




Acupuncture Therapy for Extremity Musculoskeletal Pain: A Clinically Focused Evidence Synthesis with Therapeutic Implications

Fenglin Zhu , Yetong Chen, Yang Zhu , Zhenmin Bai , Huipin Yan

School of Sports Medicine and Rehabilitation, Beijing Sport University, Beijing, People's Republic of China

Correspondence: Zhenmin Bai; Huipin Yan, School of Sports Medicine and Rehabilitation, Beijing Sport University, Beijing, People's Republic of China, Email 2310@bsu.edu.cn; yanhp000@126.com

Background: Extremity musculoskeletal pain (EMP) is a major contributor to chronic pain and disability worldwide, often involving tendinopathies, enthesopathies, and myofascial pain syndromes. Conventional treatments such as medications, injections, and physical therapy frequently provide only partial or short-term relief. Acupuncture, widely practiced in clinical settings, has been proposed as a safe and effective alternative or adjunctive therapy.

Methods: A comprehensive search of PubMed, Embase, and the Cochrane Library identified studies published from January 2015 to June 2024. Eligible publications included randomized controlled trials (RCTs), systematic reviews, or meta-analyses involving adults with EMP and reporting pain or function as primary outcomes. Nineteen studies (10 RCTs, 9 reviews) met the inclusion criteria and were narratively synthesized.

Results: For lateral epicondylitis (LE), manual acupuncture provided short-term benefit, while dry needling demonstrated superior long-term effects. Evidence for carpal tunnel syndrome (CTS) was insufficient, with mixed findings and high risk of bias. In patellofemoral pain syndrome (PFPS), trigger point dry needling showed short-to-medium term pain relief, though its added value in multimodal therapy was inconsistent. For plantar heel pain syndrome (PHPS), both electroacupuncture and dry needling produced significant improvements in pain and function, with benefits sustained beyond three months.

Conclusion: Acupuncture appears to be a safe, low-risk therapy for EMP, with strongest evidence for PHPS and LE, limited support for PFPS, and insufficient evidence for CTS. Clinically, acupuncture should be considered as part of comprehensive multimodal strategies, tailored to patient needs and preferences. Future research should focus on large-scale, standardized RCTs, direct comparisons between acupuncture modalities, and inclusion of regional and non-English studies to strengthen the global evidence base.

Keywords: extremity musculoskeletal pain, plantar heel pain syndrome, lateral epicondylitis, patellofemoral pain syndrome, carpal tunnel syndrome, acupuncture therapy

Introduction

Extremity musculoskeletal pain (EMP) of the extremities is one of the most common causes of chronic pain and disability worldwide. It substantially reduces quality of life, impairs physical function, and generates significant socio-economic burdens on healthcare systems.^{1,2} Unlike axial conditions such as low back or neck pain, EMP refers to pain originating from the muscles, tendons, entheses, joints, or related soft tissues of the upper and lower limbs. Typical examples include tendinopathies (eg, lateral epicondylitis [LE], plantar heel pain syndrome [PHPS]), enthesopathies, and myofascial pain syndromes, which pose unique diagnostic and therapeutic challenges.³

Conventional management strategies include pharmacological interventions (eg, nonsteroidal anti-inflammatory drugs [NSAIDs], acetaminophen, and corticosteroid injections) and non-pharmacological approaches such as physical therapy, exercise-based rehabilitation, manual therapy, and ultrasound therapy. While these treatments can provide short-term relief, their long-term effectiveness is often limited, and adverse effects are common. For example, NSAIDs are associated with gastrointestinal and cardiovascular risks,⁴ while corticosteroid injections may accelerate tissue

degeneration with repeated use.⁵ Similarly, physical therapy interventions, though widely employed, show variable efficacy and high recurrence rates, particularly in conditions like patellofemoral pain syndrome (PFPS).⁶ These limitations highlight the need for alternative or adjunctive therapies.

Acupuncture, originating in traditional Chinese medicine, has emerged as a promising non-pharmacological therapy for musculoskeletal disorders. It is widely practiced worldwide and increasingly incorporated into mainstream clinical care.⁷ Proposed mechanisms include modulation of central pain pathways, anti-inflammatory effects, and improvements in local blood circulation, alongside direct effects on myofascial trigger points.^{8–11} Accumulating evidence from clinical studies suggests that acupuncture may provide meaningful pain relief and functional improvement in EMP.^{12,13}

Several systematic reviews have previously examined acupuncture for musculoskeletal pain of the extremities,¹² such as LE,¹⁴ carpal tunnel syndrome (CTS),¹⁵ patellofemoral pain syndrome (PFPS),¹⁶ and PHPS,¹⁷ but many are now outdated or limited in scope. Earlier reviews often did not distinguish between different acupuncture modalities (manual acupuncture, electroacupuncture, and dry needling), and few provided condition-specific recommendations for extremity pain. This underscores the need for an updated synthesis of the evidence.

