April 2026
Agency for Care Effectiveness (ACE), MOH

Evidence-to-Recommendation Framework for 2026 ACE Clinical Guideline on the management of knee osteoarthritis – a joint effort with patients

Abstract

This Evidence-to-Recommendation (EtR) framework underpins the ACE Clinical Guideline (ACG) for the management of knee osteoarthritis (OA), providing rationale and justifications for its recommendations. Knee OA is a prevalent and debilitating condition in Singapore, with significant disease burden and impacts on healthcare utilisation costs. The ACG addresses management gaps which contribute to suboptimal clinical outcomes, including insufficient uptake of conservative management, limited knowledge of community exercise and physiotherapist resources, and inappropriate use of complementary and alternative treatments. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework was followed to develop seven evidence-based recommendations that cover comprehensive biopsychosocial assessments, mainstay management strategies, pharmacological treatment, referral to allied health professionals, complementary and alternative treatment, and specialist referrals. This EtR framework summarises the factors that have informed the direction and strength of the ACG recommendations, including balance of benefits and risks, certainty of evidence, patient preferences and values, resources and feasibility considerations, and acceptability.

Introduction

Knee osteoarthritis (OA) was identified as a priority topic in the 2023 ACE Clinical Guidelines (ACGs) topic call to address the lack of updated national guidelines, support appropriate delivery of evidence-based care in community settings and minimise use of treatments that lack robust evidence.

Knee OA is a complex, multifactorial disorder characterised by tissue breakdown and abnormal cellular changes of the entire joint,[1] resulting in three core symptoms: joint pain, stiffness, and difficulty performing daily activities.[2] Beyond these symptoms, knee OA impacts emotional wellbeing, social activities and overall life satisfaction. Psychosocial factors also negatively influence how patients perceive their pain and functional limitations.

Knee OA presents a significant global health burden and ranks among the leading causes of disability worldwide.[3] Singapore ranks third globally for knee OA prevalence and second for disease burden. Knee OA affects approximately 5.8% in Singapore and led to 189 disability-adjusted life years (DALYs) per 100,000 people in 2021.[4]

The healthcare impact has grown substantially over recent years. Between 2014 and 2022, OA-related polyclinic visits increased at a compound annual growth rate (CAGR) of 4%, whilst associated costs rose at 16% CAGR, reaching 2,968 visits per 100,000

residents and $32.8 million in 2022. While hospital admissions with OA as the principal diagnosis remained relatively stable over the past decade at approximately 150 admissions per 100,000 residents, associated costs increased at CAGR of 7% to $147.8 million in 2022, with knee OA being one of the most common subtypes of OA-related hospital admissions.[5]

Interviews with domain experts and an in-house survey of primary care physicians (n = 92) identified opportunities to enhance clinical practice, including strengthening knowledge of exercise prescription, patient education strategies and community exercise programmes. Additional areas of improvement include increasing awareness of physiotherapy benefits and services, optimising referral timing to physiotherapists, refining the use of complementary and alternative therapies, enhancing pain management for older patients and improving understanding of differential diagnoses for knee conditions.

Methods

This guideline was developed based on the ACE methods and processes for ACG development, and following a hybrid de-novo/adaptation process.[6] A systematic search for international guidelines was conducted across databases including Guideline Central, Guideline International Network Library, ECRI Guidelines Trust, PubMed, Epistemonikos, and Trip Medical Databases, supplemented by manual retrieval from relevant specialty associations. Eight English-language guidelines published within the previous five years were prioritised and assessed using the Appraisal of Guidelines for Research & Evaluation II (AGREE-II) tool Domain 3 (Rigour of Development), applying a minimum 60% scaled domain score threshold. Overall, six high-quality guidelines were selected as main reference guidelines. Recent systematic reviews and meta-analyses were identified from PubMed and Google Scholar to complement guideline evidence.

