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Review

Effect of acupuncture at ST36 and SP6 on pain management in osteoarthritis: A systematic review of randomized controlled trials and meta-analysis

[Efecto de la acupuntura en ST36 y SP6 en el manejo del dolor en la osteoartritis: una revisión sistemática de ensayos controlados aleatorios y metanálisis]

Mayang Wulandari[1,2], Kusworini Handono[3,6*], Husnul Khotimah[4], Laily Yuliatun[5]

[1]Doctoral Program in Medical Sciences, Faculty of Medicine, Universitas Brawijaya, Malang, Indonesia.
[2]Acupuncture Study Program, Institute of Science and Health Technology, Dr. Soepraoen Hospital, Malang, Indonesia.
[3]Department of Clinical Pathology, Faculty of Medicine, Universitas Brawijaya, Malang, Indonesia.
[4]Department of Pharmacology, Faculty of Medicine, Universitas Brawijaya, Malang, Indonesia.
[5]Nursing Department, Faculty of Health Sciences, Universitas Brawijaya, Malang, Indonesia.
[6]Dr. Saiful Anwar General Hospital, Malang, Indonesia.
*E-mail: rinihandono.fk@ub.ac.id

Abstract

Context: Osteoarthritis is a prevalent joint disorder that significantly impairs mobility and quality of life, particularly among older adults. Acupuncture, especially at the ST36 and SP6 acupoints, has been increasingly utilized for symptom relief due to its minimal side effects, although the strength of evidence regarding its specific effectiveness remains uncertain.

Aims: To evaluate the current evidence from randomized controlled trials on the clinical outcomes of acupuncture targeting the ST36 and/or SP6 acupoints in adults with osteoarthritis.

Methods: The review was registered in PROSPERO (CRD420251035560). Randomized controlled trials published in the past ten years were identified, screened independently, and assessed for bias using the RoB 2 tool. Meta-analysis was performed for pain (VAS) and functional (WOMAC) outcomes after treatment, while other data were narratively synthesized.

Results: Eight trials involving 465 participants aged 38–75 years were included. The pooled analysis of post-intervention VAS scores from three studies showed no significant difference between acupuncture and controls (SMD = 1.35; 95% CI: −0.38 to 3.08; p = 0.13; I^2 = 96%). Similarly, WOMAC scores from four studies indicated a non-significant pooled effect (SMD = −0.76; 95% CI: −2.09 to 0.56; p = 0.26; I^2 = 95%). Despite heterogeneity, individual studies reported clinically relevant improvements in pain and function, favoring acupuncture. Adverse events were rarely reported, indicating a favorable safety profile.

Conclusions: Acupuncture at ST36 and SP6 shows potential benefits for pain and function in osteoarthritis with good tolerability. Although pooled effects were not statistically significant, consistent positive trends warrant further standardized, high-quality trials.

Keywords: acupoints; acupuncture; electroacupuncture; osteoarthritis; systematic review; Zusanli; Sanyinjiao.

Resumen

Contexto: La osteoartritis es un trastorno articular prevalente que afecta significativamente la movilidad y la calidad de vida, especialmente en adultos mayores. La acupuntura, especialmente en los puntos ST36 y SP6, se ha utilizado cada vez más para aliviar los síntomas debido a sus mínimos efectos secundarios, aunque la solidez de la evidencia sobre su eficacia específica sigue siendo incierta.

Objetivos: Evaluar la evidencia actual de ensayos aleatorizados y controlados sobre los resultados clínicos de la acupuntura dirigida a los puntos ST36 y/o SP6 en adultos con osteoartritis.

Métodos: La revisión se registró en PROSPERO (CRD420251035560). Se identificaron ensayos aleatorizados y controlados publicados en los últimos diez años, se analizaron de forma independiente y se evaluó su sesgo mediante la herramienta RoB 2. Se realizó un metanálisis de los resultados de dolor (EVA) y de los de funcionamiento (WOMAC) después del tratamiento, mientras que otros datos se sintetizaron de forma narrativa.

Resultados: Se incluyeron ocho ensayos con 465 participantes de entre 38 y 75 años. El análisis agrupado de las puntuaciones VAS posteriores a la intervención en tres estudios no mostró diferencias significativas entre la acupuntura y los controles (DME = 1,35; IC del 95 %: −0,38 a 3,08; p = 0,13; I^2 = 96 %). De igual forma, las puntuaciones de WOMAC de cuatro estudios indicaron un efecto agrupado no significativo (DME = −0,76; IC del 95 %: −2,09 a 0,56; p = 0,26; I^2 = 95 %). A pesar de la heterogeneidad, los estudios individuales reportaron mejoras clínicamente relevantes en el dolor y la función, a favor de la acupuntura. Los eventos adversos se reportaron con escasas frecuencias, lo que indica un perfil de seguridad favorable.

Conclusiones: La acupuntura en ST36 y SP6 muestra beneficios potenciales para el dolor y la función en la osteoartritis con buena tolerabilidad. Aunque los efectos agrupados no fueron estadísticamente significativos, las tendencias positivas consistentes justifican la realización de más ensayos estandarizados de alta calidad.

Palabras Clave: acupuntura; electroacupuntura; osteoartritis; puntos de acupuntura; revisión sistemática; Sanyinjiao; Zusanli.

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AUTHOR INFO
ORCID: 0009-0009-1923-2497 (MW) 0000-0002-2374-4358 (HK)
0009-0005-3062-3473 (KH) 0000-0002-8642-9339 (LY)

Abbreviations: CI: Confidence interval; IL-1β: Interleukin-1 beta; IL-6: Interleukin-6; MIA: Monosodium iodoacetate; MMP-13: Matrix metalloproteinase-13; OA: Osteoarthritis; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT: Randomized Controlled Trial; RoB: Risk of Bias; SD: Standard deviation; SMD: Standardized mean difference; SP6: Sanyinjiao; ST36: Zusanli; VAS: Visual Analogue Scale; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disorder characterized by cartilage degradation and excessive subchondral bone formation, leading to a localized inflammatory response (Carstairs & Genever, 2014). It is the most prevalent chronic joint disease associated with aging, and no definitive pharmacological therapy has yet been established to halt its progression (O'Neill & Felson, 2018). The knee is the most frequently affected joint, with pain as the predominant symptom, often accompanied by stiffness and limited mobility. OA primarily affects the elderly, frequently resulting in functional impairment and increased healthcare costs. In advanced stages, joint replacement surgery is often required (Hunter et al., 2014). Globally, knee OA affects approximately 16% of the population (Cui et al., 2020), and the number of cases has increased by 113.25%, from 247.51 million in 1990 to 527.81 million in 2019 (Long et al., 2022). In Indonesia, OA remains a major musculoskeletal health concern, with a similar rising trend over recent decades. Notably, a growing prevalence has also been observed among younger individuals (Butarbutar et al., 2024). These findings underscore the urgent need for effective strategies to prevent, early diagnose, and manage disease at both global and national levels.

