Review Article
Therapeutic effect of Chinese Tuina on diabetic peripheral neuropathy: systematic review and meta-analysis

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Abstract: Objectives: Clinical studies suggest that Chinese Tuina therapy may benefit diabetic peripheral neuropathy (DPN), but the evidence is inconclusive. This study evaluates its clinical efficacy and safety for DPN treatment. Methods: Ten databases were searched, covering the period from their inception to February 21, 2024. Relevant data were extracted from studies meeting the inclusion criteria, and a meta-analysis was conducted using RevMan 5.3 software. Results: A total of 24 randomized controlled trials (RCTs) involving 1,989 participants were included in the study. The meta-analysis results showed that, compared to a control group, the Chinese Tuina therapy group demonstrated a higher overall clinical efficacy rate and improved Toronto Clinical Scoring System (TCSS) scores, indicating that Chinese Tuina may provide benefits beyond conventional treatment. Furthermore, improvements were observed in the motor and sensory nerve conduction velocities (MNCV and SNCV) of certain specific nerves, such as the common peroneal nerve, sural nerve, and ulnar nerve. Although the differences in MNCV and SNCV of the tibial and median nerves were not statistically significant, the overall improvement in clinical outcome supports the conclusion that Chinese Tuina is superior to conventional treatment. Conclusion: Chinese Tuina therapy is a safe and effective treatment option for DPN. It can alleviate clinical symptoms and improve the MNCV of the common peroneal nerve as well as the SNCV of the sural and ulnar nerves. Its efficacy in the tibial and median nerves remains unconfirmed, highlighting a need for future large-scale, high-quality RCTs.

Keywords: Chinese Tuina, diabetic peripheral neuropathy, systematic review, meta-analysis

Introduction

DPN is one of the most common chronic complications of diabetes, affecting approximately 50% of diabetic patients [1, 2]. It has become a major public health concern worldwide [3]. Many diabetic patients show no obvious symptoms in the early stages, and neurological damage often occurs concurrently with diabetes diagnosis. Among the complications, DPN is the most prevalent [4].

Current research indicates that factors such as diabetes duration, age, HbA1c levels, and diabetic retinopathy are strongly associated with an increased risk of DPN [3]. Early symptoms of DPN include limb numbness, paresthesia, pain, and muscle weakness, which significantly contribute to disability among diabetic patients [5].

DPN not only imposes a heavy economic burden on society but also severely affects patients' quality of life. Medications such as pregabalin, duloxetine, gabapentin, and mecobalamin are commonly used for DPN treatment, but these drugs may cause side effects and adverse reactions, leading to poor patient acceptance [6, 7]. This underscores a need for safe and effective alternative treatment strategies for DPN.

A core concept of Chinese Tuina and acupuncture in treating diseases is that stimulation of specific body regions (acupoints) can modulate physiologic functions at distant sites, presumably through hypothetical meridian channels [8]. Animal studies have shown that acupuncture can relieve DPN in rats by regulating P2X4 expression and inflammation in spinal microglia

[9]. Diabetic neuropathy is a complex group of disorders affecting both the somatic and autonomic components of the nervous system. A recent bioinformatic study on acupuncture for COVID-19 treatment found that acupuncture is associated with suppression of inflammatory stress, immune enhancement, and regulation of nervous system functions, including neuroactive ligand-receptor interaction and calcium signaling pathways [10].

Chinese Tuina, a traditional alternative therapy used in China for thousands of years, has been shown to improve microcirculation and promote blood flow. As a safe therapeutic option with fewer adverse effects, Chinese Tuina has notable advantages for pain alleviation and improving physical function [11, 12].

This study aimed to evaluate the effectiveness and safety of Chinese Tuina therapy for DPN. By analyzing the clinical total effective rate, TCSS score, SNCV, MNCV, and other outcome indicators, we aim to draw clear conclusions and propose Chinese Tuina as a safe and effective complementary therapy for DPN treatment.

Materials and methods

Registration

This meta-analysis was performed by adhering to the PRISMA guidelines [13]. This systematic review was prospectively registered with the International Prospective Register of Systematic Reviews (number: CRD42022358629).

Search strategy

Search of databases: We searched several databases including PubMed, Embase, Web of Science, Cochrane Library, China National Knowledge Infrastructure (CNKI), Wan Fang Database (Wan Fang), Chinese Biomedical Literature Database (CBM), VIP Database for Chinese Technical Periodicals (VIP), Medline, and Clinical Trial Register (CTR) for RCTs up to February 21, 2024.

Search terms: Following the "PICOS" criteria (patients, intervention, comparison, outcome, and study design), we used the following search terms: (1) "Diabetic peripheral neuropathy", "DPN", "diabetes", and their Medical Subject Headings (MeSH) terms, connected with "OR";

(2) "Chinese Tuina", "Tuina", "Massage", and their MeSH terms, also connected with "OR"; (3) Terms from sets (1) and (2) were then combined with "AND". The search strategy was adapted for each database's characteristics. All searches were limited to RCTs in humans. Two authors (Huixin Yan and Hongyi Guan) independently selected articles and extracted data, with any discrepancies resolved by consulting a third reviewer (Jiabao Sun). We also applied these search terms in the Chinese Clinical Trial Registry and the International Clinical Trials Registry Platform (ICTRP). Additionally, we conducted supplementary searches, such as manually reviewing original literature for possibly relevant trials and seeking gray literature from other sources.

Inclusion and exclusion criteria

Inclusion criteria: (1) Type: the clinical RCTs of DPN; (2) Participants: patients diagnosed with DPN according to certain guidelines [14-16]; (3) Intervention: patients in the experimental group received Chinese Tuina therapy on the basis of the routine treatment and nursing of DPN; (4) Comparison: the patients in the control group received routine treatment and nursing of DPN, including health education, dietary guidance, blood sugar control, and oral vitamin B or mecobalamin; (5) Outcomes: the primary outcome was the total effective rate, the secondary outcomes were NCV (sensory, motor or mixed) and TCSS score. Supplementary explanation: the definition of clinical efficacy was not similar among trials. Evaluation of clinical efficacy in included trials was based on the following criteria: 1) Effective: Symptoms and/or signs of peripheral nerve dysfunction improved, and SCV or MCV increased. 2) Ineffective: Symptoms and/or signs of peripheral nerve dysfunction had not improved, or SCV or MCV did not obviously improve [17, 18].

