggesting a risk of publication bias and possible positive selection bias. The Egger test revealed significant small-study effects for both response rate (intercept = 1.74, $P < 0.001$) and AEs (intercept = -2.59, $P = 0.001$), but in opposite directions; small studies tended to report greater efficacy and fewer AEs (eFigure 8). The Egger tests for VAS ($P = 0.08$), BPI quality of life ($P = 0.074$), BPI facial pain ($P = 0.291$), and frequency of pain attacks ($P = 0.060$) were all non-significant. Funnel plots were constructed for outcomes with more than four studies (response rate, VAS, AEs, and frequency of pain attacks). The data points were asymmetrically distributed (eFigure 9), suggesting possible publication bias. Given the small number of studies and limited statistical

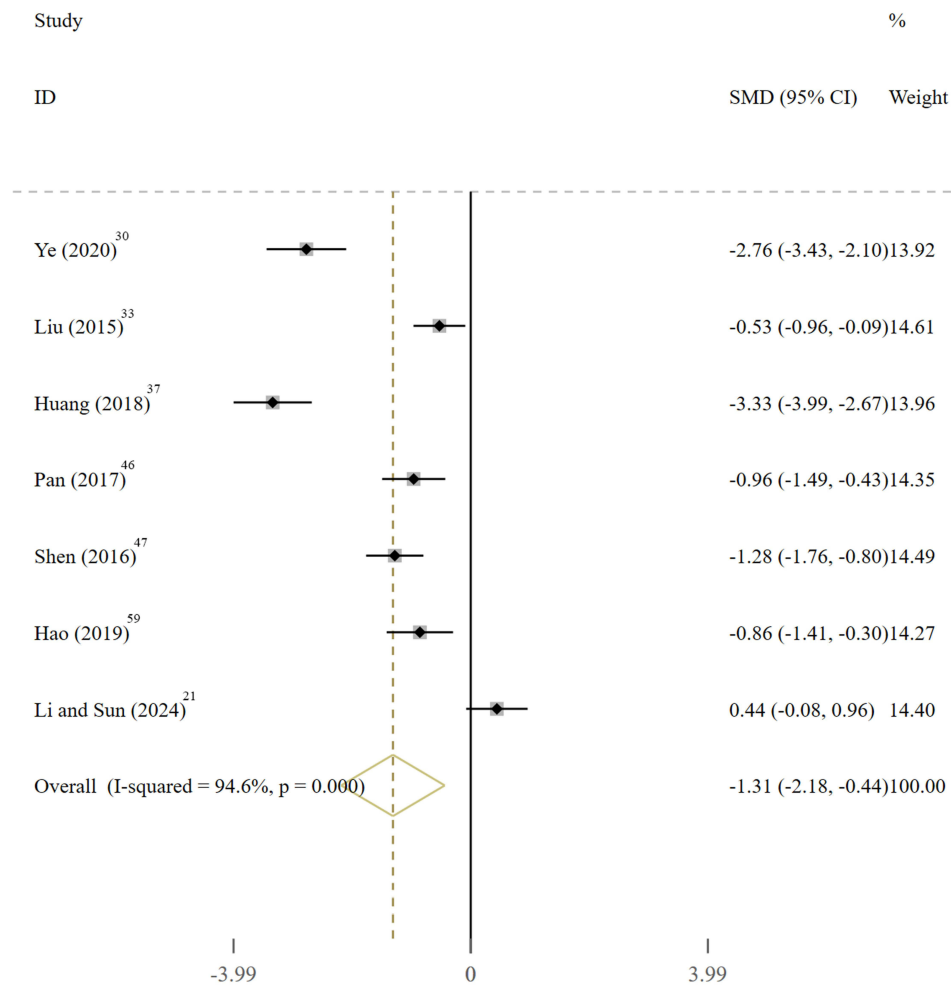


Figure 6 Forest plots for the experimental and control groups: Frequency of pain attacks.

power, a non-significant Egger’s test does not rule out bias. In summary, publication bias cannot be ruled out, and this bias may result in overestimated efficacy and underestimated adverse event rates.

GRADE Assessment

Direct and indirect evidence was compared using the GRADE approach. The quality of outcome measures ranged from very low to moderate. However, most evidence was rated as very low certainty evidence (Table 3), primarily due to risk of bias, inconsistency, and imprecision.