Various therapeutic strategies have been developed to manage OA-related pain, including lifestyle modifications, adjustments in physical activity, and pharmacological options such as non-steroidal anti-inflammatory drugs (NSAIDs), as well as non-pharmacological alternatives to joint replacement surgery (Cotter et al., 2020). Among these, acupuncture is widely used for OA management, particularly knee OA, due to its potential to provide long-term pain relief and improve joint function (Hinman et al., 2014; Kloppenburg & Berenbaum, 2020; Sharma, 2021). Acupuncture is believed to restore the balance of Qi and blood, which, in traditional Chinese medicine, represents the flow of vital energy and circulatory function; from a scientific perspective, this may correspond to measurable effects such as modulation of inflammatory markers and improvements in pain and joint function (Luo et al., 2023). ST36 (Zusanli) and SP6 (Sanyinjiao) are the primary acupuncture points used in the treatment of knee OA. ST36, located on the Stomach Channel of Foot-Yangming, exhibits anti-inflammatory activity and has been shown to downregulate proinflammatory cytokines in adjuvant-induced arthritis models (Torres-Rosas et al., 2014; Xu et al., 2018). SP6, situated medially about four finger-widths above the ankle, serves as a general tonification point and has demonstrated anti-inflammatory and analgesic effects in knee OA (Klajing et al., 2023). A systematic review also identified acupuncture as one of the most effective physical therapies for reducing knee pain in patients with OA (Luo et al., 2023).

Although multiple reviews have explored acupuncture for OA management, none have specifically examined the therapeutic effects of the ST36 (Zusanli) and SP6 (Sanyinjiao) acupoints within randomized controlled trials (RCTs). This systematic review provides the first focused synthesis of RCT evidence on acupuncture at these points, addressing a gap in the current literature. The analysis evaluates clinical outcomes, including pain relief, functional improvement, and quality of life in adult patients with OA treated at ST36 and/or SP6. By emphasizing acupoint-specific efficacy rather than general acupuncture outcomes, this review offers a novel, targeted perspective that may help refine future clinical practice and research design.

MATERIAL AND METHODS

Review methodology

This review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD420251035560. This study employed a systematic review approach to evaluate the effectiveness of acupuncture interventions, with a particular focus on the ST36 and SP6 acupoints in patients with osteoarthritis. This systematic review was conducted in accordance with the PRISMA 2020 guidelines and structured according to the PICO framework, as shown in Table 1.

Table 1. Description of PICO.

Population	Adults (≥18 years) diagnosed with osteoarthritis, regardless of sex or geographic background.
Intervention	Acupuncture using ST36 and/or SP6 (manual or electroacupuncture), provided by qualified practitioners.
Comparison	Sham/placebo acupuncture, no treatment, or conventional therapy (e.g., NSAIDs, physical therapy).
Outcome	Pain reduction and improvement in physical function.

Eligibility criteria

This review included studies published between 2015 and 2025 that met the predefined eligibility criteria. The review focused on RCTs involving adult participants aged 18 years or older who have been clinically diagnosed with osteoarthritis. Eligible studies evaluated acupuncture interventions specifically targeting the ST36 (Zusanli) and/or SP6 (Sanyinjiao) acupoints. Comparators included sham acupuncture, no treatment, or conventional therapies such as nonsteroidal anti-inflammatory drugs or physiotherapy.

To minimize methodological and clinical heterogeneity, only studies that clearly reported treatment frequency, session duration, and total intervention period were included. The primary analysis focused on post-intervention outcomes assessed approximately eight weeks after acupuncture treatment, as this time frame reflects the typical duration of therapeutic response in osteoarthritis. Studies with different intervention durations or assessment points were analyzed separately or narratively to maintain consistency across comparisons. Studies involving multi-acupoint protocols were included only if ST36 and/or SP6 were explicitly defined as the principal acupoints, and the contribution of additional points was clearly documented. This criterion ensures that the therapeutic effects can be reasonably attributed to ST36/SP6 stimulation while allowing for clinical relevance in typical acupuncture practice. Where appropriate, sensitivity or subgroup analyses were applied to address potential confounding arising from auxiliary acupoints.

The review considered outcomes related to pain reduction, improvement in physical function, joint mobility, and overall quality of life. Only studies published in English and available in full text were included. Studies were excluded if they were not randomized controlled trials, such as observational studies, case reports, or literature reviews. Research that did not involve the ST36 or SP6 points, or that was conducted on animals or in laboratory settings, was also excluded. Articles that were not available in English or lacked full-text access were not included. Additionally, studies focusing on preventive acupuncture or those in which the specific effects of acupuncture could not be clearly distinguished from other interventions were excluded. This review included studies conducted in any healthcare or clinical setting, including hospitals, outpatient clinics, or rehabilitation centers, that used acupuncture therapeutically for osteoarthritis in adults.

Information sources

Relevant studies were identified through a systematic search of the following electronic databases: PubMed, ScienceDirect, BioMed Central (BMC), Google Scholar, and the Cochrane Library. The search included articles published within the last ten years, from January 2015 to March 2025. All searches were completed between March 1 and April 1, 2025. This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency and rigor in the identification and selection of relevant studies.

Search strategy

The articles selected for this review were highly relevant to the research topic, identified through a comprehensive search using titles, abstracts, and keywords from publications within the last ten years (2015–2025) in PubMed, ScienceDirect, BioMed Central (BMC), Google Scholar and Cochrane Library databases. The search was refined using the Boolean operator combination: ("acupuncture" OR "electroacupuncture") AND ("ST36" OR "Zusanli") AND ("SP6" OR "Sanyinjiao") AND ("osteoarthritis") AND ("randomized controlled trial" OR "RCT") AND ("pain" OR "physical function"), ensuring a focused and thorough selection of studies related to the effectiveness of acupuncture in osteoarthritis.

Selection process

The article screening process was conducted by at least two people in two stages. The first stage involved screening the title and abstract, followed by confirming that the full text was available. This step was carried out using the Zotero reference manager software to filter out duplicate articles. In the second stage, the full text of the articles was reviewed in detail to assess their alignment with the inclusion or exclusion criteria. Any disagreements between reviewers during either stage of the screening were resolved through discussion or, if necessary, consultation with a third reviewer. The screening and selection process was documented and presented using the PRISMA flow diagram, which showed the number of studies identified, screened, excluded, and included in the final review (Fig. 1).

Data collection and synthesis process

Two reviewers independently screened the articles and extracted data using a standardized form to ensure consistency and accuracy. The extracted information included the author(s), publication year, and country of origin, as well as the sample size, participant characteristics, and the location and severity of osteoarthritis. Intervention details, including the specific acupuncture points used, treatment frequency, and duration, were collected, along with information on the comparison group and its characteristics. Outcome measures and corresponding results were gathered to

evaluate the effectiveness of the interventions. The risk of bias for each study was assessed systematically. To ensure inter-rater reliability, agreement between reviewers was evaluated using Cohen's kappa coefficient. Any discrepancies between reviewers were resolved through discussion or, when necessary, by consulting a third reviewer.