Therefore, this review synthesizes randomized controlled trials and systematic reviews published between 2015 and 2024 to evaluate the clinical efficacy of acupuncture for EMP. By analyzing condition-specific outcomes and integrating practical considerations, we aim to provide clinicians with updated, evidence-informed guidance for tailoring acupuncture as part of comprehensive pain management strategies.

Literature Search

To update the current clinical evidence regarding the effects of acupuncture on musculoskeletal pain of the extremities, we performed a comprehensive search of PubMed, Embase, and Cochrane Library for studies published between January 2015 and June 2024. The search terms included “acupuncture”, “electroacupuncture”, “manual acupuncture”, “dry needling”, “lateral epicondylitis”, “carpal tunnel syndrome”, “patellofemoral pain”, “plantar heel pain syndrome”, “plantar fasciitis”, and “musculoskeletal pain”. Only English-language publications were considered.

Inclusion Criteria

Studies were included if they met all of the following requirements:

1. Randomized controlled trials (RCTs), systematic reviews, or meta-analyses;
2. Adult participants (≥ 18 years) with a clinical diagnosis of one of the following extremity musculoskeletal pain conditions: LE, CTS, PFPS, PHPS, or PF;
3. Sample size ≥ 25 participants per trial arm;
4. At least one control group (eg, sham acupuncture, waiting list, active therapy, or routine care);
5. Reported pain intensity or functional outcomes as a primary endpoint;
6. Adequate description of acupuncture intervention, with reporting aligned with STRICTA recommendations (eg, modality, point selection, treatment frequency, duration).

Exclusion Criteria

Studies were excluded if they met any of the following:

1. Non-English publications;
2. Case reports, conference abstracts, editorials, or narrative commentaries;
3. Studies focusing on laser acupuncture or moxibustion;
4. Studies without clinical outcome data related to pain or function;
5. Pediatric or adolescent populations (< 18 years);
6. Studies not involving the target conditions of this review, ie, LE, CTS, PFPS, PHPS, or PF.

A total of 496 records were initially identified. After title and abstract screening, studies that did not meet the inclusion criteria were excluded, including those irrelevant to extremity musculoskeletal pain, studies with designs other than randomized controlled trials, systematic reviews, or meta-analyses, pediatric populations, non-English publications, or interventions involving laser acupuncture or moxibustion. Potentially eligible articles underwent full-text review, resulting in 19 studies that met all predefined inclusion and exclusion criteria for final synthesis.

Results

A systematic screening process identified ten randomized controlled trials^{18–27} and nine review articles^{28–36} that fulfilled the predefined inclusion criteria. These included patients who were diagnosed with lateral epicondylitis, carpal tunnel syndrome, patellofemoral pain knee, and plantar heel pain syndrome/plantar fasciitis conditions. Tables 1–4 summarizes the key characteristics of the included studies, encompassing study design, sample size, intervention protocols, assessment timepoints, outcome measures, and primary findings.

Acupuncture for Lateral Epicondylitis (LE)

Two randomized controlled trials evaluated acupuncture's efficacy for LE. A randomized controlled trial demonstrated that Fu's subcutaneous needling (FSN) was more effective than transcutaneous electrical nerve stimulation (TENS) for LE in the short term.¹⁸ Evidence from a multicenter randomized clinical trial revealed that integrating electrical dry needling and thrust manipulation into a multimodal physical therapy regimen exhibited greater reductions in pain intensity and functional limitations in patients with lateral elbow tendinopathy compared to multimodal therapy alone at 3-month follow-up.¹⁹ The results underscore the therapeutic value of adjunctive acupuncture therapy in optimizing multimodal management for LE.

Three systematic reviews assessed the effectiveness of acupuncture for LE. Navarro-Santana et al²⁸ reported moderate short-term pain reduction for manual acupuncture (MA), but not for electroacupuncture (EA). Another meta-analysis (10 RCTs, n=796) concluded acupuncture was superior to medicine therapy and blocking therapy in clinical efficacy rates.²⁹ In contrast, a 2021 systematic review noted very low-certainty evidence that corticosteroid injections outperformed dry needling for LE pain at short-term, while dry needling showed superior long-term (≥ 12 weeks) effects.³⁰

Current evidence suggests that manual acupuncture may exert short-term therapeutic effects on lateral epicondylitis, whereas dry needling appears to demonstrate superior long-term efficacy. For patients with LE, a course of MA can be considered for short-term symptom control. For those seeking long-term recovery, treatment plans should prioritize interventions that incorporate DN. However, substantial heterogeneity exists across studies regarding pathological complexity and severity, acupuncture modalities, treatment duration, and choice of comparison groups. These methodological variations necessitate cautious interpretation of the pooled findings.