A multidisciplinary expert group (EG) comprising two orthopaedic surgeons, six primary care physicians, two pain medicine physicians, two pharmacists, one physiotherapist, one occupational therapist, two nurses, and one Traditional Chinese Medicine (TCM) physician was appointed to provide clinical expertise throughout guideline development.

Draft recommendations were formulated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) EtR framework, incorporating five key domains: balance of benefits and harms; certainty of evidence; values and preferences; resources and feasibility; and acceptability and other considerations. EG members individually rated recommendation appropriateness using the RAND/UCLA Appropriateness Method, followed by structured discussions to achieve consensus.

Recommendation 1: Assess the patient's pain level, functional capacity, quality of life, psychosocial factors and response to previous treatments (if applicable) to create an individualised management plan.

Strength of recommendation: **Strong** Conditional

Summary: Assessing these domains constitute a comprehensive biopsychosocial evaluation focused on outcomes that matter most to patients.

Balance of benefits and harms

Besides assessing the three core knee OA symptoms (joint pain, stiffness, and difficulty performing daily activities[2]), assessing the patient's QoL and psychosocial factors captures the broader impact of knee OA on their emotional wellbeing, social activities and overall life satisfaction. Psychosocial factors like kinesiophobia, pain catastrophising, depression and poor sleep can negatively influence how patients perceive their pain and functional limitations, and affect adherence to mainstay strategies.[7] These assessments are not expected to present any harm to patients, and a comprehensive approach increases the likelihood of treatment success by ensuring the management plan addresses the individual's specific needs and circumstances.

Certainty of evidence	Values and preferences
Reference guidelines strongly recommend assessing pain, function, QoL, psychosocial factors and treatment response to accurately assess a patient's condition and guide treatment approaches.	An international workgroup comprising patients with OA, orthopaedic surgeons, primary care physicians and physiotherapists established that the outcomes that matter most to patients include joint pain, physical functioning, QoL and overall satisfaction with treatment result.[8] No significant variability in patient preferences is expected, though the definition of outcomes will depend on individual patient's circumstances (e.g. age, prior activity/exercise levels, productivity needs).
Resources and feasibility	**Acceptability and other considerations**
The recommendation aligns well with local clinical practice, though different settings may have varying degrees of resources available e.g. consultation time, which may affect feasibility considerations.	Clinicians prefer rapid and simple assessment tools for pain, function and QoL which can be generalised across disciplines and require minimal training.

EG deliberation of the above factors

The EG agreed to a strong recommendation for these assessment domains as they are important for a holistic biopsychosocial evaluation. The Expert Group also agreed that no specific assessment tools should be recommended, allowing for clinician choice based on available time and required depth of assessment.

Recommendation 2: Provide patient education, exercise programmes and weight management as mainstay strategies for all patients with knee OA, tailoring advice based on individual patient profile.

Strength of recommendation: **Strong** Conditional

Summary:
Patient education, exercise programmes and weight management are the foundational management strategies for knee OA. While longer consultations may be initially required for comprehensive patient education, this could reduce future consultation frequencies through improved self-management.

Balance of benefits and harms

Patient education is recognised across reference guidelines as an integral part of knee OA management.[9-11] It works synergistically with other treatment approaches such as exercise and weight management to provide greater benefits compared to a single approach.[12-14] No harms are associated with education, but limitations with implementation may mean that short-term improvements in OA knowledge from education sessions may not necessarily translate into belief and behavioural change.[15]

Exercise is demonstrated to have sustained benefits (up to one year) on pain reduction and functional improvement.[10, 12, 16-18] Other benefits include delaying cartilage and bone degeneration and reducing inflammation.[19] While some guidelines recommend specific low-impact exercises like walking, muscle-strengthening and/or hydrotherapy, others cite insufficient evidence to recommend one form of exercise over another.[10, 20, 21] It may be more beneficial to recommend an exercise programme which patients find acceptable to improve adherence and outcomes for pain, function and QoL. Most risks associated with exercise are minor and involve transient increased pain and swelling at the knee joints.[20, 21]

Weight management is an umbrella term encompassing weight loss, weight maintenance and prevention of weight gain.[22] Like exercise, weight loss can improve pain and disability compared to minimal care, with larger improvements in pain when combined with patient education.[23] While gradual and sustained weight loss are associated with benefits for patients with knee OA, rapid weight loss has been associated with risks like joint instability, sarcopaenia and osteoporosis.[24] Long-term weight loss maintenance also remains a challenge, with high rates of weight regain observed in OA patients.[24] To minimise these risks, patients should be advised to adopt strategies which promote gradual and sustainable weight loss.