A quantitative synthesis (meta-analysis) was performed for pain and functional outcomes consistently reported across studies, specifically the Visual Analogue Scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Effect sizes were pooled using either a fixed-effect or random-effects model, depending on the degree of heterogeneity (I^2 statistic). Forest plots were used to present the pooled mean differences with 95% confidence intervals. To minimize heterogeneity among acupuncture protocols, only post-intervention outcomes (typically around eight weeks following treatment initiation) were included in the pooled analysis, ensuring comparability of overall treatment effects across studies. Other outcomes, including biomarkers, mobility measures, and quality-of-life scores, were synthesized narratively due to variations in measurement tools and reporting formats. This approach enabled a comprehensive yet methodologically transparent interpretation of the findings. The certainty of evidence for each main outcome (VAS and WOMAC) was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach, which considers five domains: risk of bias, inconsistency, indirectness, imprecision, and publication bias.

Data items (outcomes)

The extracted data items from the included studies encompassed details such as study population characteristics (age, sex, sample size, affected joints, and duration of osteoarthritis), intervention details including the type of acupuncture (manual or electroacupuncture), specific points used (ST36 and/or SP6), frequency and duration of sessions, total treatment period, and practitioner qualifications. Information on the type of comparator was also collected, such as sham or placebo acupuncture, no treatment, or conventional therapies like NSAIDs or physical therapy. Study design elements, including randomization methods, blinding, and follow-up duration, were documented, along with outcome measures focused on pain reduction and improvement in physical function, assessed using tools such as the VAS, Numeric Rating Scale (NRS), WOMAC, or SF-36. Data on adverse events, statistical significance of the findings, funding sources, and any reported conflicts of interest were also extracted. The primary objective of this systematic review was to evaluate the efficacy and safety of acupuncture at ST36 and/or SP6 in adults with osteoarthritis, with particular attention to outcomes related to pain relief and functional improvement.

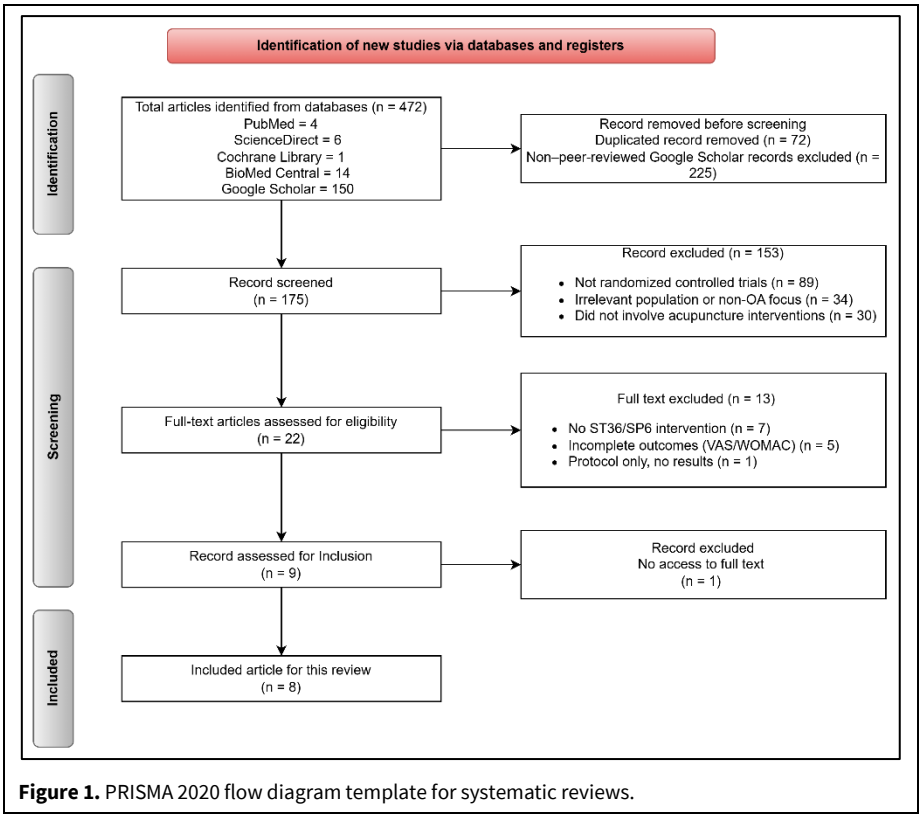

Figure 1. PRISMA 2020 flow diagram template for systematic reviews.

Study of risk of bias assessment

In the quality appraisal section, the risk of bias for each included study was assessed using the Cochrane Risk of Bias 2.0 (RoB 2.0) tool, which was designed specifically for RCTs. This tool was evaluated for various factors that may introduce bias, including randomization, allocation concealment, blinding, incomplete data, selective reporting, and other potential sources of bias. The goal was to systematically assess the methodological quality of the studies and determine the risk of bias in their findings. Publication bias was planned to be assessed through visual inspection of funnel plots if ≥10 studies were available for a given outcome. However, because fewer than ten studies contributed data to the meta-analyses of VAS and WOMAC, formal assessment of publication bias was not feasible. Potential reporting bias was therefore qualitatively discussed based on study characteristics and selective outcome reporting.

RESULTS

Study characteristics

A total of 472 records were identified across five databases, including PubMed, ScienceDirect, Cochrane Library, BioMed Central, and Google Scholar. After removing duplicates and non–peer-reviewed records from Google Scholar, 175 studies remained for screening. Following title and abstract review, 22 full-text articles were assessed for eligibility. Fourteen studies were excluded due to the absence of ST36/SP6 interventions (n = 7), incomplete or irrelevant outcomes (n = 5), or being study protocols without reported results (n = 2). Ultimately, eight randomized controlled trials fulfilled all inclusion criteria and were included in the final synthesis. Inter-rater reliability showed substantial agreement (Cohen's κ = 0.76). The PRISMA 2020 flow diagram (Fig. 1) illustrates the selection process. This systematic review analyzed eight RCTs published from 2015 to 2025, mostly carried out in China (six studies) by (Jia et al., 2020; Jiang et al., 2025; Lin et al., 2020; Shi et al., 2020; Sun et al., 2016; Wang et al., 2020), with one each from Indonesia (Helianthi et al., 2016) and Turkey (Atalay et al., 2021). The sample sizes ranged from 30 to 100 participants, totaling 465 adults diagnosed with osteoarthritis. Participants' ages ranged from 38 to 75 years, with most falling within the 45-75 age bracket. Both genders were represented in all included studies. All the research includes acupuncture at the ST36 (Zusanli) and/or SP6 (Sanyinjiao) points. The interventions were evenly split between manual acupuncture and electroacupuncture, each applied in four studies. Treatment courses lasted 4 to 8 weeks, with frequency ranging from 1 to 3 sessions per week. Control groups received sham acupuncture in five studies, physiotherapy in one study (Atalay et al., 2021), ankle training using an elastic band in one study (Jiang et al., 2025), and electroacupuncture in one study (Lin et al., 2020).