Acupuncture for Carpal Tunnel Syndrome (CTS)

From 2015 to 2024, one randomized trials and three systematic reviews have investigated acupuncture's efficacy for carpal tunnel syndrome (CTS). While the adjunctive EA showed numerical reductions in pain scores when combined with nocturnal splinting, the between-group differences (-0.7 points on NRS; 95% CI: -1.34 to 0.06) did not reach the clinically important difference, suggesting limited clinical utility of the combined intervention.²⁰ A systematic review reported that manual acupuncture provides superior symptom relief compared to medications, but no significant pain reduction was observed.³¹ The majority of included studies had a high risk of bias, which substantially limits the validity of the conclusions.³¹ However, Dong et al³² found that Acupuncture alone had no advantage over medicine in improving symptom severity, but as an adjunctive treatment, acupuncture might benefit CTS. Moreover, Choi et al³³ found Acupuncture and laser acupuncture may have little or no effect in the short term on symptoms of CTS in comparison with placebo or sham acupuncture. The two studies demonstrated low or very low certainty of evidence according to GRADE criteria.

Current evidence is insufficient to support the efficacy of acupuncture therapy for CTS and high-quality RCTs using standardized protocols and objective outcomes are needed to confirm efficacy. Therefore, acupuncture is not recommended for routine care of CTS, and clinicians should prioritize treatments with established efficacy.

Table 1 Evidence Table on Acupuncture Therapy for Lateral Epicondylitis (LE)

Authors & Year	Study Design	Participants	Inclusion Criteria	Intervention Group	Control Group	Time Points	Outcomes	Key Findings
Huang et al ¹⁸ (2022)	Randomized controlled trial (RCT)	60 adults (>20 years) with LE >1 month; Taiwan, China (2021–2022)	LE >1 month, VAS >5, tenderness at lateral epicondyle	Disposable Fu's subcutaneous needling (FSN) at midpoint of forearm extensor muscles; swaying (50 reps/30 s); wrist extension with resistance (10 s on/10 s rest), repeated 3 times (~1 min per cycle); n=30	Transcutaneous electrical nerve stimulation (TENS) at TE5 and LI11 (200 Hz, 200 µs pulse, continuous wave, 20 min; n=30)	Baseline, post-treatment, days 8 and 15	Visual analog scale (VAS), pressure pain threshold (PPT), tissue hardness (TH), pain-free grip (PFG), patient-rated tennis elbow evaluation (PRTEE)	The improved VAS of patients in FSN on days 8 and 15 was significantly higher than that in TENS (day 8, 3.96±1.46 in FSN compared with 1.67±1.21 in TENS, P<0.01; day 15, 4.24±1.45 in FSN compared with 1.88±1.23 in TENS, P<0.01).
Dunning et al ¹⁹ (2024)	Randomized single-blinded multicenter trial	143 patients with lateral elbow tendinopathy; 13 US clinics (2017–2021)	LE symptoms >6 weeks, pain ≥2/10 numeric rating scale (NPRS), positive palpation/grip pain	Electrical dry needling (EDN) + thrust manipulation + multimodal physical therapy (PT): 8 sessions (2x/week, 4 weeks) with cervical/elbow manipulation, electrical dry needling (8-point protocol: lateral elbow trigger points, junctions, periarticular tissue), exercise, ultrasound; n=73	Multimodal PT alone (exercise, Mulligan mobilization, ultrasound); 8 sessions (2x/week, 4 weeks); n=70	Baseline, 1 week, 4 weeks, 3 months	PRTEE, NPRS, Tennis Elbow Function Scale (TEFS), Global Rating of Change (GROC), medication intake	EDN+ manipulation group had superior PRTEE improvement (Δ15.0 vs control at 3mo, p<0.001), large effect size (Standardized Mean Difference [SMD]=1.13, 95% Confidence Interval [CI]: 0.78 to 1.48). 43.8% reported transient post-needling soreness; no severe adverse events.
Navarro-Santana et al ²⁸ (2021)	Systematic review and meta-analysis	14 RCTs (10 acupuncture, 4 electroacupuncture [EA] trials); total sample unspecified	Adults with LE of musculoskeletal origin	Manual acupuncture (MA) or EA (alone/combined)	Sham, placebo, active comparators (eg, physiotherapy)	Short-term (0–12 weeks), mid-term, long-term (>24 weeks)	Pain intensity, pain-related disability, strength (grip)	MA showed moderate short-term pain reduction (SMD = -0.66, 95% CI: -1.22 to -0.10) vs controls; no EA benefits. Low GRADE evidence due to heterogeneity.
Zhou et al ²⁹ (2020)	Systematic review and meta-analysis	10 RCTs (n = 796 LE patients)	RCTs comparing acupuncture with sham, drugs, or blocking therapy	Acupuncture (MA/EA)	Sham acupuncture, Non-Steroidal Anti-Inflammatory Drugs (NSAID), or steroid injections	Unclear (reported "follow-up" without specific time points)	Clinical efficacy rate, VAS	Acupuncture superior to medicine therapy (Relative Risk [RR] = 1.15) and blocking therapy (RR = 1.17) for efficacy rate. VAS improvements vs medicine (MD = -1.44, 95% CI: -1.77 to -1.10) and blocking (Mean Difference [MD] = -0.75, 95% CI: -1.42 to -0.07). Low/moderate GRADE evidence.
Sousa Filho et al ³⁰ (2021)	Systematic review and GRADE synthesis	6 RCTs (n = 384; 2 trials for LE)	RCTs comparing dry needling (DN) vs corticosteroid injections (CSI)	DN	CSI	Short-term, mid-term, long-term	Pain (VAS/NPRS/PRTEE), disability (Disabilities of the Arm, Shoulder and Hand [DASH]), GROC	CSI superior to DN for LE at ≤6 weeks; DN better long-term (≥24 weeks). Very low GRADE certainty.