Discussion

This systematic review offers several novel contributions through its comprehensive integration of recently published evidence. Our study includes 38 RCTs up to December 2025, involving a total of 2836 patients. Notably, the study’s methodological rigor is evidenced by its preregistration on PROSPERO and strict adherence to PRISMA guidelines. The multidimensional treatment outcomes have been analyzed in this study, including efficacy rates, pain intensity, attack frequency, and safety profile, complemented by comprehensive subgroup analyses, sensitivity testing, and GRADE evidence grading. Quantitative analysis further shows that acupuncture is more effective than CBZ in reducing AEs. However, due to certain methodological limitations, the quality of the evidence is relatively low; therefore, the results should be interpreted with caution.

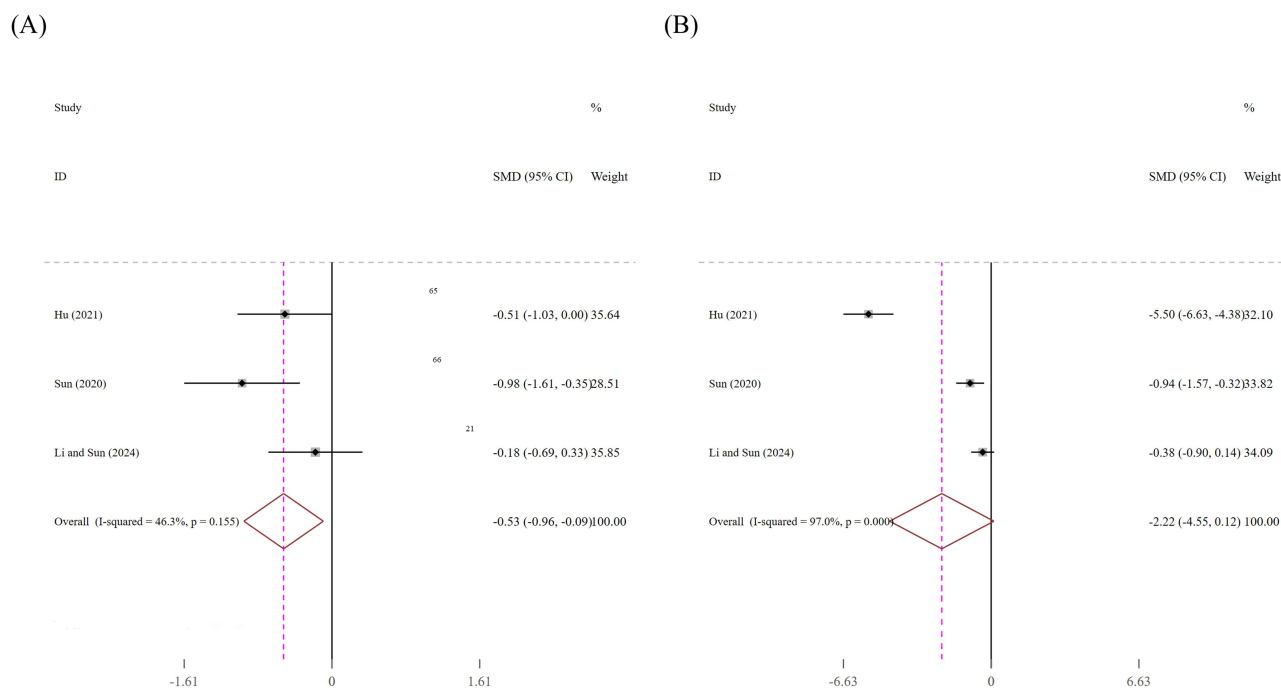


Figure 7 Forest plots for the experimental and control groups: Brief Pain Inventory (BPI). **(A)** Facial pain severity; **(B)** Pain interference with life. **Abbreviation:** CI, confidence interval.

In terms of therapeutic efficacy, the evidence suggests the effectiveness of acupuncture. First, acupuncture increased the overall treatment response rate (RR = 1.14). Subgroup analysis further revealed that acupuncture combined with either CBZ or TCM demonstrated higher efficacy compared to monotherapy with the respective drugs. Second, acupuncture was associated with a reduction in pain intensity (VAS, SMD = -1.19) and a decrease in the frequency of pain episodes (SMD = -1.31). MA has demonstrated positive effects across all core efficacy indicators, and it was the most frequently evaluated acupuncture modality in the included studies. Additionally, acupuncture was associated with an improvement in the BPI facial pain score.