Exclusion criteria: (1) The type of research was not clearly explained; (2) Unable to extract data from the literature or insufficient data; (3) Repeated literature; (4) Unable to get the full text; (5) Review or animal experimental literature; (6) There was no control group, the control group was blank control, and the treatment group was combined with the intervention of other non-Tuina therapy; (7) Chinese Tuina was

Table 1. Characteristics of studies included in meta-analysis

Reference	Sample (E/C)	Intervention (E/C)	Frequency (Period)	Evaluation	Place
Chen et al. [19], 2015	30/30	A1+A2/A2	2 per D (20D)	A3	Guiyang
Cui et al. [20], 2020	32/32	A1+A2/A2	3 per D (14D)	A3	Nanjing
Dong et al. [21], 2004	47/43	A1+A2/A2	1 per D (NR)	A3	Taian
Guo et al. [22], 2016	38/38	A1+A2/A2	1 per D (30D)	A3	Yulin
Huang et al. [23], 2020	49/49	A1+A2/A2	2 per D (1-3M)	A3, A5, A6	Zhuzhou
Jin et al. [24], 2017	42/42	A1+A2/A2	2 per W (NR)	A3	Beijing
Li [25], 2013	30/30	A1+A2/A2	1 per D (30D)	A3, A4, A5, A9, A10	Changchun
Liang [26], 2019	30/30	A1+A2/A2	1 per D (21D)	A3, A4	Guangzhou
Liu et al. [27], 2013	30/30	A1+A2/A2	1 per D (30D)	A3, A4	Changchun
Liu et al. [28], 2017	39/39	A1+A2/A2	2 per D (21D)	A3	Yunnan
Liu et al. [29], 2016	30/30	A1+A2/A2	1 per D (30D)	A5, A12	Hongan
Long et al. [30], 2018	30/30	A1+A2/A2	2 per D (14D)	A3	Guangzhou
Shang et al. [31], 2005	30/30	A1+A2/A2	1-2 per D (25D)	A3, A5, A12	Xian
She [32], 2011	20/20	A1+A2/A2	1 per D (180D)	A5, A6, A9, A10, A11	Nanjing
Si [33], 2012	30/30	A1+A2/A2	1 per D (NR)	A3, A7, A8	Zhengzhou
Xu [34], 2014	48/48	A1+A2/A2	1 per D (NR)	A3	Anhui
Xu GX [35], 2014	80/80	A1+A2/A2	1 per D (30D)	A3	Jinzhou
Xu et al. [36], 2018	100/100	A1+A2/A2	1-2 per D (30D)	A3	Fuzhou
Yang et al. [37], 2015	80/80	A1+A2/A2	1 per D (30D)	A3	Yunnan
Yang et al. [38], 2010	20/20	A1+A2/A2	1 per D (90D)	A3, A5, A6, A9, A10, A11	Nanjing
Zheng et al. [39], 2017	40/40	A1+A2/A2	2 per D (NR)	A3, A4	Hangzhou
Zhou et al. [40], 2009	56/27	A1+A2/A2	1-2 per D (6M)	A3, A7, A8	Beijing
Zhou [41], 2018	30/30	A1+A2/A2	1 per D (14D)	A3	Luoyang
Zhu [42], 2019	50/50	A1+A2/A2	3 per D (14D)	A3	Guangdong

Note: A1 = Chinese Tuina; A2 = routine treatment and nursing of DPN; A3 = total effective rate; A4 = Toronto clinical scoring system (TCSS); A5 = MNCV of common peroneal nerve; A6 = SNCV of sural nerve; A7 = MNCV of tibial nerve; A8 = SNCV of tibial nerve; A9 = MNCV of median nerve; A10 = SNCV of median nerve; A11 = SNCV of ulnar nerve; A12 = NCV of uncertain nerve; NCV = nerve conduction velocity; MNCV = motor nerve conduction velocity; SNCV = sensory nerve conduction velocity; (E/C) = experimental groups/control groups; Y = year(s); M = month(s); W = weeks; D = day(s); T = time(s); NR = not reported.

not mentioned in the treatment; (8) Sample size less than 20 cases.

Search procedures and data extraction

Two investigators (Huixin Yan and Hongyi Guan) independently searched each of the above databases to retrieve relevant literature and recorded the titles and abstracts to assess eligibility. For eligible articles, relevant data were extracted in a double-blind manner. These data included the first author, publication year, sample sizes of the treatment and control groups, gender, age, intervention methods, outcome indicators, and other relevant information. After the two researchers independently completed data collection, any discrepancies were resolved through consensus with other researchers. The characteristics of the included literature are presented in **Table 1**.