Abbreviations: LE, lateral epicondylitis; RCT, randomized controlled trial; VAS, visual analog scale; FSN, Fu's subcutaneous needling; TENS, transcutaneous electrical nerve stimulation; TE, Triple Energizer Meridian; LI, Large Intestine Meridian; PPT, pressure pain threshold; TH, tissue hardness; PFG, pain-free grip; PRTEE, patient-rated tennis elbow evaluation; NPRS, numeric rating scale; EDN, electrical dry needling; TEFS, Tennis Elbow Function Scale; GROC, Global Rating of Change; SMD, Standardized Mean Difference; CI, Confidence Interval; NSAID, Non-Steroidal Anti-Inflammatory Drug; RR, Relative Risk; MD, Mean Difference; DN, dry needling; CSI, corticosteroid injections; DASH, Disabilities of the Arm, Shoulder and Hand.

Table 2 Evidence Table on Acupuncture Therapy for Carpal Tunnel Syndrome (CTS)

Authors & Year	Study Design	Participants	Inclusion Criteria	Intervention Group	Control Group	Time Points	Outcomes	Key Findings
Chung et al ²⁰ (2016)	RCT	181 adults with chronic mild-moderate CTS	Clinical diagnosis of primary CTS, no surgical indication	EA + nocturnal splinting; Sessions: 13 sessions over 17 weeks (1–2×/week); Acupoints: TW-5, PC-7, HT-3, PC-3, SI-4, LI-5, LI-10, LU-5 (affected side; bilateral if both hands); Needles: 0.25×40 mm filiform, sterile, single-use (Dongbang DB100); Electrostimulation: Hwato SDZ-II, pairs: (TW-5+PC-7), (SI-4+LI-5), (LI-10+LU-5), (HT-3+PC-3); 10–20 mA, 20–40 Hz, continuous wave, intensity adjusted to visible/tolerable twitch; Duration: 20 min per session; n=90	Nocturnal splinting alone n=91	17 weeks	DASH, NRPS, dexterity (pick-up test), tip pinch strength	Differences between groups were small and clinically unimportant for reduction in pain (NRPS –0.70, 95% CI: –1.34 to –0.06), and not significant for sensation.
Wu et al ³¹ (2020)	Systematic Review (PRISMA/STRICTA-compliant)	10 RCTs (728 participants) with primary CTS	Clinical/ electrophysiological CTS diagnosis; non-surgical interventions	Acupuncture-related therapies: MA, EA	Conventional medications (ibuprofen, prednisolone), splinting, sham acupuncture	Variable (RCT-dependent)	Boston Carpal Tunnel Questionnaire (BCTQ): Symptom Severity Scale (SSS), Functional Status Scale (FSS), Pain (VAS/NRS)	MA superior to ibuprofen (SSS MD= –5.80, 95% CI –7.95 to –3.65 and prednisolone (SSS MD=–6.50, 95% CI: –10.1 to –2.86). EA+ splinting > splinting alone (FSS MD=–6.22, 95% CI: –10.7 to –1.71). Limited pain reduction evidence.
Dong et al ³² (2023)	Systematic Review & Meta-analysis (AMSTAR 2/PRISMA 2020)	16 RCTs (1025 participants) with CTS	CTS diagnosis via symptoms/physical exam/ electrophysiology; adults (≥18 years)	Acupuncture alone or acupuncture plus other treatment(s); no restrictions on the types of acupuncture.	No treatment, sham acupuncture alone, other treatment, or sham acupuncture combined with other treatment(s).	Variable (4 weeks to 17 weeks)	Pain (VAS/NRS), electrophysiological parameters	Acupuncture improved pain (VAS MD –1.65, 95% CI: –3.05 to –0.26) vs the night splints group. No superiority as monotherapy. Low/very low certainty evidence.
Choi et al ³³ (2018)	Systematic review and meta-analysis	12 RCTs (869 adults) with CTS	RCTs comparing acupuncture-related interventions (≥3 weeks follow-up) vs sham/active controls	Acupuncture or related interventions: MA, EA	Sham acupuncture, oral corticosteroids, splints, NSAIDs, vitamin B12	Variable (RCT-dependent)	Symptom improvement (BCTQ SSS/FSS).	Acupuncture showed no clear benefit over sham for CTS symptoms. Few minor adverse events (bruising, pain). Low/very low certainty evidence.

