Electroacupuncture as a Non-Pharmacologic Adjunct for Postoperative Recovery Following Total Knee Arthroplasty: A Systematic Review and Meta-analysis

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INTRODUCTION

Postoperative pain following total knee arthroplasty (TKA) contributes substantially to analgesic utilization, delayed functional recovery, and rehabilitation burden. Electroacupuncture (EA) has emerged as a potential non-pharmacologic adjunctive strategy within multimodal postoperative care pathways.

OBJECTIVE

This study evaluated the effectiveness and implementation-relevant outcomes of EA following TKA.

METHODS

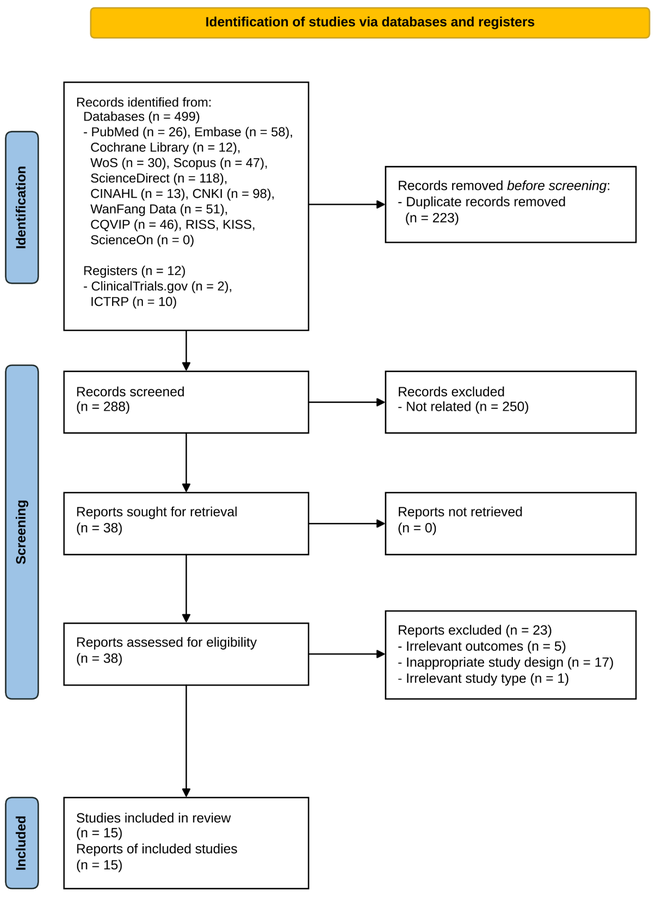
- A systematic review and meta-analysis of randomized controlled trials was conducted across 13 electronic databases.
- Studies evaluating EA following TKA were included. Primary outcomes included **postoperative pain intensity**. Secondary outcomes included **range of motion (ROM), recovery-related outcomes**, and adverse events.
- Risk of bias was assessed using the Cochrane RoB 2 tool. Random-effects meta-analyses were performed using standardized mean differences (SMDs) and 95% confidence intervals (CIs).

15	1,318	13	RoB 2
randomized controlled trials	patients	electronic databases searched	Cochrane risk-of-bias tool

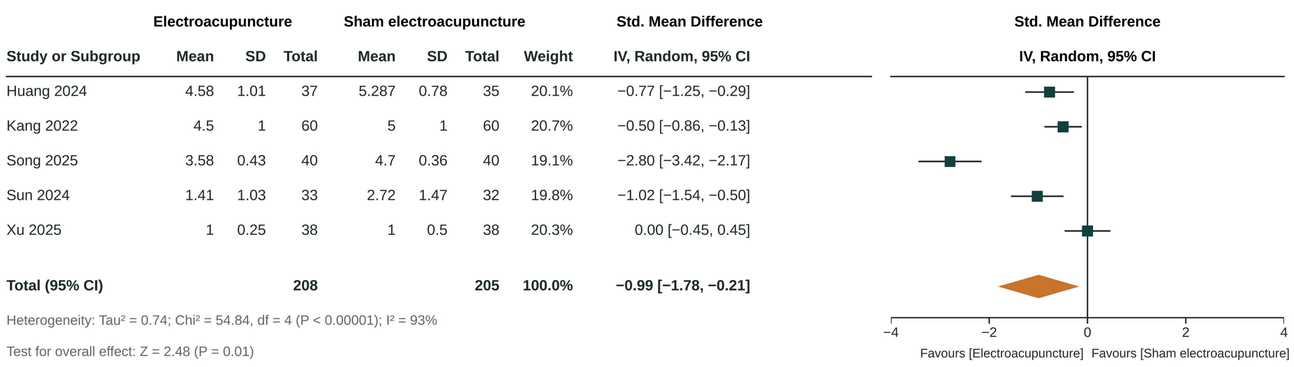
RESULTS

Fifteen randomized controlled trials involving 1,318 patients were included.