The main outcomes assessed were pain reduction and improvement in physical function, measured using validated scales, including the VAS and the WOMAC. Additionally, one study using the Timed Up and Go Test assessed outcomes (Wang et al., 2020). Other outcomes also reported in some trials involved quality of life, patient global assessment, and adverse event monitoring. A comprehensive overview of the included studies' characteristics is shown in Table 2.

Table 2. Baseline demographic characteristics of participants in the eight included studies.

Study (year)	Country	Sample size (n)	Mean age (years)		BMI (kg/m^2)		OA grade (n)	
			Intervention	Control	Intervention	Control	Intervention	Control
(Atalay et al., 2021)	Turkey	100	57.82	57.18	33.54	31.26	Grade 2 (28) Grade 3 (22)	Grade 2 (26) Grade 3 (22)
(Helianthi et al., 2016)	Indonesia	59	69	68	25.8	26.3	Grade 2 (14) Grade 3 (16)	Grade 2 (9) Grade 3 (14)
(Jia et al., 2020)	China	36	54	59.5	23.3	23.14	Grade 1 (10) Grade 2 (6) Grade 3 (1)	Grade 1 (7) Grade 2 (7) Grade 3 (4)
(Jiang et al., 2025)	China	73	67.73	67.22	24.73	24.49	Grade 1 Grade 2	Grade 1 Grade 2
(Lin et al., 2020)	China	60	61.5	62.5	25.4	25.8	Grade 2 Grade 3	Grade 2 Grade 3
(Shi et al., 2020)	China	58	58.89		25.12		Grade 2 Grade 3	Grade 2 Grade 3
(Sun et al., 2016)	China	42	59.5	60	24.2	24.6	Grade 2 Grade 3	Grade 2 Grade 3
(Wang et al., 2020)	China	30	63.5	65.2	24.2	26	Grade 2 (7) Grade 3 (8)	Grade 2 (7) Grade 3 (8)

Table 3. Risk of bias assessment using Cochrane risk of bias tools.

Study (year)	Randomization process	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selective reporting	Overall risk of bias
(Atalay et al., 2021)	Low risk	Low risk	Low risk	Some concern	Low risk	Some concern
(Helianthi et al., 2016)	Low risk	Some concern	Low risk	Low risk	Low risk	Low risk
(Jia et al., 2020)	Low risk	Some concern	Some concern	Low risk	Low risk	Some concern
(Jiang et al., 2025)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Lin et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
(Shi et al., 2020)	Low risk	Some concern	Low risk	Low risk	Low risk	Some concern
(Sun et al., 2016)	Low risk	Low risk	Some concern	Low risk	Low risk	Some concern
(Wang et al., 2020)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

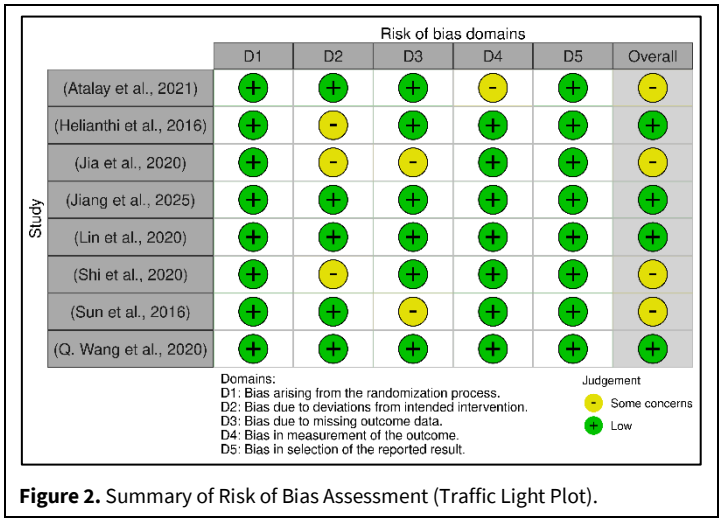

Figure 2. Summary of Risk of Bias Assessment (Traffic Light Plot).

Risk of bias in studies

In this systematic review, eight articles were thoroughly assessed for risk of bias using the RoB 2 tool. Four of these studies were judged to have a low risk of bias, reflecting strong methodological quality. The other four studies raised some concerns, mainly due to difficulties in blinding participants and acupuncturists, which are often unavoidable in acupuncture research, given its hands-on nature. Additionally, participant dropouts during the studies led to changes in the data analysis. Although this could potentially introduce bias, the studies reported that these missing data did not have a significant impact on the results. Overall, these findings highlight the challenges in conducting acupuncture trials but still support the reliability of the evidence. Complete data from the risk of bias assessment are presented in Table 3 and Fig. 2, providing a detailed overview of the evaluation across all included studies.

Results of individual studies

Following a quality appraisal based on the PRISMA 2020 checklist, eight randomized controlled trials were deemed eligible for inclusion in the final systematic review (Table 4). These studies offered high-relevance evidence on the therapeutic effects of acupuncture targeting ST36 and/or SP6 in improving pain outcomes and physical function among adults with osteoarthritis, contributing valuable insights to the current body of clinical knowledge.

Results of meta-analysis

A meta-analysis was conducted using three randomized controlled trials (Atalay et al., 2021; Helianthi et al., 2016; Sun et al., 2016) that reported post-intervention pain scores measured by the VAS. The pooled standardized mean difference (SMD) was 1.35 [95% CI: –0.38 to 3.08; p = 0.13], indicating that although the acupuncture group showed a tendency toward greater pain reduction compared to controls, this difference was not statistically significant. Substantial heterogeneity was observed among the included studies (I^2 = 96%, p<0.00001), suggesting considerable variability in treatment effects. This heterogeneity may be due to differences in study design, acupuncture protocols (manual vs. electroacupuncture), treatment duration, or comparator types.

Table 4. Summary of included RCT study on Acupuncture for osteoarthritis using ST36 and SP6 acupoints.