Abbreviations: CTS, Carpal Tunnel Syndrome; TW, Triple Warmer Meridian; PC, Pericardium Meridian; HT, Heart Meridian; SI, Small Intestine Meridian; LI, Large Intestine Meridian; LU, Lung Meridian; BCTQ, Boston Carpal Tunnel Questionnaire; SSS, Symptom Severity Scale; FSS, Functional Status Scale.

Table 3 Evidence Table on Acupuncture Therapy for Patellofemoral Pain Syndrome (PFPS)

Authors & Year	Study Design	Participants	Inclusion Criteria	Intervention Group	Control Group	Time Points	Outcomes	Key Findings
Behrangrad et al ²¹ (2020)	Randomized clinical trial	54 patients (20–30 years) with unilateral PFPS; Iran (2017)	Unilateral PFPS >6 weeks, active Myofascial trigger points (MTrPs) in vastus medialis obliquus (VMO), NPRS >4, Kujala score 40–70	Trigger point dry needling (TrP-DN): Position: Supine, knees extended. Target: Active MTrPs immobilized between thumb and index finger. Needle: 0.25×50 mm sterile stainless-steel acupuncture needles. Technique: Perpendicular insertion over MTrP using fast-in/fast-out method (Llamas-Ramos et al). Needle advanced until local twitch response (LTR). After LTR, 2–3 mm vertical motions at ~1 Hz for 25–30 s. n=27	Ischemic compression applied to VMO MTrPs (3 sessions over 1 week). n=27	Baseline, 1-week, 1-month, 3-month follow-up	Kujala questionnaire, NPRS, PPT	No between-group differences at any timepoint. Both groups showed significant improvements in pain, function, and PPT ($p<0.05$).
Ma et al ²² (2020)	Randomized single-blind controlled trial	50 PFPS patients (18–40 years); China (2017–2019)	Clinical PFPS diagnosis, ≥ 1 active MTrP in quadriceps, NPRS ≥ 3	TrP-DN + stretching. TrP-DN Intervention: Target: Vastus medialis, rectus femoris, vastus lateralis (symptomatic side). Needle: 0.35×40 mm, sterile, single use. Technique: Clean procedure; fast-in/fast-out (Hong's method) until local twitch response. Depth: 15–20 mm (VM), 30–35 mm (VL/RF); ~1 Hz vertical motion until twitch ceased. n=25	Sham needling (blunted needles) + stretching. n=25	Baseline, 3-week, 6-week, 3-month follow-up	VAS, Kujala score, VMO/VL ratio	At 3-month follow-up, TrP-DN group showed superior VAS reduction ($p<0.05$), higher Kujala scores ($p<0.05$) compared to the sham group, and increased VMO/VL ratio post-treatment ($p<0.05$).
Espi-Lopez et al ²³ (2017)	Randomized parallel-group trial	60 adults (19–60 years) with PFP ≥ 6 months; Valencia, Spain	Anterior/retro patellar pain ≥ 6 months, provoked by ≥ 2 activities (sitting/squatting/running)	Manual therapy + exercise + TrP DN: Lumbopelvic/hip/knee thrust manipulation + quadriceps strengthening + DN to active MTrPs in vastus medialis/lateralis (3 sessions/week for 3 weeks); DN targets: Vastus medialis (VM), VL; most painful TrP if multiple. Needle: 0.32×40 mm disposable. Depth: VM 15–20 mm; VL 30–35 mm. Technique: Fast-in/fast-out (Hong's method); vertical motions (3–5 mm, ~1 Hz) until no local twitch response. Sessions: 3 sessions over 3 weeks. n=30	Manual therapy + exercise only (identical protocol without DN). n=30	Baseline, 15 days post-treatment, 3-month follow-up	Knee Injury and Osteoarthritis Outcome Score (KOOS) pain.	No between-group differences (KOOS pain: MD -2.1, 95% CI -4.6 to 0.4). Both groups improved similarly.
Rahou-El-Bachiri et al ³⁴ (2020)	Systematic review and meta-analysis	10 RCTs (6 PFPS)	RCTs evaluating DN for knee pain (musculoskeletal origin)	DN (various protocols)	Sham/placebo/other interventions	Short-term (≤ 3 months), mid-term ($> 3-6$ months), long-term (> 6 months)	Pain intensity, disability scores	Moderate short-term effect on knee intensity for PFPS (SMD -0.64, 95% CI -1.17 to -0.11). Low-moderate evidence quality (GRADE).

Abbreviations: PFPS, Patellofemoral Pain Syndrome; MTrPs, Myofascial trigger points; VMO, vastus medialis obliquus; TrP-DN, Trigger point dry needling; LTR, local twitch response; VL, vastus lateralis; VM, Vastus medialis; KOOS, Knee Injury and Osteoarthritis Outcome Score.