Figure 1. Flow diagram of the study selection process



Compared with sham electroacupuncture, EA demonstrated significant reductions in postoperative pain at post-intervention (n=413; SMD -0.99; 95% CI -1.78 to -0.21; I^2=93%).



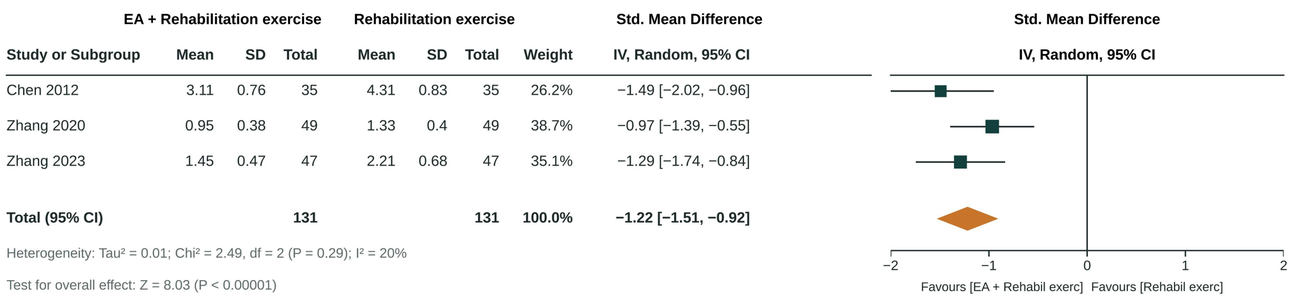
Study or Subgroup	Electroacupuncture Mean	SD	Total	Sham electroacupuncture Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
Huang 2024	4.58	1.01	37	5.287	0.78	35	20.1%	−0.77 [−1.25, −0.29]
Kang 2022	4.5	1	60	5	1	60	20.7%	−0.50 [−0.86, −0.13]
Song 2025	3.58	0.43	40	4.7	0.36	40	19.1%	−2.80 [−3.42, −2.17]
Sun 2024	1.41	1.03	33	2.72	1.47	32	19.8%	−1.02 [−1.54, −0.50]
Xu 2025	1	0.25	38	1	0.5	38	20.3%	0.00 [−0.45, 0.45]
Total (95% CI)			**208**			**205**	**100.0%**	**−0.99 [−1.78, −0.21]**

Heterogeneity: Tau² = 0.74; Chi² = 54.84, df = 4 (P < 0.00001); I² = 93%

Test for overall effect: Z = 2.48 (P = 0.01)

Figure 2. Postoperative pain at post-intervention (Electroacupuncture vs. sham electroacupuncture)

EA combined with rehabilitation exercise also showed greater pain reduction versus rehabilitation alone (n=262; SMD -1.22; 95% CI -1.51 to -0.92; I^2=20%).



Study or Subgroup	EA + Rehabilitation exercise Mean	SD	Total	Rehabilitation exercise Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
Chen 2012	3.11	0.76	35	4.31	0.83	35	26.2%	−1.49 [−2.02, −0.96]
Zhang 2020	0.95	0.38	49	1.33	0.4	49	38.7%	−0.97 [−1.39, −0.55]
Zhang 2023	1.45	0.47	47	2.21	0.68	47	35.1%	−1.29 [−1.74, −0.84]
Total (95% CI)			**131**			**131**	**100.0%**	**−1.22 [−1.51, −0.92]**

Heterogeneity: Tau² = 0.01; Chi² = 2.49, df = 2 (P = 0.29); I² = 20%

Test for overall effect: Z = 8.03 (P < 0.00001)

Figure 3. Postoperative pain at post-intervention (Electroacupuncture in combination with rehabilitation exercise vs. rehabilitation exercise)

Improvements in ROM and functional recovery outcomes were reported in several studies. Reported adverse events were minimal, suggesting a favorable safety profile. However, methodological concerns including inadequate blinding and inconsistent reporting reduced overall certainty of evidence.

CONCLUSIONS

EA may represent a promising non-pharmacologic adjunctive intervention for postoperative pain management and rehabilitation following TKA.

The observed improvements in pain and functional recovery outcomes suggest potential relevance for value-based postoperative care pathways and opioid-sparing rehabilitation strategies.

Higher-quality trials incorporating healthcare utilization, patient-reported outcomes, and cost-related endpoints are needed to support evidence-informed implementation decisions.

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