Study (year)	Country	Sample size	Age range (years)	Intervention type	Treatment duration	Comparator	Outcome
(Atalay et al., 2021)	Turkey	100	38–80	Acupuncture in 13 locals points were GB34, SP10, SP9, ST36, ST35, ST34, EX-LE2, EX-LE5, EXLE4, and the distal (distant) points were KI3, SP6, LI4, and ST41.	20 minutes per session twice weekly for 6 weeks with a total of 12 sessions	Physiotherapy (12 sessions)	No significant differences were observed between acupuncture and physiotherapy groups in pain, total WOMAC, or SF-36 scores at baseline, post-treatment, or 12-week follow-up ($p>0.05$). Both groups showed significant functional improvements: acupuncture 63.8 ± 20.81 → 53.72 ± 19.43, physiotherapy 59.04 ± 21.49 → 52.28 ± 19.54 ($p<0.05$). Pain (VAS) decreased in both groups by week 12: acupuncture 8.32 ± 1.61 → 5.54 ± 2.34, physiotherapy 7.86 ± 1.9 → 5.68 ± 2.42 ($p<0.05$). No treatment-related adverse events were reported.
(Helianthi et al., 2016)	Indonesia	59	>60 years	Active laser acupuncture at the acupuncture points of ST35 Dubi, ST36 Zusanli, SP9 Yinlingquan, GB34 Yanglingquan and EX-LE-4 Neixiyan	Twice a week as many as 10 sessions	Inactive laser acupuncture at the acupuncture points of ST35 Dubi, ST36 Zusanli, SP9 Yinlingquan, GB34 Yanglingquan and EX-LE-4 Neixiyan	The active laser acupuncture group showed significantly greater improvements in VAS scores than the placebo group: after four sessions, a mean difference of 0.39 ($p<0.001$); after nine sessions, 37.48 ($p<0.001$); and 2 weeks post-final session, 39.15 ($p<0.001$). The Lequesne index also improved significantly in the active group.
(Jia et al., 2020)	China	36	45–75	Acupuncture in 12 acupoints, they are Lingquan (GB34), Dubi (ST35), Nei xiyan (EX-LE4), Zusanli (ST36), Xue Hai (SP10), Liang Qiu (ST34), Yin Lingquan (SP9), He Ding (EX-LE2), Wei Zhong (BL40), YINGU (KI10) Weiyang (BL39), Xiguan (LR7), and Ququan (LR8).	Three treatments sessions per week (every other day) for four consecutive weeks (12 sessions in total)	Acupuncture treatment at the five low/non-sensitized points	At all assessment points, the high-sensitization group showed WOMAC total, pain, stiffness, and physical function scores comparable to or lower than the control group. Quality of life outcomes followed a similar trend, and no adverse events were reported.

Table 4. Summary of included RCT study on Acupuncture for osteoarthritis using ST36 and SP6 acupoints (continued...)

Study (year)	Country	Sample size	Age range (years)	Intervention type	Treatment duration	Comparator	Outcome
(Jiang et al., 2025)	China	78	40-80	Electroacupuncture treatment included Jiexi, Taixi, Kunlun, Zusanli, and Yanglingquan; the allied points were taken according to the site of pain: Qiuxu, Xuanzhong, ShenMai, and Zulinqi of the foot for outer ankle pain; and Zhaohai, Rangu, Shangqiu, and Sanyinjiao for inner ankle pain	5 times per week for 4 weeks (total 20 session)	Ankle training using elastic bands in four directions: plantarflexion, dorsiflexion, inversion, and eversion.	No significant differences were observed between groups at baseline. After treatment, significant improvements were found in AOS and AOFAS-AHS scores both between the experimental and control groups and within groups ($p<0.05$). Electroacupuncture may restore natural gait dynamics by reducing pain, improving joint flexibility, and enhancing motor control.
(Lin et al., 2020)	China	60	45-75	Acupuncture in ST32, ST34, ST36, ST40, EX-LE2, BL39, BL40, BL57, BL60, GB31, GB34, GB36, GB39, GB41, SP4, SP6, SP9, SP10, KI3, KI10, LR3, and LR7	3 sessions per week (TSWA)	Electroacupuncture 1 session per week (OSWA)	At week 8, response rates did not differ significantly between TSWA and OSWA (64.7% vs. 50.0%; difference 14.7 percentage points [95% CI, −10.1 to 39.4]; $p = 0.435$), but TSWA showed higher rates at weeks 4 and 16 (44.7 and 46.0 percentage points; $p<0.001$) and greater improvements in NRS, WOMAC function, and Patient Global Assessment, with no differences in WOMAC stiffness or SF-12.
(Shi et al., 2020)	China	60	45-75	Electroacupuncture in ST34 (Liangqiu), ST35 (Dubi), ST36 (Zusanli), Heding, Neixiyan, GB33 (Xiyangguan), GB34 (Yanglingquan), SP9 (Yinlingquan), SP10 (Xuehai), LR7 (Xiguan), LR8 (Ququan) and ah shi points, and at 2–3 distal points, which included GB31 (Fengshi), GB36 (Waiqiu), GB39 (Xuanzhong), GB41 (Zulinqi), ST40 (Fenglong), ST41 (Jiexi), LR3 (Taichong), BL60 (Kunlun), SP6 (Sanyinjiao) and KI3 (Taixi)	8 weeks	Manual acupuncture at the same point	Both 8-week EA and MA significantly reduced TNF-α and IL-1β and cartilage degradation markers MMP-3 and MMP-13, while increasing anti-inflammatory IL-13 compared with pre-treatment ($p<0.05$). TNF-α reduction was greater in EA than MA ($p = 0.046$), with no significant between-group differences for IL-1β ($p = 0.102$), MMP-3 ($p = 0.113$), MMP-13 ($p = 0.623$), or IL-13 ($p = 0.935$). VAS and WOMAC function improved clinically in both groups, without significant differences.

Table 4. Summary of included RCT study on Acupuncture for osteoarthritis using ST36 and SP6 acupoints (continued...)

Study (year)	Country	Sample size	Age range (years)	Intervention type	Treatment duration	Comparator	Outcome
(Sun et al., 2016)	China	42	45–75	Acupuncture points are selected on the traditional Chinese Medicine theory of the 'Bi' syndrome. These points are composed of 10 local points (ST34, ST35, ST 36, EX-LE2, EX-LE5, GB33, GB34, SP9, SP10, LV8) and 11 distal points (GB31, GB36, GB39, GB41, ST40, ST41, LR3, BL60, SP6, KI3, LI4)	8 weeks	Manual acupuncture in non-acupoints in a superficial puncture	Traditional Chinese acupuncture showed numerically greater improvements in WOMAC total, pain, and function scores and a trend toward lower VAS pain compared to sham acupuncture, but none were statistically significant (all p>0.05; VAS p = 0.081). SF-12 physical and mental scores also showed no significant differences. Minor adverse events occurred in the TCA group (one hematoma, one post-needling pain), with no serious events reported.
(Wang et al., 2020)	China	30	45-75	Electroacupuncture at *ST35*, *EX-LE5*, *GB33*, *LR8* and an *ashi* point (the point where the patient felt most pain). Adjunct acupoints (ST32, ST34, EX-LE2, ST36, ST40, SP10, KI10, SP9, LR7, SP6, KI3, LR3, SP4, BL39, BL40, BL57, BL60, GB31, GB34, GB36, GB39, GB41	8 weeks	Sham electroacupuncture in eight non-acupoints	Of 30 patients, 27 (90%) completed the study. No significant difference in TUG was observed between groups at 8 weeks (p = 0.856), and no adverse effects were reported.