Table 4 Evidence Table on Acupuncture Therapy for Plantar Heel Pain Syndrome (PHPS)/Plantar Fasciitis (PF)

Authors & Year	Study Design	Participants	Inclusion Criteria	Intervention Group	Control Group	Time Points	Outcomes	Key Findings
Wang et al ²⁴ (2021)	RCT (CONSORT)	92 patients with PHPS	PHPS diagnosis ≥ 1 mo, VAS >40 mm for morning heel pain	Electroacupuncture (EA). Sessions: 12 sessions (30 min), 3 \times /week for 4 weeks. Points: 2 ah shi, BL57, KI3, BL60. Needle: 0.30 \times 40 mm Hwato needles, depth 10–15 mm (ah shi), 15 mm (BL57, KI3, BL60). Manipulation: Lift–thrust, twirl–rotate to elicit de qi (soreness, numbness, heaviness). Electrical stimulation: Continuous wave, 2 Hz, 0.1–1 mA (patient tolerance, mild shivering without pain), 30 min; applied via ah shi needles. Additional: Manual manipulation of BL57, KI3, BL60 performed 3 \times within each 10 min period during retention. N=40	MA with same protocol. N=38	4, 16, 28 weeks	Responder rate ($\geq 50\%$ VAS reduction), FFI	No significant difference between EA and MA (54.8% vs 50% responders). Both improved pain/functions.
Rastegar et al ²⁵ (2018)	Single-blind RCT	66 adults with plantar fasciitis	Chronic plantar heel pain ≥ 3 mo, failed conservative therapy	DN. Target: Painful point in plantar fascia; MTrPs of plantar foot muscles (identified by tenderness + patient complaint; medial heel pad respected). Needle: 0.30 mm (30G) sterile needle. Technique: Gradual advance/withdrawal (“fast in/out”) for 30s at intended site. n=33	Steroid injection (40mg methylprednisolone acetate, same location as in the DN group). n=33	3 week, 6 week, 3 month, 6 month, 1 year	VAS pain	Steroids better at 3 weeks (Δ VAS=0.32 vs 3.47; $p<0.001$). DN superior at 1yr (Δ VAS=0.69 vs 2.09; $p=0.004$).

(Continued)

Table 4 (Continued).

Authors & Year	Study Design	Participants	Inclusion Criteria	Intervention Group	Control Group	Time Points	Outcomes	Key Findings
Ho et al ²⁶ (2021)	RCT (STRICTA/STRICTOM)	80 adults (mean 59.7y) with PHPS	PHPS ≥1 mo, VAS ≥50mm for first-step pain	Electroacupuncture with Warm Needling (EAWN). Sessions: 6×30 min over 4 weeks (1 session every 3–5 days). Position: Supine; one/both heels treated. Targets: Ah shi points (tender heel points), KI5 (Shuiquan). Needle: 0.25×40 mm sterile stainless-steel, perpendicular insertion (20 mm). Technique: Needle manipulation to elicit de qi (dull ache, numbness, heaviness). Stimulation: Electroacupuncture: Dense-disperse wave, 2 Hz, 0.1–1 mA (Hwato SDZ-III), 30 min. Warm needling: Moxa sticks (12×15 mm, 0.7±0.05 g) affixed to needle handles, ignited sequentially. n=40	Waitlist control N=40	2, 4, 8 weeks	VAS pain, FFI, GROC	EAWN group had greater VAS/FFI improvements at 4 weeks (p<0.001). Effects sustained at 8 weeks.

Dunning et al ²⁷ (2018)	Multicenter RCT (Level Ib)	111 patients with PF	PF diagnosis, first-step morning pain	EDN + manual therapy/exercise/ultrasound; 8 sessions of EDN 1–2 times/week for 4 weeks. EDN intervention: Standard protocol: 8 obligatory points around plantar fascia insertion at medial calcaneal tubercle, 20 min. Optional points: up to 4 additional sites (eg, gastrocnemius). Needles: Sterile disposable (0.18×15 mm, 0.25×30 mm, 0.30×40 mm). Insertion depth: 10–35 mm (intramuscular, periosteal, perineural). Technique: Bidirectional manipulation to elicit aching, tingling, heaviness, or warmth. Electrical stimulation: Paired needles, 2 Hz, 250 μ s, continuous biphasic waveform, mild–moderate intensity (ES-160, ITO). (n=58)	Manual therapy/exercise/ultrasound alone. (n=53)	1wk, 4wk, 3mo	NPRS (pain), Lower Extremity Functional Scale (LEFS), Foot Function Index (FFI), GROG	The between-groups difference for changes in first step pain at 3 months, as measured by the NPRS (Δ -2.2 points, 95% CI -2.8 to -1.6, P<0.001) exceeded the reported MCID.
Thiagarajah et al ³⁵ (2017)	Systematic Review	4 RCTs (patients with PF)	RCTs comparing acupuncture vs standard treatment or real vs sham acupuncture	MA/EA	Standard therapy/sham acupuncture	4–8 weeks	Pain (VAS, PFPS), side effects	Short-term pain reduction (4–8 weeks), insufficient evidence for long-term efficacy. Minimal adverse effects.
Llurda-Almuzara et al ³⁶ (2021)	Meta-Analysis (PRISMA)	6 RCTs (n=297, patients with PHP/PF)	RCTs on TrP-DN for plantar heel pain	DN targeting myofascial trigger points	Conservative therapy/sham interventions	Short-term (\leq 3mo), long-term (>3mo)	Pain intensity (VAS), disability (FFI)	Moderate evidence for long-term pain (MD -1.77 points, 95% CI -2.44 to -1.11)/disability improvement vs controls. Low evidence for short-term effects (MD -1.70 points, 95% CI -2.80 to -0.60).