Quality assessment

In accordance with evidence-based medicine research guidelines, the Cochrane Risk of Bias tool was used to assess the quality of the included studies based on six criteria: randomization, allocation concealment, blinding (participants, personnel, and outcome assessment), integrity of outcome data, selective reporting, and other potential sources of bias. During statistical analysis, quality assessments were classified as follows: studies were rated as low risk of bias if the total score was 4 or above, moderate risk of bias if the total score was 3 to 4, and high risk of bias if the total score was below 3.
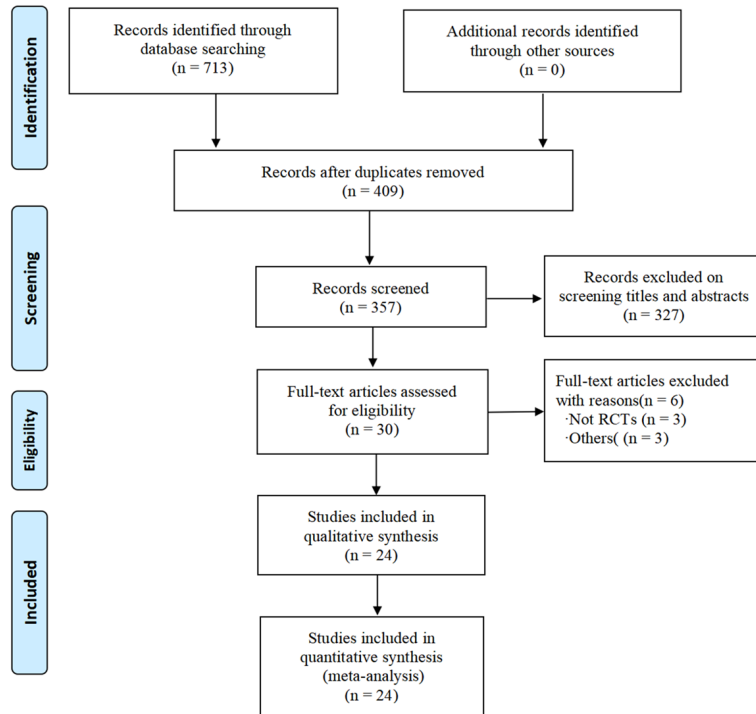
Figure 1. Flow diagram of the study selection process.

Statistical analysis

Review Manager software (RevMan, Version 5.3 for Windows) was used to conduct the meta-analysis. The total clinical effective rate was treated as dichotomous data, while the TCSS score, NCV (sensory, motor, or mixed), and other outcomes were considered continuous data. The Chi-square test and I^2 statistic were used to assess study heterogeneity based on the P and I^2 values. If heterogeneity was low (P > 0.1; I^2 < 50%), a fixed-effect model was applied for the meta-analysis; otherwise, a random-effects model was used. Odds ratio (OR) and mean difference (MD) with 95% confidence intervals (CIs) were provided as estimates of the combined effect size, with *P* values less than 0.05 considered significant.

Results

Study selection and screening process

In this meta-analysis, we identified 713 studies from ten electronic databases, including CNKI (n = 133), Wan Fang (n = 189), VIP (n = 82), Chinese Biomedical Literature Database (n = 114), PubMed (n = 89), Embase (n = 4), Cochrane Library (n = 36), Web of Science (n = 16), Medline (n = 50), and Clinical Registries (n = 0). No articles were retrieved from other sources. After deduplication, 409 articles remained. Of these, 52 were excluded due to being reviews, systematic reviews, or animal studies, leaving 357 articles for primary screening. Additionally, after reviewing the titles and abstracts, 327 articles with irrelevant research content or intervention measures were excluded, resulting in 30 papers that met the preliminary inclusion criteria. After downloading and reading the full texts, we further excluded six articles due to non-RCT designs, flawed experimental design, or inconsistent trial methods. Ultimately, 24 studies were included [19-42]. The flow diagram of the search and evaluation process is shown in **Figure 1**.

Characteristics of included studies and intervention details

In this meta-analysis, all RCTs were conducted in China and published in Chinese. A total of 1,989 DPN patients participated across 24 RCTs, including 1,011 patients in the experimental group and 978 patients in the control group. **Table 1** provides the detailed characteristics of the included studies. Participants received routine blood glucose management, including oral hypoglycemic drugs or insulin injections, along with standard care and health education. In the experimental group, Chinese Tuina was the primary intervention, with treatment sites primarily on the limbs and manipulation types focused on loosening techniques. According to Chinese Tuina theory, these techniques are thought to promote qi and reduce blood stasis, thus enhancing blood circulation, and they share similar therapeutic principles. Chinese Tuina is therefore widely applied in the treatment of DPN. Additionally, five studies [20, 23, 30, 39, 42] employed acupoint Tuina combined with meridian patting. Meridian patting, a form of percussion manipulation in

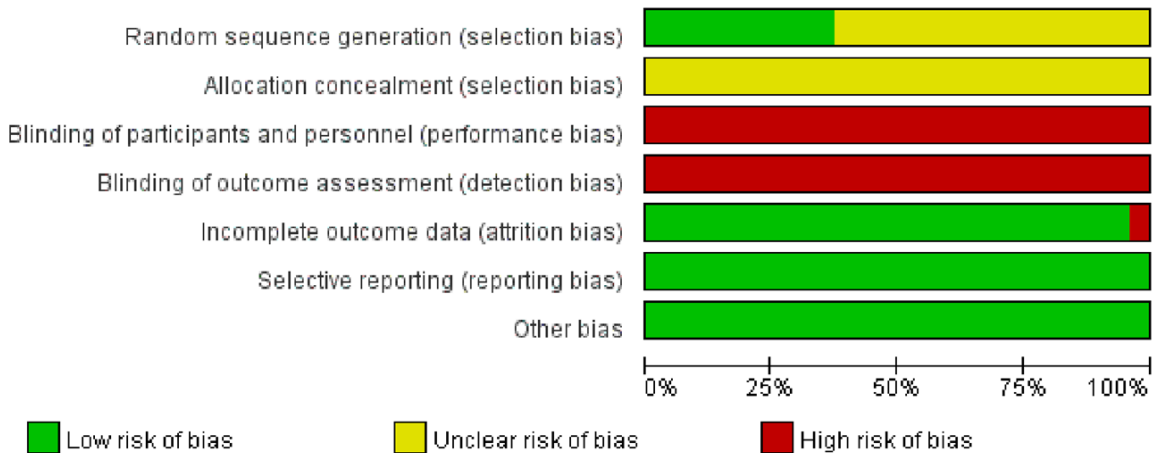**Figure 2.** Methodologic quality of included studies.

Figure 3. Distribution of the methodologic quality of included studies.

Chinese Tuina, provides stronger stimulation and can further improve microcirculation along meridian pathways. Besides Chinese Tuina therapy, many trials also utilized neurotrophic drugs such as methylcobalamin. Most studies evaluated the "total effective rate" based on subjective indicators, such as whether clinical symptoms improved or disappeared. Several studies also included NCV (sensory, motor, or mixed), TCSS score, neuropathy score, and Chinese Tuina syndrome score as outcome indicators.