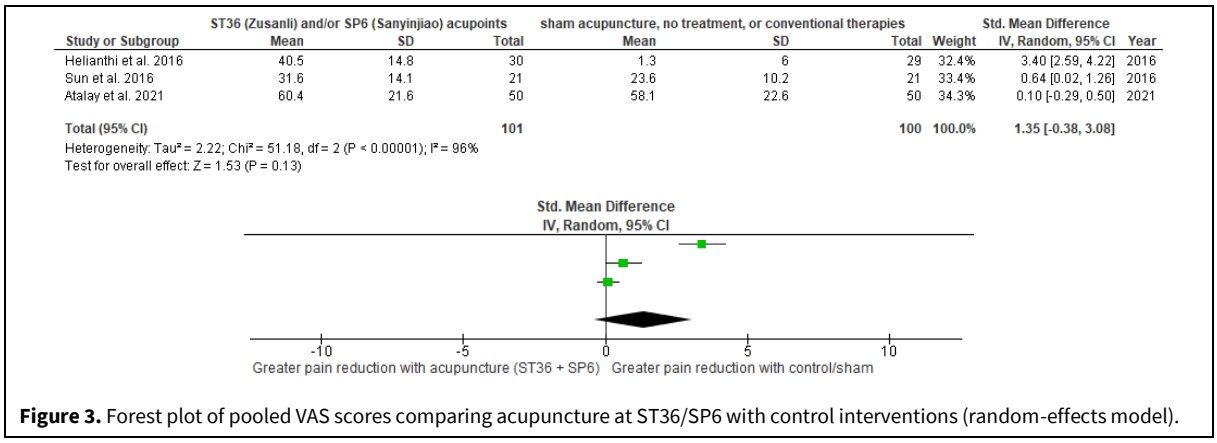

Figure 3. Forest plot of pooled VAS scores comparing acupuncture at ST36/SP6 with control interventions (random-effects model).

Notably, Helianthi et al. (2016) reported a large positive effect size (SMD = 3.40), suggesting meaningful pain reduction with acupuncture, whereas Sun et al. (2016) and Atalay et al. (2021) reported smaller or minimal effects (SMD = 0.64 and 0.10, respectively). This variation likely contributed to the wide confidence interval and high heterogeneity observed in the pooled result. Overall, while the direction of effect generally favored acupuncture, the lack of statistical significance and marked heterogeneity indicate that the evidence remains inconclusive regarding the superiority of acupuncture over control interventions for pain reduction based on VAS outcomes (Fig. 3).

Similarly, a meta-analysis of four trials (Atalay et al., 2021; Jia et al., 2020; Lin et al., 2020; Sun et al., 2016) reporting the WOMAC scores showed a pooled SMD of 0.01 [95% CI: –0.23 to 0.26; p = 0.92], indicating no significant difference in functional outcomes between the acupuncture and control groups. In contrast to the VAS findings, the WOMAC analysis exhibited no heterogeneity (I^2 = 0%, p = 0.46), suggesting consistency

across included studies. These results imply that while acupuncture targeting ST36 and/or SP6 may alleviate pain in some contexts, its impact on functional improvement appears comparable to control or conventional interventions (Fig. 4).

Heterogeneity assessment

Statistical heterogeneity across studies was formally assessed using the statistic and the Chi-squared test. For the VAS outcome, substantial heterogeneity was observed ($I^2 = 95\%$, $p<0.001$), warranting a downgrading in the Certainty of Evidence to Low. Conversely, the WOMAC outcome showed only moderate inconsistency ($I^2 = 45\%$), which was not considered a serious concern. The high inconsistency for VAS was primarily explored through subgroup analysis based on the total duration of the acupuncture intervention. However, these subgroup analyses did not fully explain the observed variance, suggesting that unmeasured clinical or methodological differences may be the potential sources of heterogeneity. Key clinical and methodological variations among the included studies, which may contribute to the observed statistical heterogeneity (Inconsistency) in the meta-analysis, particularly for the VAS and WOMAC outcomes, are identified in Table 5. Given the observed variability and the precision of pooled estimates, the certainty of evidence for each outcome was assessed using the GRADE approach.

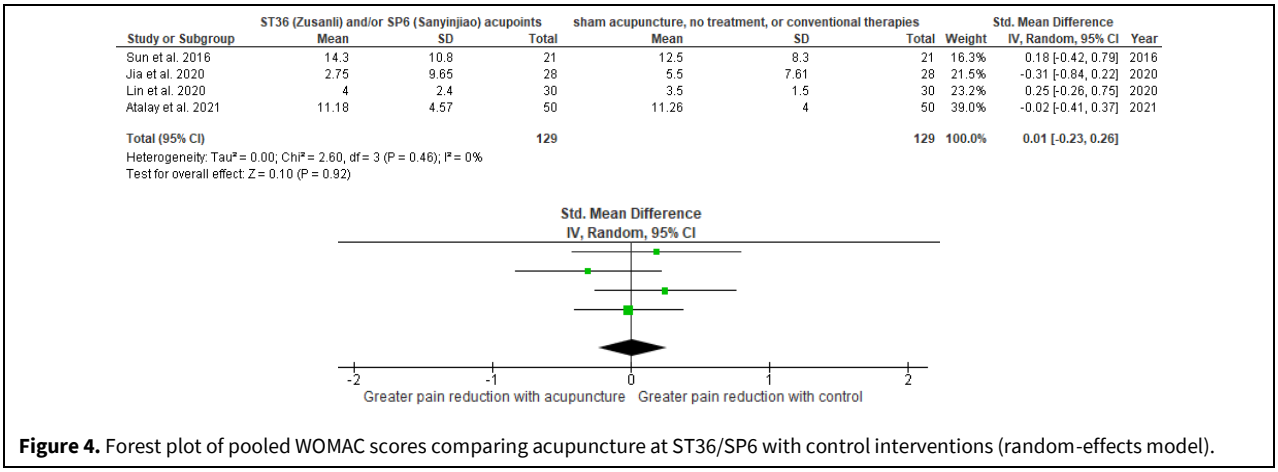

Figure 4. Forest plot of pooled WOMAC scores comparing acupuncture at ST36/SP6 with control interventions (random-effects model).

Table 5. Summary of heterogeneity in interventions and outcomes among included studies

Domain of heterogeneity	Identified source of variation	Range of differences across studies	Clinical/methodological implication
Intervention (P, I)	Acupuncture point protocol	Core points (ST36 & SP6) only vs. a combination of core points with auxiliary/local points (e.g., Ashi points or GB34).	The inclusion of auxiliary points may modify the treatment effect, potentially leading to varied outcomes and increasing inconsistency.
	Dose and duration	Protocols range from 8 total sessions (2 sessions/week for 4 weeks) vs. 24 total sessions (3 sessions/week for 8 weeks).	This significant difference in cumulative dose is a primary contributor to the inconsistency (I^2 value), as efficacy may be dose dependent.
Control Group (C)	Comparator type	Sham Acupuncture (non-penetrating or non-acupoint needling) vs. Waiting List/Usual Care (e.g., standard physiotherapy or medication).	The varying strength of the placebo/control effect across studies can inflate or dampen the observed effect size, thus creating heterogeneity.
Outcome (O)	Follow-up timing	Primary outcome measured precisely at 8 weeks vs. measured at non-standard times (e.g., 4 weeks, 12 weeks, or 6 months).	Differences in follow-up time require careful subgroup analysis, as short-term effects (8 weeks) may be different from long-term effects.
Population (P)	Severity of osteoarthritis	Patient groups with Mild-to-Moderate OA (Kellgren-Lawrence Grade I-II) vs. Severe OA (Grade III-IV).	Patients with greater disease severity often exhibit a lower treatment response, introducing clinical heterogeneity that can lead to statistical inconsistency.