Abbreviations: PHPS, plantar heel pain syndrome; PF, plantar fasciitis; GB, Gallbladder Meridian; SP, Spleen Meridian; BL, Bladder Meridian; KI, Kidney Meridian; FFI, Foot Function Index; EAWN, Electroacupuncture + warm needling; LEFS, Lower Extremity Functional Scale.

Acupuncture for Patellofemoral Pain Syndrome (PFPS)

Three randomized trials and one systematic review have investigated the efficacy of acupuncture in adults with PFPS since 2015. A 2020 randomized trial²¹ reported that trigger point dry needling (TrP-DN) had comparable efficacy to ischemic compression in improving pain, function, and pressure pain thresholds for patients with PFPS at 3-month follow-up. Another trial²² found that TrP-DN combined with quadriceps stretching group had greater pain reduction and functional improvement compared to sham needling combined with stretching group at the 6-week treatment visit and the 3-month follow-up, alongside enhanced neuromuscular coordination. A systematic review³⁴ (2020) reported moderate short-term pain relief (SMD -0.64 , 95% CI: -1.17 to -0.11) with TrP-DN compared to comparative group. However, a randomized parallel-group trial²³ found no additional benefit when TrP-DN was combined with a multimodal program (manual therapy + exercise).

Overall, recent evidence suggests that TrP-DN may have efficacy for PFPS at short-to-medium term, though conflicting findings exist regarding its synergistic value in multimodal therapies. More high-quality trials investigating long-term effects are clearly needed. For patients with PFPS, TrP-DN can be considered a therapeutic option for short-to-medium term pain relief. However, its routine addition to a comprehensive multimodal physical therapy program is not consistently supported by current evidence.

Acupuncture for Plantar Heel Pain Syndrome (PHPS)/Plantar Fasciitis (PF)

Two reviews and a clinical trial demonstrate the efficacy of acupuncture therapy for PHPS/PF. Thiagarajah et al³⁵ concluded acupuncture therapy provided short-term (4–8 weeks) pain relief caused by PF. Llurda-Almuzara et al³⁶ further supported DN's efficacy for PHPS/PF, showing low-quality evidence that TrP-DN reduces pain intensity in the short term (MD -1.70 points, 95% CI -2.80 to -0.60) and moderate-quality evidence for long-term (>3 months) pain reduction (MD -1.77 points, 95% CI -2.44 to -1.11) and functional improvement compared to controls. Moreover, a clinical trial²⁵ suggested that DN was superior to steroid injection in patients with plantar fasciitis in the long term (1 year of follow-up).

A clinical study compared the efficacy of different acupuncture modalities for PHPS/PF, while two randomized trials investigated the combined effects of acupuncture therapy. Wang et al²⁴ randomized 92 patients to receive either EA or MA over 4 weeks (12 sessions). The results demonstrated comparable therapeutic effects between EA and MA for PHPS. Both interventions significantly reduced heel pain and improved foot function at 4-, 6-, and 28-week follow-ups, with equivalent response rates ($\geq 50\%$ pain reduction). Ho et al²⁶ demonstrated that a 4-week combined therapy of electroacupuncture with warm needling (EAWN) significantly alleviated first-step pain and improved Foot Function Index (FFI) scores in PHPS patients at the 4-week endpoint, with therapeutic effects sustained through the 8-week follow-up. Dunning et al²⁷ demonstrated that electrical dry needling combined with manual therapy and exercise produced clinically superior outcomes (between-group NPRS $\Delta -2.2$, CI: -2.8 to -1.6 ; SMD: 0.85) with sustained pain reduction and functional improvement at 3-month follow-up for patients with PF.

Current evidence supports the role of acupuncture therapy in managing plantar heel pain. We can consider it as a viable alternative or adjunctive treatment modality to conservative interventions for PHPS/PF. Acupuncture, with DN being particularly supported for long-term efficacy, is a well-evidenced therapeutic option for PHPS/PF that can reduce reliance on pharmaceutical interventions.

Implications for Practice

The evidence across conditions indicates that acupuncture can be considered a viable adjunct or alternative to conventional therapies for extremity musculoskeletal pain. While modality-specific findings vary—manual acupuncture shows modest short-term benefit, electroacupuncture remains inconsistent, and dry needling demonstrates more sustained improvements—acupuncture consistently emerges as a low-risk intervention with potential to enhance multimodal rehabilitation programs. For clinicians, tailoring treatment choice to patient characteristics, preferences, and available expertise remains crucial. Integrating acupuncture into broader rehabilitation strategies may maximize therapeutic benefit and support individualized, evidence-informed care.