In terms of safety, the combined treatment regimen incorporating acupuncture was associated with a lower reported overall incidence of AEs compared to the conventional drug therapy group primarily using CBZ. Specifically, adverse reactions directly related to acupuncture itself (such as mild dizziness or localized discomfort) occurred infrequently, are mild in severity, and are often transient. In contrast, monotherapy with CBZ is frequently associated with relatively more common and severe adverse reactions, including dizziness, abnormal liver function, rash, and gastrointestinal symptoms. Notably, when acupuncture is in combination with CBZ, it may be associated with improved efficacy and a lower risk of AEs associated with the latter. Although acupuncture combined with medication may offer potential advantages over monotherapy, the current evidence is of low quality and should be interpreted with caution. Future research urgently needs to employ standardized and rigorous RCTs to further validate the clinical utility of acupuncture in the management of TN.

TN is a neuropathic pain syndrome characterized by sudden, severe, and brief episodes of pain on one side of the face.⁶⁶ This type of pain not only frequently leads to functional disability and a significant decline in quality of life,⁶⁷ but also imposes a substantial disease burden. Epidemiological data indicate that its incidence rate can reach 25.33 per 100,000 person-years, with a global annual prevalence of 45.38 per 100,000 and a lifetime prevalence as high as 108.43 per 100,000.⁶⁸ Correspondingly, TN patients exhibit a significantly elevated risk of sleep disorders, depression, and anxiety, with over one-third exhibiting suicidal tendencies, which are closely correlated with pain intensity.^{69,70}

In response to this clinical challenge, conventional drugs such as CBZ primarily exert their therapeutic effects by acting on sodium channels,^{71,72} representing a relatively singular mode of action. This study reveals that acupuncture treatment for TN may exert its effects through a multi-target, multi-pathway integrated regulatory mechanism, offering

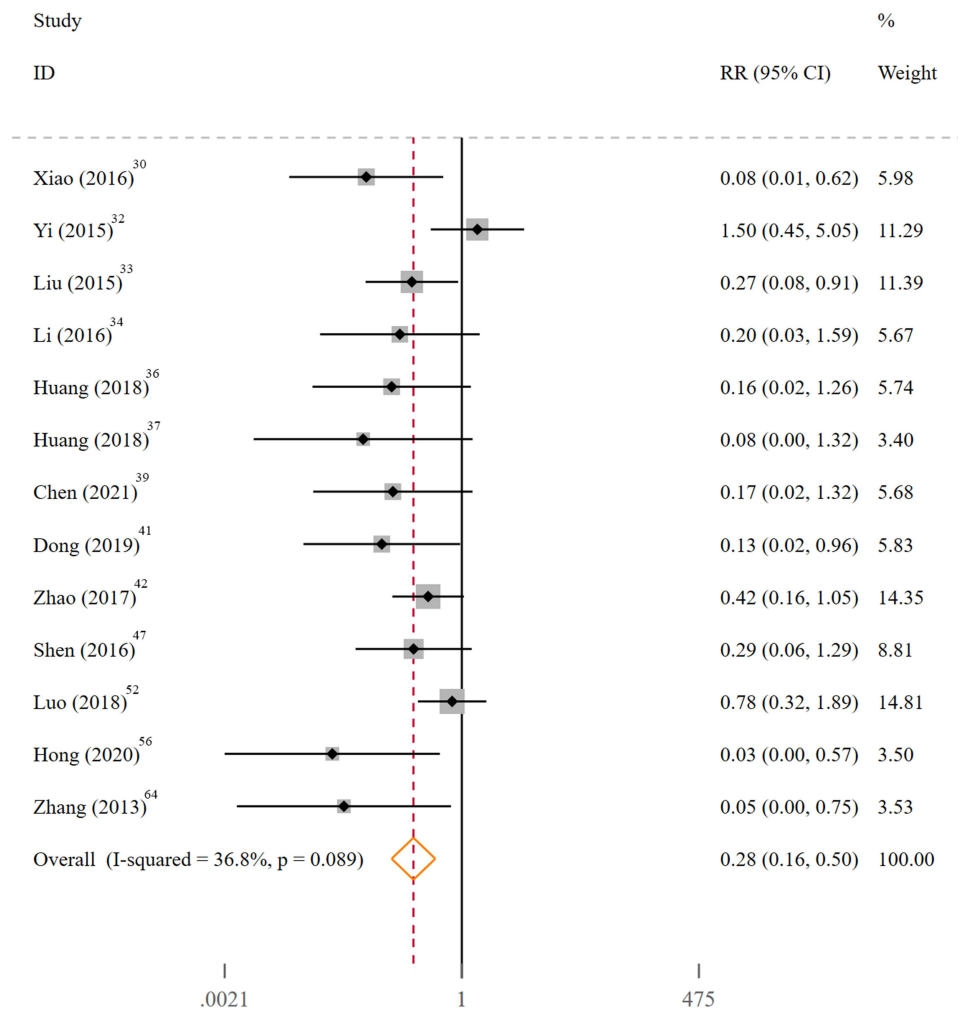


Figure 8 Forest plots for the experimental and control groups: adverse events(AEs). **Abbreviation:** CI, confidence interval.

new insights for therapeutic approaches. Current understanding suggests that the pathogenesis of TN involves neurovascular compression, voltage-gated sodium/potassium channel dysfunction, and abnormal restructuring of brain structural and functional connectivity.^{73–77} It is a multifaceted disorder encompassing peripheral and central sensitization pathways.