Methodological quality and risk of bias assessment

According to the results of the Cochrane risk of bias tool, the randomization approach was clearly and appropriately described in 9 trials, while 15 trials did not clearly report the random allocation method. Due to the specific nature of Chinese Tuina therapy and the requirement for

informed consent, it was challenging to implement blinding for participants and therapists in these trials. In this study, a schematic diagram of the methodologic quality assessment is presented in **Figure 2**, and the proportion of each item is provided in **Figure 3**.

Effectiveness of Chinese Tuina and bias analysis

22 articles reported improvements in the total effective rate of DPN with Chinese Tuina therapy. A heterogeneity test indicated that the heterogeneity among the selected studies was statistically significant (I^2 = 61%, P = 0.0001 for the Q test), necessitating further investigation. Sensitivity analysis revealed that Cui et al., 2020 [20] and Huang et al., 2020 [23] had a substantial influence on heterogeneity. After excluding these studies and conducting the heterogeneity test again, the results showed no significant heterogeneity among the remaining

Study or Subgroup	Experimental Events	Total	Control Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Odds Ratio M-H, Fixed, 95% CI
Chen et al,2015	26	30	7	30	2.6%	21.36 [5.53, 82.43]	
Cui et al,2020	26	32	31	32		Not estimable	
Dong et al,2004	46	47	24	43	1.5%	36.42 [4.59, 288.76]	
Guo et al,2016	36	38	30	38	4.3%	4.80 [0.95, 24.34]	
Huang et al,2020	37	49	45	49		Not estimable	
Jin et al,2017	40	42	37	42	4.9%	2.70 [0.49, 14.79]	
Li,2013	28	30	24	30	4.4%	3.50 [0.65, 18.98]	
Liang,2019	30	30	29	30	1.3%	3.10 [0.12, 79.23]	
Liu et al,2013	28	30	24	30	4.4%	3.50 [0.65, 18.98]	
Liu et al,2017	36	39	28	39	5.9%	4.71 [1.20, 18.53]	
Long et al,2018	25	30	18	30	8.3%	3.33 [1.00, 11.14]	
Shang et al,2005	28	30	18	30	3.3%	9.33 [1.87, 46.68]	
Si,2012	28	30	19	30	3.5%	8.11 [1.61, 40.77]	
Xu ,2014	73	80	42	80	10.1%	9.44 [3.87, 23.00]	
Xu et al,2016	98	100	78	100	4.3%	13.82 [3.15, 60.58]	
Xu,2014	44	48	37	48	8.5%	3.27 [0.96, 11.13]	
Yang et al,2010	18	20	6	20	1.7%	21.00 [3.66, 120.37]	
Yang,2015	73	80	42	80	10.1%	9.44 [3.87, 23.00]	
Zheng et al,2017	39	40	30	40	2.1%	13.00 [1.58, 107.23]	
Zhou et al,2009	52	56	17	27	4.5%	7.65 [2.12, 27.57]	
Zhou,2018	28	30	23	30	4.2%	4.26 [0.81, 22.53]	
Zhu,2019	45	50	37	50	10.2%	3.16 [1.03, 9.69]	
Total (95% CI)		**880**		**847**	**100.0%**	**7.16 [5.27, 9.72]**	
Total events	821		570				

Heterogeneity: Chi² = 17.31, df = 19 (P = 0.57); I² = 0%
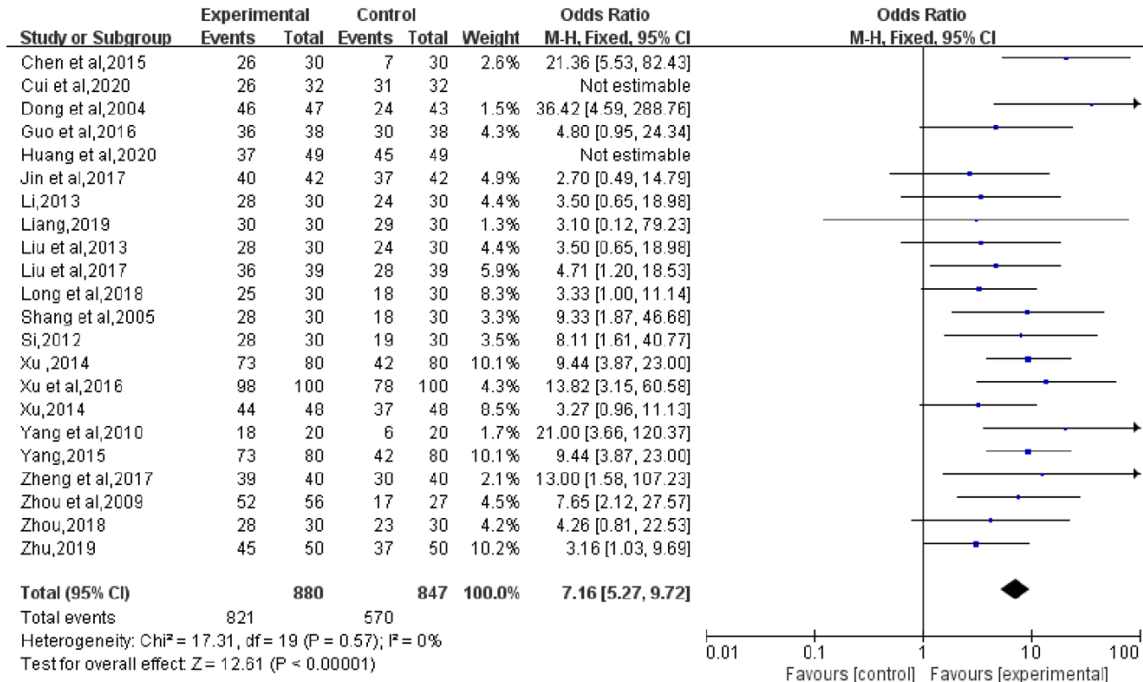Test for overall effect: Z = 12.61 (P < 0.00001)