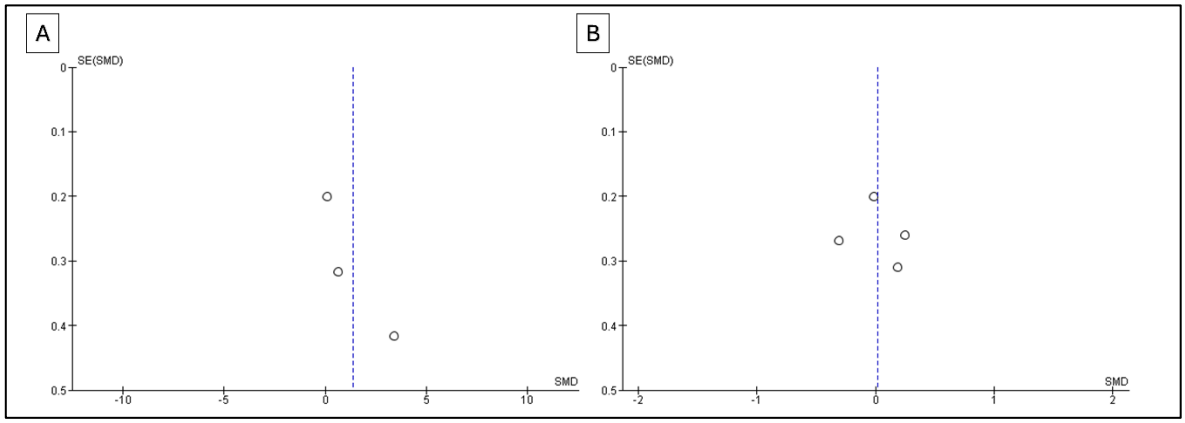

Figure 5. Funnel plots assessing potential publication bias.
(A) VAS outcome and **(B)** WOMAC outcome.

Publication bias assessment

To assess the potential presence of publication bias, funnel plots were generated for the main outcomes, including the VAS and the WOMAC. The symmetry of the plots was visually examined to evaluate the distribution of studies around the estimated overall effect size. For the VAS outcome (Fig. 5A), the funnel plot shows an asymmetrical distribution of studies, with points scattered unevenly around the central line. This pattern may suggest the presence of publication bias or heterogeneity among the included studies. However, because fewer than ten studies were included in the analysis, the interpretation of asymmetry remains unreliable. Therefore, no firm conclusion regarding publication bias can be made for this outcome. For the WOMAC outcome (Fig. 5B), the funnel plot appears more symmetrical, with the included studies distributed relatively evenly on both sides of the mean effect line. This suggests a lower likelihood of publication bias for this particular outcome. Nonetheless, as with the VAS analysis, the limited number of studies reduces the reliability of the visual assessment, and any indication of bias should be interpreted with caution.

GRADE assessment

The certainty of evidence for each outcome was evaluated using the GRADE approach. For pain intensity measured by the VAS, the overall certainty was rated as low. The evidence was downgraded due to serious inconsistency (I^2 = 96%), reflecting considerable heterogeneity across studies, and serious imprecision, as indicated by the wide confidence interval that crossed the line of no effect. Despite some individual studies showing clinically meaningful improvements, the pooled estimate demonstrated uncertainty regarding the true magnitude of benefit. For physical function measured by the WOMAC, the certainty of evidence was assessed as moderate. Although the included studies were generally consistent and had low risk of bias, the overall estimate (SMD = 0.01 [–0.23 to 0.26]) showed a wide confidence interval encompassing both minimal benefit and potential null effect, leading to downgrading for imprecision. These findings indicate that while acupuncture at ST36 and/or SP6 may provide pain relief and functional improvement in knee osteoarthritis, the evidence supporting these outcomes remains limited. The summary of findings and certainty ratings is presented in Fig. 6.

DISCUSSION

OA is a progressive degenerative joint disorder that primarily affects weight-bearing joints, leading to chronic pain, stiffness, functional impairment, and reduced quality of life. Due to limitations and adverse effects of long-term pharmacological therapy, non-pharmacological interventions such as acupuncture have gained attention as safer alternatives (Li et al., 2019). Acupuncture involves inserting fine needles into specific acupoints, followed by manual or electrical stimulation (Oh & Kim, 2022). Among these, ST36 (Zusanli) and SP6 (Sanyinjiao) are frequently applied in OA therapy. ST36, located on the anterior leg over the tibialis anterior, exhibits anti-inflammatory, antioxidant, and immunomodulatory effects relevant to joint inflammation (Wang et al., 2017; Zhang et al., 2021; Zhu et al., 2015), while SP6, on the medial lower leg above the ankle, provides analgesic benefits traditionally used for dysmenorrhea but also effective in OA pain reduction (Chen et al., 2013). Across eight randomized controlled trials published between 2015 and 2025, acupuncture at ST36 and SP6, whether manual or electrical, consistently reduced pain and improved function, assessed using VAS, WOMAC, Lequesne Index, and NRS, with longer interventions generally producing greater benefits, especially in knee OA (Liu et al., 2024). Notably, Shi et al. (2020) reported that both 8-week electroacupuncture and manual acupuncture significantly reduced pro-inflammatory cytokines

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Acupuncture using ST36 and/or SP6 (manual or electroacupuncture)	Sham/placebo acupuncture, no treatment, or conventional therapy	Relative (95% CI)	Absolute (95% CI)		
VAS												
3	randomised trials	not serious	serious[a]	not serious	serious[b]	none	101	100	-	SMD **1.35 higher** (0.38 lower to 3.08 higher)	⨁⨁◯◯ Low[a,b]	CRITICAL
WOMAC												
4	randomised trials	not serious	not serious	not serious	serious[c]	none	129	129	-	SMD **0.01 higher** (0.23 lower to 0.26 higher)	⨁⨁⨁◯ Moderate[c]	CRITICAL

Figure 6. GRADE summary of evidence for pain and function outcomes.

(TNF-α, IL-1β) and cartilage degradation markers (MMP-3, MMP-13), while enhancing anti-inflammatory IL-13 levels, with TNF-α reduction being greater in the electroacupuncture group ($p = 0.046$). Collectively, these findings support acupuncture at ST36 and SP6 as an effective complementary therapy for osteoarthritis.

The eight included studies showed mixed risk of bias, with four rated low and four raising concerns, primarily due to difficulties in fully blinding acupuncturists and participants, as acupuncture elicits recognizable sensations; nonpenetrating needles remain the only tool allowing partial practitioner blinding (Vase et al., 2015), and various sham techniques such as minimal insertion, non-acupoint stimulation, or placebo devices have been used, though no universally accepted method exists. Measures including adequate randomization, allocation concealment, and validated outcome assessments (VAS, WOMAC) by independent evaluators were implemented in several studies (Yang et al., 2025). Overall, the evidence is generally reliable but should be interpreted cautiously. Participants were mostly aged 45–75, predominantly women, reflecting the typical osteoarthritis population (Rahini & Hadaye, 2024; Sananta et al., 2022), though younger adults under 60 were increasingly affected due to obesity or joint injury (Birtwhistle et al., 2015; Driban et al., 2020; Yip et al., 2020). Nonpharmacological interventions such as acupuncture are gaining attention for pain management and functional improvement without long-term drug dependence. However, six of the eight studies were conducted in China, potentially limiting generalizability, and future research should involve more diverse populations to confirm applicability globally.