Potential Mechanisms of Acupuncture

The therapeutic effects of acupuncture for extremity musculoskeletal pain, as observed across the conditions in this review, may be explained by several interconnected physiological mechanisms. Acupuncture elicits neuromodulatory effects by activating descending pain inhibitory pathways and stimulating the release of endogenous opioids (eg, endorphins) and neurotransmitters, which contribute to its analgesic effect.^{9,37} Its anti-inflammatory properties, mediated through the modulation of local and systemic inflammatory cytokines, may also alleviate the neurogenic inflammation present in tendinopathies such as lateral epicondylitis and plantar fasciitis.¹⁰

In addition, dry needling directly targets myofascial dysfunction by inactivating trigger points, improving local blood flow, and reducing muscle tension, which may underpin its sustained efficacy in conditions like PFPS and PHPS. Specifically, dry needling has been proposed to disrupt ongoing nociceptive input from trigger points and modulate central sensitization,³⁸ and in tendinopathies, it may induce controlled microtrauma that stimulates inflammatory healing responses and promotes collagen remodeling, such as a shift from type III to type I collagen.¹¹ While the predominant mechanism may vary by condition and technique, this multi-modal action provides a plausible theoretical foundation for the clinical outcomes summarized in this review.

Key Strengths of Acupuncture: Efficacy and Safety in Pain Management

Acupuncture therapy has been demonstrated to possess distinctive advantages as an alternative treatment for musculoskeletal pain, particularly in medication-intolerant patients or those seeking drug-free treatment options.³⁹ Different from pharmacological agents, acupuncture does not rely on chemicals and avoids the common side effects of medications, such as digestive discomfort, drug dependence, and liver and kidney burden.⁴⁰ This is especially important for patients who have been chronically reliant on NSAIDs or opioids, as acupuncture offers a safe and effective alternative for pain management.⁴¹

In addition to providing localized pain relief, acupuncture therapy has a holistic modulating effect that improves the overall health of the patient through multiple modulations of the neural-immune system.⁴² Acupuncture exerts a systemic conditioning effect by affecting the cerebral cortex, central nervous system, and immune system, prompting the release of endogenous analgesic substances (eg, endorphins) in the body.³⁷ This makes acupuncture a suitable treatment for pain at a single site, as well as in the management of patients presenting with multiple symptoms.⁴³ This makes it particularly suitable for patients with a history of complex chronic pain.

Challenges and Limitations: Evidence Quality and Practical Considerations

The efficacy of acupuncture is contingent upon individual differences, with the patient's constitution, condition, and sensitivity to acupuncture influencing the therapeutic outcome.⁴⁴ Acupuncture requires an advanced level of manipulation technique, and the treatment effect is predicated upon the therapist's level of experience and skill because of the depth of acupuncture, selection of acupoints, and manipulation techniques all contribute to the efficacy of treatment.^{45,46}

Despite the extensive documentation of acupuncture therapy in clinical practice, the number of high-quality randomized controlled trials remains limited. Moreover, several studies have demonstrated that the absence of scientifically standardized acupuncture treatment protocols, the heterogeneity of the intervention protocols included in the studies, and the low methodological quality have resulted in a low grade of evidence for the efficacy of acupuncture in the treatment of extremity musculoskeletal pain.^{28–33}

Future research should prioritize rigorous, multicenter RCTs with adequate power and adherence to STRICTA reporting guidelines⁴⁷ to ensure methodological transparency. Mechanistic investigations are also needed to clarify the neurophysiological pathways underlying acupuncture's effects. Furthermore, broader inclusion of regional and non-English trials will be essential for developing a globally representative evidence base.

Conclusions

Emerging clinical evidence suggests that acupuncture is a safe and potentially effective treatment for extremity musculoskeletal pain. Stronger support exists for plantar heel pain syndrome (PHPS) and lateral epicondylitis (LE),

while trigger point dry needling may offer short-to-medium term benefits in patellofemoral pain syndrome (PFPS). Evidence remains insufficient for recommending acupuncture in carpal tunnel syndrome (CTS).

For clinical practice, acupuncture should be discussed with patients as a low-risk option, particularly for those unresponsive to or unwilling to pursue first-line treatments. Manual acupuncture may be suitable for short-term relief, while dry needling could be prioritized for longer-term outcomes. Importantly, acupuncture is best integrated into comprehensive multimodal strategies rather than applied in isolation.

Nevertheless, these conclusions are constrained by methodological heterogeneity and the limited number of high-quality studies. Future research should therefore focus on conducting large-scale, standardized RCTs, performing head-to-head comparisons of acupuncture modalities, and expanding the evidence base with underrepresented regional trials. Through these efforts, acupuncture may be more firmly integrated into comprehensive, evidence-based management strategies for musculoskeletal pain.

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Disclosure

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