Figure 4. Comparison of the total effective rate.
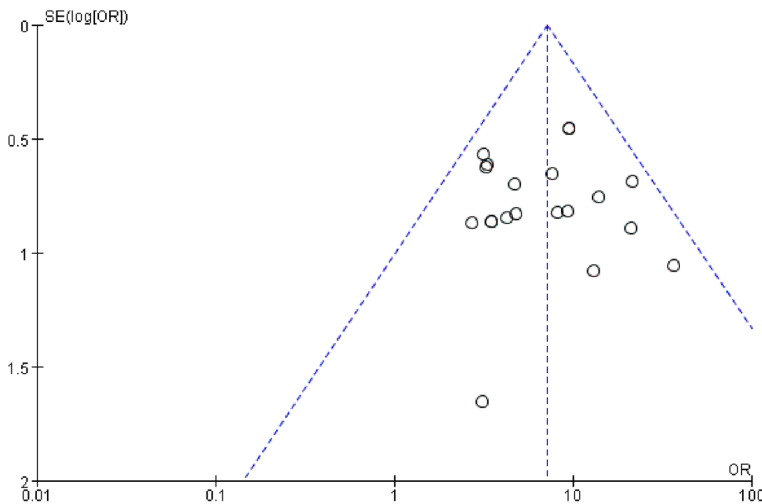
Figure 5. Funnel chart of the total clinical effective rate.

studies, with 880 patients (498 cases) in the experimental group (Chinese Tuina) and 847 patients (331 cases) in the control group showing effectiveness. A statistically significant difference was observed between the two groups (OR = 7.16, 95% CI: 5.27-9.72, Z = 12.61, P < 0.05), indicating that Chinese Tuina therapy for DPN was superior to standard treatment. Details are presented in **Figure 4**.

We conducted a publication bias analysis of the included studies and generated a funnel plot, as shown in **Figure 5**. Based on the figure, we observed that the effect values of individual studies were dispersed at the bottom, suggesting the presence of small-sample studies among the included literature. Using the OR value as the baseline, the plot presented a symmetrical inverted funnel shape with minimal dispersion, with values evenly distributed on both sides of the baseline and within the 95% CI. However, gaps in the plot indicate potential bias, possibly due to unpublished

studies (I² = 0%, P = 0.57), allowing the use of a fixed-effects model for the meta-analysis. Upon examining potential sources of heterogeneity, it was found that Cui et al., 2020 [20] had a higher frequency of interventions and a shorter treatment session per day, while Huang et al., 2020 [23] had different session durations and more frequent interventions daily. This suggests that frequency and treatment duration may contribute to heterogeneity. A total of 1,727 participants were included in the 20
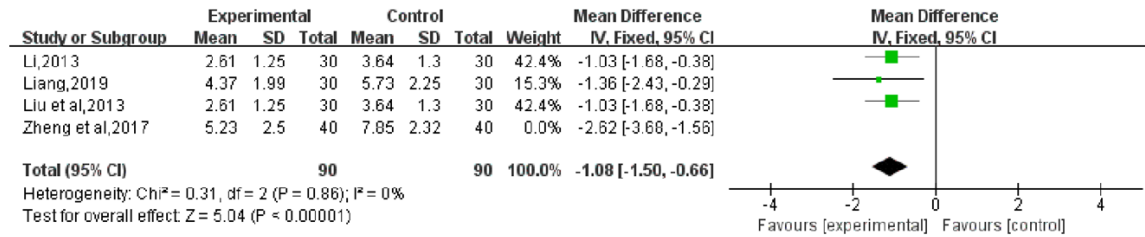
Figure 6. Comparison of TCSS scores. Note: TCSS: Toronto clinical scoring system.

studies with negative results in small samples, variations in treatment methods and frequency in the intervention group, or differences in methodological quality across studies. These sources of bias can be summarized as publication age bias, implementation bias, and others, which warrant further investigation.

Chinese Tuina therapy significantly improves TCSS scores

In this study, 4 articles [25-27, 39] reported on the effects of Chinese Tuina therapy on TCSS scores in treating DPN. A heterogeneity test indicated statistically significant heterogeneity among the selected studies (I^2 = 59%, P = 0.06), making it necessary to investigate the source of this heterogeneity. Sensitivity analysis revealed that Zheng et al., 2017 [39] had a substantial impact on the heterogeneity. After removing this article, the remaining 3 studies were tested again, and the results showed no significant heterogeneity (I^2 = 0%, P = 0.86), allowing the use of a fixed-effect model for the meta-analysis. To explore further the possible sources of heterogeneity, all studies in this group were analyzed. Among them, Zheng et al., 2017 [39] had a higher frequency of interventions compared to other trials, suggesting that intervention frequency may contribute to the heterogeneity. A total of 180 patients were included across the 3 studies, with 90 patients in each group (experimental and control). The difference in TCSS scores between the two groups after treatment was significant (MD = -1.08, 95% CI [-1.50, -0.66], Z = 5.04, P < 0.05), indicating that the Chinese Tuina group was superior to the control group in improving TCSS scores, as shown in **Figure 6**.

Chinese Tuina therapy significantly enhances MNCV of the common peroneal nerve

In this study, 6 articles [23, 25, 29, 31, 32, 38] examined the effects of Chinese Tuina on

MNCV. A heterogeneity test indicated significant heterogeneity among the articles (I^2 = 85%, P < 0.1), warranting investigation into the sources of heterogeneity. Sensitivity analysis of the 6 articles revealed that Shang et al., 2005 [31] had a substantial impact on heterogeneity. When this article was excluded, the remaining 5 articles were re-tested, showing minimal heterogeneity (I^2 = 17%, P = 0.30), allowing the use of a fixed-effect model for meta-analysis. To fexplore potential sources of heterogeneity, we analyzed the results within this group and found that in Shang et al., 2005 [31], the frequency and duration of interventions varied daily. This suggests that differences in the frequency and duration of Chinese Tuina therapy may contribute to the observed heterogeneity.