In response to this complexity, acupuncture achieves synchronized regulation across multiple systems. At the central level, it not only promotes the release of endogenous opioids, modulates neurotransmitters such as 5-HT and NE, and activates descending inhibitory pathways to directly suppress pain transmission,^{78,79} but also suppresses neuroinflammation and central sensitization by regulating signaling pathways such as TLR4/NF-κB.^{80,81} Additionally, acupuncture helps remodel abnormal functional connectivity in brain regions such as the anterior cingulate cortex and insula, thereby reversing pain-related neuroplasticity changes.^{82,83} At the peripheral level, acupuncture improves the microenvironment at the injury site by increasing local blood flow, clearing inflammatory mediators, and promoting adenosine release. This reduces peripheral sensitization, thereby achieving comprehensive relief of facial pain.^{84,85}

A UK study on TN showed that acupuncture had a slightly higher treatment efficacy rate (86.5%) than MVD (79.3%) and CBZ (71.7%). Among the three treatments, acupuncture also had the lowest side effect incidence (22.7%) and the lowest psychological distress score (53 points). A long-term cost analysis indicated that acupuncture became the most cost-effective option at 65 weeks of treatment, with a total cost of approximately £750 over five years—half that of CBZ and significantly lower than surgery.⁸⁶ A study by Zhao et al on neuropathic pain, including one three-arm trial and 15

Table 2 Adverse Events in Included RCTs

Interventions	Study	Sample size	Adverse Events
MA	Xiao 2016 ²⁹	50	Needle phobia: 1 case
	Liu 2015 ³²	42	Somnolence: 3 cases
	Li 2016 ³³	25	1 case
	Huang 2018 ³⁵	32	Small patch of pigmentation: 1 case
	Huang 2018 ³⁶	43	0 cases
	Chen 2021 ³⁸	40	1 case
	Dong 2019 ⁴⁰	44	Somnolence: 1 case
	Hong 2020 ⁵⁵	60	0 cases
CBZ	Xiao 2016 ²⁹	50	Gastrointestinal adverse: 6 cases reactions; Abnormal liver function: 4 cases; Rash: 2 cases
	Liu 2015 ³²	42	Dizziness: 3 cases; Drowsiness: 5 cases; Vomiting: 3 cases
	Li 2016 ³³	25	5 cases
	Huang 2018 ³⁵	31	Exfoliative dermatitis: 1 case; Dizziness: 5 cases
	Huang 2018 ³⁶	43	Dizziness: 5 cases; Rash: 1 case
	Chen 2021 ³⁸	40	6 cases
	Dong 2019 ⁴⁰	44	Somnolence: 2 cases; Nausea: 3 cases; Vomiting: 3 cases
	Shen 2016 ⁴⁶	40	Dizziness: 6 cases; Exfoliative dermatitis: 1 case
	Hong 2020 ⁵⁵	60	Somnolence: 3 cases; Abnormal liver function: 4 cases; Dizziness: 7 cases
	Zhang 2013 ⁶³	30	Gastrointestinal reactions: 6 cases; Dizziness: 5 cases
EA	Zhang 2013 ⁶³	30	1 case
MA+CoA	Zhao 2017 ⁴¹	34	5 cases
MA+CBZ	Shen 2016 ⁴⁶	40	Small patches of pigmentation: 2 cases
MA+TCM	Luo 2018 ⁵¹	42	Dizziness: 1 case; Dry mouth: 1 case; Somnolence: 1 case; Nausea and vomiting: 1 case; Constipation: 2 cases
MA+CBZ+TCM	Yi 2015 ³¹	60	Nausea and vomiting: 2 cases; Constipation: 2 cases
TCM	Luo 2018 ⁵¹	42	Dry mouth: 3 cases; Drowsiness: 1 case; Nausea and vomiting: 2 cases; Constipation: 3 cases
CBZ+CoA	Zhao 2017 ⁴¹	34	12 cases
CBZ+TCM	Yi 2015 ³¹	60	Dizziness: 1 case; Somnolence: 1 case; Dry mouth: 1 case; Nausea and vomiting: 1 case; Constipation: 2 cases