When compared with previous systematic reviews, the present analysis offers a more targeted perspective. Earlier reviews reported moderate analgesic effects but included diverse acupoint combinations and adjunct modalities, thereby limiting interpretation of specific point efficacy (Manyanga et al., 2014; Purepong et al., 2012; Zhu et al., 2025). Likewise, studies examining the external validity of acupuncture for knee OA noted frequent use of ST36 and SP6 but did not isolate their individual contributions. In contrast, this review represents the first synthesis focused exclusively on randomized controlled trials employing ST36 and/or SP6, allowing for clearer insight into their specific therapeutic effects. While the overall pooled results did not reach statistical significance, consistent trends toward pain reduction and functional improvement across trials suggest that these points play a meaningful role within broader acupuncture protocols. The clinical implication of this targeted synthesis is that practitioners can confidently integrate ST36 and SP6 into treatment plans for knee OA, acknowledging their specific contribution to analgesic and functional outcomes. Variability in acupuncture techniques, stimulation modes, and outcome measures likely contributed to heterogeneity, as observed in previous reviews. Together, these findings reinforce acupuncture's potential as a safe and complementary therapy for osteoarthritis management while highlighting the need for future studies with standardized intervention parameters, longer follow-up durations, and larger sample sizes to strengthen the evidence base for acupoints ST36 and SP6.

Across the included studies, acupuncture and related interventions were generally well tolerated, with mostly mild and transient adverse events. Pain after needling, often referred to as post-needling soreness, and minor hematomas are commonly reported effects of acupuncture, reflecting normal tissue response to needling (Valera-Calero et al., 2024). Atalay et al. (2021)

reported five participant dropouts due to personal reasons or concomitant medication use, but no treatment-related side effects were observed. Helianthi et al. (2016) reported pain in 17 of 30 participants (56.7%) during the first few laser acupuncture sessions, which did not recur in subsequent sessions. Lin et al. (2020) observed acupuncture-associated adverse events in 13.8% of participants in the TSWA group (three sessions per week) and 11.5% in the OSWA group (one session per week), which resolved spontaneously within two weeks; two serious adverse events occurred but were unrelated to acupuncture. Shi et al. (2020) recorded mild adverse events, including needling pain and hematoma, which remitted within one week. Sun et al. (2016) reported two adverse events in the Traditional Chinese acupuncture group (one hematoma, one needling pain) and one event in the manual acupuncture group (needling pain). Overall, these findings suggest that acupuncture is safe, with adverse events generally mild, transient, and self-limiting.

One limitation of this review is the variability in acupuncture protocols across studies. Although ST36 and SP6 were consistently targeted, several studies incorporated additional acupoints, making it difficult to isolate the specific therapeutic effects of ST36 and SP6 alone. Furthermore, differences in needle stimulation techniques, treatment durations, and session frequencies contribute to heterogeneity, which may influence the consistency of the outcomes. While both manual and electroacupuncture showed comparable efficacy, the lack of standardized treatment protocols limits the ability to draw definitive conclusions about the superiority or optimal parameters of each modality. This review provides encouraging evidence for clinical practice, especially for osteoarthritis patients looking for alternatives to medication. Acupuncture focused on the ST36 and SP6 points shows potential as a safe and effective supplementary treatment, particularly for those aiming to reduce reliance on drugs and avoid their side effects. The consistent pain relief and functional improvements reported in the studies, along with minimal adverse effects, underscore its practical value.

Additionally, these findings emphasize the importance of non-pharmacological therapies in managing chronic conditions and support a more integrated approach to joint health. Healthcare providers might consider including acupuncture in comprehensive treatment plans, particularly for middle-aged and elderly patients. Future studies should aim for stronger methodology, larger sample sizes, longer follow-up durations, and more precise descriptions of treatment details. Including older adults aged 75 and older and patients with multiple health issues would also improve the applicability of the results. In conclusion, this review advocates for acupuncture as part of a holistic osteoarthritis treatment strategy, reflecting the increasing focus on personalized, safe, and patient-friendly care options worldwide.

CONCLUSION

Based on current randomized controlled trial synthesis, moderate evidence suggests that acupuncture at ST36 and SP6 acupoints can reduce pain intensity and improve functional outcomes in patients with osteoarthritis. These results support its use as a complementary non-pharmacological intervention within comprehensive OA management. However, due to methodological limitations, small sample sizes, and variability in intervention protocols, the findings should be interpreted with caution. Further well-designed, multicenter randomized trials with standardized acupuncture protocols are warranted to confirm efficacy and guide clinical practice.

CONFLICT OF INTEREST

The research was conducted entirely free from any involvement in commercial, financial, or personal matters that might be perceived as a possible conflict of interest or that could have influenced the outcomes or interpretation of the study.

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GENERATIVE ARTIFICIAL INTELLIGENCE (AI)

The authors declare that no generative artificial intelligence (AI) or AI-assisted technologies were used in the preparation, writing, or editing of this manuscript. All content was developed solely by the authors, who take full responsibility for its accuracy and integrity.

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AUTHOR CONTRIBUTION:

Contribution	Wulandari M	Handono K	Khotimah H	Yuliatun L
Concepts or ideas	x	x	x	x
Design	x	x	x	x
Definition of intellectual content	x	x	x	x
Literature search	x	x	x	x
Experimental studies	-	-	-	-
Data acquisition	x	x	x	x
Data analysis	x	x	x	x
Statistical analysis	-	-	-	-
Manuscript preparation	x	x	x	x
Manuscript editing	x	x	x	x
Manuscript review	x	x	x	x

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Annex 1. PRISMA 2020 item checklist.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 3
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 3
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 3
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 3
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 3
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 4
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 4
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 5
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 4
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 5
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	There's no missing data
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 3-4
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 3-4
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 3-4
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 3-4
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Page 5
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 5

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 5
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 5
Study characteristics	17	Cite each included study and present its characteristics.	Page 5
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 6-9
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Page 6-9
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 6-9
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Page 6-9
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 10
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Page 10
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Page 10
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Page 10
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 11
	23b	Discuss any limitations of the evidence included in the review.	Page 12-13
	23c	Discuss any limitations of the review processes used.	Page 13
	23d	Discuss implications of the results for practice, policy, and future research.	Page 13
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 2
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Page 2
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 13
Competing interests	26	Declare any competing interests of review authors.	Page 13
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Page 13

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

Annex 2. PRISMA 2020 for Abstracts checklist

PRISMA 2020 for Abstracts Checklist

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	Yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	Yes
Synthesis of results	6	Specify the methods used to present and synthesise results.	Yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	Yes
Interpretation	10	Provide a general interpretation of the results and important implications.	Yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	No
Registration	12	Provide the register name and registration number.	Yes