Five articles were ultimately included, with a total of 298 patients, 149 in each group (experimental and control). The results showed a significant difference between the two groups (MD = 3.35, 95% CI [2.38, 4.32], Z = 6.77, P < 0.05), indicating that the Chinese Tuina group was superior to the control group for improving MNCV. Details are provided in **Figure 7**.

Chinese Tuina therapy significantly enhances sural nerve SNCV

In this study, three references [23, 32, 38] examined the effects of Chinese Tuina on the SNCV of the sural nerve. The heterogeneity test results indicated no significant heterogeneity (I^2 = 0%, P = 0.37), allowing the use of a fixed-effect model for meta-analysis. The total sample size across the three studies was 178 cases, with 89 cases in both the experimental and control groups. The results showed a significant difference (MD = 3.77, 95% CI [2.16, 5.38], Z = 4.59, P < 0.05), suggesting that the Chinese Tuina group was superior to the control group for improving the SNCV of the sural nerve. Details are provided in **Figure 8**.
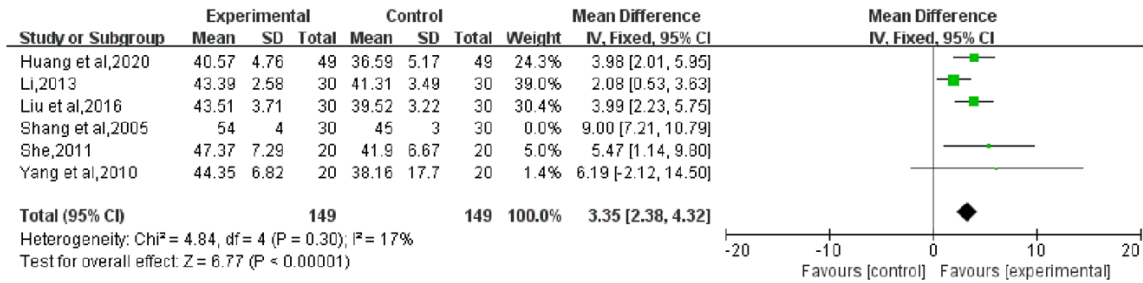
Figure 7. Comparison of MNCV of common peroneal nerve. Note: MNCV: Motor nerve conduction velocities.
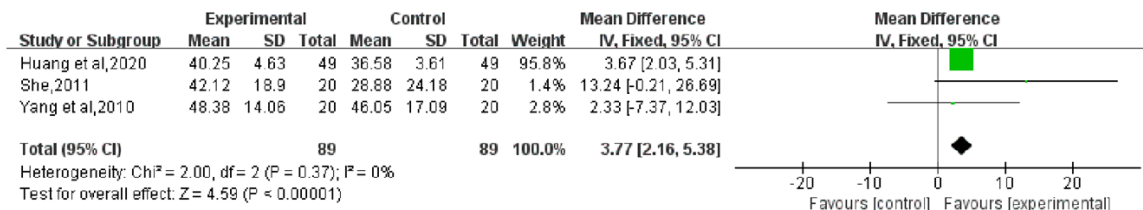

Figure 8. Comparison of SNCV of sural nerve. Note: SNCV: Sensory nerve conduction velocities.
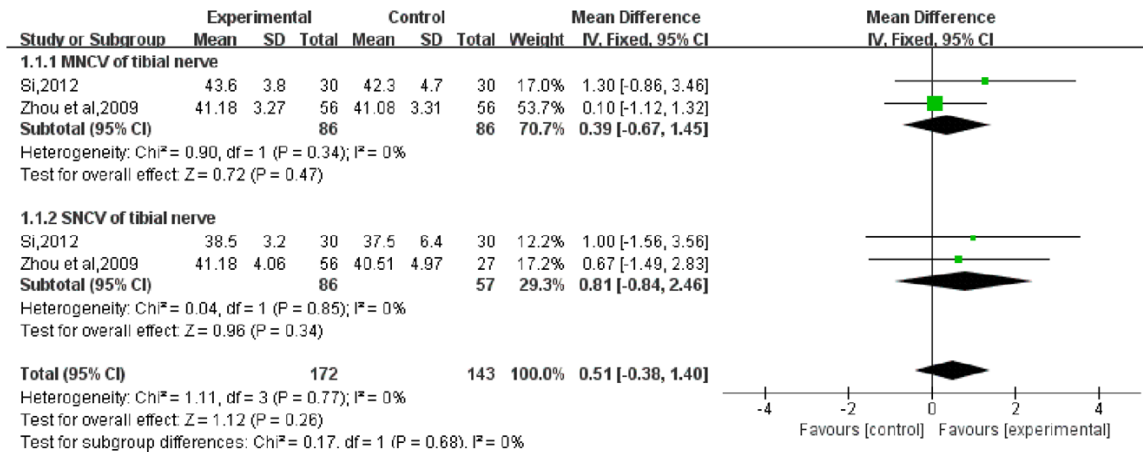

Figure 9. Comparison of NCV of tibial nerve. Note: NCV: Nerve conduction velocities.

Chinese Tuina shows no significant effect on tibial nerve NCV

In this study, two articles [33, 40] examined the effects of Chinese Tuina on NCV, with a total sample size of 143 participants, including 86 in the experimental group and 57 in the control group. A fixed-effect model was used as the heterogeneity test result was not statistically significant (I^2 = 0%, P = 0.73). Additionally, a subgroup analysis was conducted for the SNCV and MNCV of the tibial nerve. The differences between the two groups were not significant (MNCV: MD = 0.39, 95% CI [-0.67, 1.45], Z =

0.72, P > 0.05; SNCV: MD = 0.81, 95% CI [-0.84, 2.46], Z = 0.96, P > 0.05), indicating that Chinese Tuina did not show a significant advantage for improving MNCV or SNCV of the tibial nerve. Details are provided in **Figure 9**.