Abbreviations: MA, Manual acupuncture; EA, Electroacupuncture; TCM, Traditional Chinese Medicine; CoA, Cyanocobalamin injection.

two-arm trials, found that the total weekly treatment costs (including direct and indirect costs) in descending order were as follows: EA (¥1160.60), AM (¥789.95), MA (¥687.18), FA (¥547.75), antiepileptic drugs (¥140.39), and nonsteroidal anti-inflammatory drugs (NSAIDs)(¥100.63).⁸⁷ Overall, acupuncture may slightly increase short-term direct medical costs for TN. However, it can shorten illness duration, reduce cumulative costs from long-term medication and frequent clinic visits, and decrease reliance on analgesics and psychological well-being.⁸⁸ Currently, there is a lack of comparative studies on the time of pain relief among different acupuncture modalities, which is a key area for future research.

Unlike previous reviews that primarily compared different single acupuncture therapies, this study focuses on systematically integrating evidence for the combined treatment of acupuncture with conventional medication. This approach further helps clarify its potential value in achieving synergistic clinical effects. From a clinical practice perspective, this value is notable. Evidence indicates that incorporating acupuncture as an adjunct therapy to CBZ or TCM not only enhances treatment efficacy but also reduces the risk of adverse reactions associated with drug therapy alone. Therefore, this combined strategy offers a potential complementary treatment option for TN patients who are intolerant to drug side effects or experience poor therapeutic response.

However, this study also has certain limitations: the methodological quality of the included studies was generally low, with deficiencies in random allocation concealment, implementation of blinding, and reporting. For example, only 4 out of 38 studies adequately described the randomisation process. Due to the lack of pain biomarkers, pain assessment in the included studies relied heavily on non-blinded subjective outcome measures (eg, VAS score, response rate), which likely

Table 3 GRADE Summary of Findings

Outcome	Effect Size (95% CI)	Number of Studies	Sample Size	Risk of Bias	Inconsistency	Imprecision	Indirectness	Publication Bias	Overall Certainty of Evidence
Effective Rate	RR 1.14 (1.11 to 1.18)	35	2456	Downgraded by 1 level	Not downgraded	Not downgraded	Not downgraded	Downgraded by 1 level	Very low
VAS	SMD -1.19 (-1.19 to -0.76)	24	1683	Downgraded by 1 level	Downgraded by 2 levels	Not downgraded	Not downgraded	Not downgraded	Very low
Attack Frequency	SMD -1.31 (-2.18 to -0.44)	7	492	Downgraded by 1 level	Downgraded by 2 levels	Downgraded by 1 level	Not downgraded	Not downgraded	Very low
BPI Facial Pain	SMD -0.53 (-0.96 to -0.09)	3	163	Downgraded by 1 level	Downgraded by 1 level	Downgraded by 1 level	Not downgraded	Not downgraded	Very low
BPI Quality of Life	SMD -2.22 (-4.50 to 0.12)	3	163	Downgraded by 1 level	Downgraded by 2 levels	Downgraded by 2 levels	Not downgraded	Not downgraded	Very low
Adverse Events	RR 0.28 (0.16 to 0.50)	13	1077	Downgraded by 2 level	Downgraded by 1 level	Not downgraded	Not downgraded	Not downgraded	High

led to overestimation of the pooled estimates. In addition, many Chinese clinical trials used unvalidated or study-specific criteria, and the definition of “response rate” varied across studies, introducing indirectness and bias. The quality of evidence for most outcomes was rated as “low” or “very low,” with insufficient or uncertain evidence for some outcomes and a lack of long-term efficacy assessments. Furthermore, the safety reports are insufficiently comprehensive, and the predominance of Chinese literature may introduce language bias. Therefore, although acupuncture combined with medication shows potential advantages over monotherapy, the strength of the current evidence is limited, and the findings should be interpreted with caution.

Conclusion

Acupuncture combined with medication may improve efficacy and reduce adverse events compared to medication alone for TN, but these findings should be interpreted with caution due to the low certainty of evidence. To translate these findings into clinical practice, future rigorously designed, multicenter RCTs must employ standardized acupuncture protocols, blinded outcome assessment, and longer-term follow-up. Until such evidence is available, clinicians should weigh these potential benefits against the limitations cautiously.

Declaration Section

This study protocol is registered with PROSPERO (registration number: CRD420251269307).

Data Sharing Statement

The data used and/or analyzed in this study may be obtained upon reasonable request to the corresponding author, Rongrong Li.

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.

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Disclosure

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