No significant effect of Chinese Tuina on median nerve SNCV and MNCV

Three articles [25, 32, 38] investigated the effects of Chinese Tuina on the SNCV of the median nerve. The total sample size was 140, with 70 patients in the Chinese Tuina treatment group and 70 in the control group. The hetero-
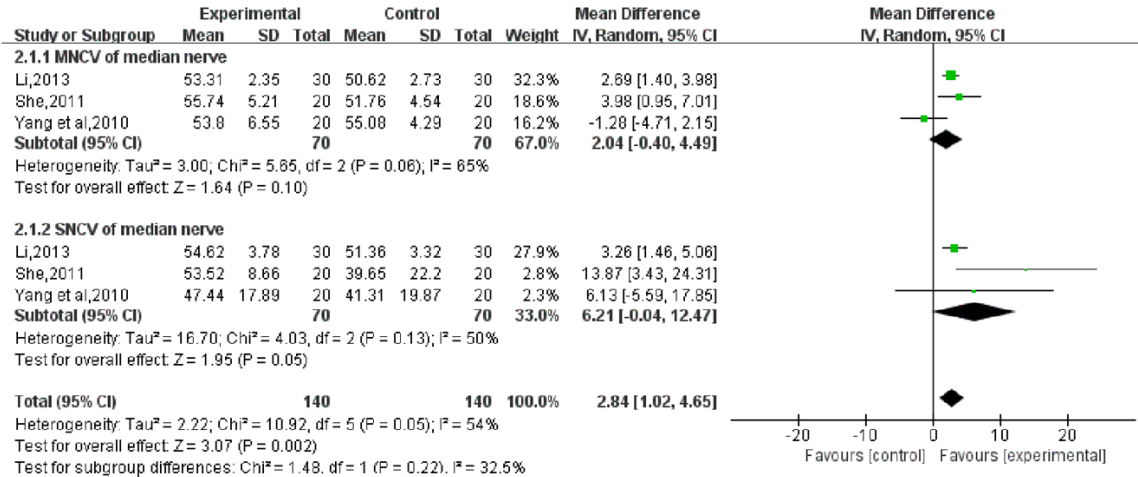
Figure 10. Comparison of NCV of median nerve. Note: NCV: Nerve conduction velocities.
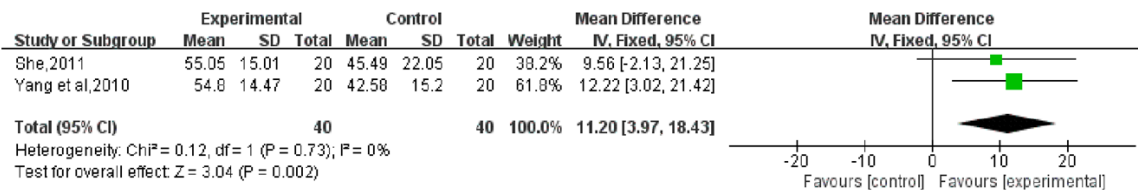

Figure 11. Comparison of SNCV of ulnar nerve. Note: SNCV: Sensory nerve conduction velocities.

geneity test indicated statistically significant heterogeneity (I^2 = 54%, P = 0.05), and a fixed-effects model was adopted due to acceptable heterogeneity. Additionally, a subgroup analysis was performed for the SNCV and MNCV of the median nerve. The results showed no significant differences (MNCV: MD = 2.04, 95% CI [-0.40, 4.49], Z = 1.64, P = 0.10; SNCV: MD = 6.21, 95% CI [-0.04, 12.47], Z = 1.95, P = 0.05), so that Chinese Tuina did not show a significant advantage over the control group for improving SNCV or MNCV of the median nerve. Details are provided in **Figure 10**.

Chinese Tuina therapy significantly improves ulnar nerve SNCV

According to the heterogeneity test in this study (I^2 = 0%, P = 0.73), no statistical heterogeneity was observed between the two articles [32, 38]; therefore, a fixed-effect model was used. A total of 80 cases were included, with 40 in the experimental group and 40 in the control group. The difference was significant (MD = 11.20, 95% CI [3.97, 18.43], Z = 3.04, P < 0.05), suggesting that the Chinese Tuina group was supe-

rior to the control group for improving the SNCV of the ulnar nerve. See **Figure 11** for details.

Low incidence of reported adverse events in Chinese Tuina trials

No adverse events were reported in five trials [25, 26, 30, 33, 39], while the remaining studies did not report whether any adverse events occurred.

Discussion

Chinese Tuina therapy is a traditional external treatment in traditional Chinese medicine (TCM) [43]. Known for its simple application, low cost, clear therapeutic effects, and minimal side effects, it has been practiced for thousands of years in China. Before the Ming Dynasty, Tuina was often referred to as "massage", and today the terms are used interchangeably in Chinese academic circles. The main theoretical foundations of Chinese Tuina are meridians and acupoints. Through syndrome differentiation, targeted acupoint selection, and treatment, Chinese Tuina can help to clear meridians, improve circulation, and regu-

Table 2. Acupoints used in the included RCTs

Acupoint	RCT
Zusanli (ST 36)	17
Sanyinjiao (SP 6)	15
Taixi (KI 3)	10
Quchi (LI 11)	8
Yongquan (KI 1)	8
Chengshan (BL 57)	7
Weizhong (BL 40)	7
Yanglingquan (GB 34)	6
Taichong (LR 2)	6
Hegu (LI 4)	5
Neiguan (PC 6)	5
Laogong (PC 6)	4
Waiguan (TE 5)	4
Yinlingquan (SP 9)	4
Feishu (BL 13)	3
Houxi (SI 3)	3

Note: RCT: Randomized controlled trial.

late qi and blood flow. In TCM, the primary syndrome of DPN is considered "phlegm and blood stagnation obstructing the collaterals". Qi and blood stagnation in the limbs can lead to pain, numbness, restricted movement, and other symptoms. Chinese Tuina can improve microcirculation and reduce inflammation by stimulating meridians, acupoints, and response areas. Like other external therapies, Chinese Tuina is a non-invasive method that can be administered by clinicians or practiced by patients themselves, promoting better compliance. Although Chinese Tuina therapy has broad applications and certain advantages, it also has contraindications. For patients with diabetic neuropathy and lower extremity arterial thrombosis, Chinese Tuina should be avoided to prevent complications. Therefore, clinical use of Chinese Tuina therapy should remain within its indications.

In the present study, we included a total of 24 RCTs on DPN with 48 acupoints, 16 of which were used three or more times, as shown in **Table 2**. Additionally, five studies [20, 23, 30, 39, 42] used acupoint Tuina combined with meridian patting. The main patting sites included the spleen, stomach, liver, gallbladder, kidney, and bladder, accessed through the lower limb circulation. Two articles [32, 38] selected foot reflexology regions as Tuina sites, which were regarded as generalized ashi points. Only

one study used a positive and negative instrument with a Tuina function, but the specific sites were not reported. It is notable that the 24 RCTs applied acupoints not only on the limbs but also on the abdomen (e.g., Zhongwan [CV 12], Guanyuan [CV 4], Qihai [CV 6]) and back (e.g., Feishu [BL 13], Pishu [BL 20], Weiwanxiashu [EX-B 3]) for Chinese Tuina therapy. This approach reflects the regulatory effect of abdominal and back acupoints on both local and systemic levels, aiming to treat both symptoms and underlying causes by harmonizing the viscera, meridians, qi, and blood. Among the 24 RCTs, three trials [19, 28, 31] used machines to simulate manipulative therapy, while the remaining trials relied on manual manipulation by physicians or nurses. In the present study, 16 different types of Tuina technique were used, with 13 studies employing two or more types, as shown in **Table 3**.

This meta-analysis included 24 RCTs with a total of 1,989 participants, aiming to provide high-quality evidence on the clinical safety and efficacy of Chinese Tuina for DPN. Clinically, the total effective rate is defined as the sum of the effective rate and markedly effective rate. Analysis of 20 trials indicated that the total effective rate of Chinese Tuina for DPN was significantly higher than that of the control group, based on symptomatic and supportive care. The TCSS score, which has high diagnostic value for DPN, is widely used in epidemiologic screening and comprises a neurological symptom score, neurological reflex score, and sensory function score. Clinicians use the TCSS score to diagnose the extent and severity of DPN [44, 45]. In this study, three trials showed that Chinese Tuina therapy significantly improved the TCSS score compared to conventional treatment.

NCV has substantial clinical value in diagnosing and assessing DPN and is regarded as the gold standard [46]. Due to its strong objectivity, high sensitivity, accurate repeatability, and quantification, NCV can reliably and sensitively reflect the clinical effects of DPN treatments [47, 48]. First, the results of five trials showed that the improvement in MNCV of the common peroneal nerve was significantly better in the Chinese Tuina group than in the control group. Second, three trials indicated that the SNCV of the sural nerve showed better results in the Chinese Tuina group than in the control group. Third, in

Table 3. Types of Chinese Tuina techniques used in the included RCTs

Type of Chinese Tuina Technique	RCT
Kneading Manipulation (Roufa)	5
Pressing Manipulation (Anyafa)	5
Patting Manipulation (Paidafa)	5
Pushing Manipulation (Tuifa)	3
Digital-pressing Manipulation (Dianfa)	2
Pressing Manipulation (Anfa)	2
Palm-twisting Manipulation (Cuofa)	2
Circular Rubbing Manipulation (Mofa)	2
Knocking Manipulation (Jifa)	2
Pushing Manipulation with One-finger (Yizhichan Tuifa)	2

Note: RCT: Randomized controlled trial.

four trials, the Chinese Tuina group demonstrated significant improvement in the SNCV of the ulnar nerve compared to the control group. Fourth, it was inconclusive whether the Chinese Tuina group was superior to the control group in improving the MNCV and SNCV of the tibial nerve. Fifth, three trials showed that the Chinese Tuina group was more effective than the control group in improving the MNCV and SNCV of the median nerve. However, for the SNCV and MNCV of the median and tibial nerves, the small number of studies and patients included means it is not conclusive that Chinese Tuina therapy has a strong therapeutic effect on DPN. Large-sample, multi-center, high-quality RCTs are needed to provide more evidence in the future.

In conclusion, Chinese Tuina therapy, when combined with routine treatment, offers certain advantages for DPN. Thus, Chinese Tuina therapy is a valuable complementary and alternative therapeutic option for DPN and warrants further clinical application.

Limitations

This review had several limitations. (1) Due to the limited existing literature, the sample size was small. Although the control group received treatment with western medicine and routine care, while the treatment group included Chinese Tuina, the manipulations for DPN treatment were not entirely consistent. (2) Only Chinese and English publications were retrieved, and all included studies were from Chinese databases, potentially introducing publication bias. (3) Although randomization was mentioned in most studies, only three provided specific details about the randomization methods. Generally, the low methodologic quality of the trials may introduce a non-negligible risk of bias. (4) None of the included studies explicitly mentioned blinding, allocation concealment, follow-up, or dropout indicators, suggesting a low overall quality of the literature. (5) There is no uniform international standard for defining total clinical effective rate; the evaluation was based on guiding principles for clinical research of new Chinese medicine [17]. However, this evaluation may introduce some subjectivity and variability, affecting the accuracy and reliability of the results. (6) Chinese Tuina varies in manipulation type, sites, frequency of intervention, and treatment courses, all of which may influence the research outcome.

Conclusion

A systematic review and meta-analysis demonstrated that Chinese Tuina therapy may be a safe and effective treatment option for DPN. For total effective rate, Chinese Tuina therapy showed improvement over routine treatment, suggesting benefits in overall symptom relief. In terms of TCSS scores, Tuina therapy led to notable improvements, indicating enhanced management of neurological symptoms associated with DPN. Regarding NCV, Tuina therapy significantly improved MNCV in the common peroneal nerve, and SNCV in the sural and ulnar nerves, while no significant improvements were observed in the tibial and median nerves. Future clinical trials warrant exploration with an expanded sample size to investigate the effects of Chinese Tuina therapy on the NCV of various peripheral nerves, including the tibial and median nerves, in patients with DPN.

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Disclosure of conflict of interest

None.

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