Certainty of evidence	Values and preferences
Patient education: Very low-to-moderate certainty due to inconsistent methodologies, risk of bias and imprecision.[10, 13, 20]	Patient education, exercise and weight management can improve pain, function and QoL, which matter most to patients.[8] No significant variability in how patients value outcomes is anticipated.[15, 27-29]

Exercise programmes: Moderate certainty evidence due to inconsistency of exercise protocols, duration and degree of supervision.[9, 12, 21, 25] Weight management: Very low-to-moderate certainty due to substantial heterogeneity and high risk of bias.[22, 23, 26]	
Resources and feasibility	**Acceptability and other considerations**
Although consultation durations will likely be longer, comprehensive education could reduce future consultation frequency if patients become more self-sufficient in managing their condition.	Patients generally wish to understand more about their condition and how to manage it through individualised, evidence-based education.[27] Exercise is highly preferred by patients due to its benefits for knee OA and minimal adverse effects compared to oral non-steroidal anti-inflammatory drugs (NSAIDs).[15, 28] However, some report difficulty exercising when they have joint pain. Therefore, providing personalised information about the safety and importance of exercise could increase the adoption of exercise interventions.[15] While most patients with obesity or overweight will agree that losing weight would help with OA symptoms, they find it difficult to lose weight and sustain it.[29] It is anticipated that there will be some variability in the acceptability of all three interventions, depending on the clinician's delivery of the advice.
EG deliberation of the above factors	
The EG agreed to a strong recommendation, though not all patients with OA may need all these strategies (e.g. patients who are bedbound, underweight). Therefore, the caveat 'tailoring advice based on individual patient profile' was added to acknowledge the importance of individualising these strategies.	

Recommendation 3: To complement or support adherence to mainstay strategies for knee OA:

a) Offer a topical NSAID

b) Consider prescribing short courses of an oral NSAID if topical NSAIDs are ineffective or unsuitable

Strength of recommendation	**Strong**	Conditional	**(3a):**
Strength of recommendation	Strong	**Conditional**	**(3b):**

Summary: Topical NSAIDs are strongly recommended due to their favourable benefit and safety profile compared to oral NSAIDs and other analgesics, as well as patient preferences. Short courses of oral NSAIDs, which carry higher risks of adverse effects, can be offered if topical NSAIDs prove ineffective or unsuitable.

Balance of benefits and harms

Topical NSAIDs are strongly recommended by reference guidelines due to their favourable risk-benefit profile and similar efficacy to oral NSAIDs.[9, 10, 16, 25, 30] A network meta-analysis (NMA) of 122 randomised controlled trials (RCTs) and observational studies found that topical NSAIDs outperformed paracetamol in functional improvement (standardised mean difference [SMD] 0.29, 95% confidence interval [CI] 0.06 to 0.52), and demonstrated similar benefits for pain.[31] Additionally, topical NSAIDs demonstrated a better safety profile than paracetamol, with only mild local skin reactions and lower risks of gastrointestinal (GI) adverse effects (relative risk [RR] 0.52, 95% CI 0.35 to 0.76).[31] Topical NSAIDs also demonstrated similar benefits for pain (SMD 0.21, 95% CI −0.16 to 0.58) and function (SMD 0.03, 95% CI −0.16 to 0.22) as oral NSAIDs, but lower risks for GI adverse effects (RR 0.46, 95% CI 0.34 to 0.61).[31]

A meta-analysis of 32 RCTs demonstrated that oral NSAIDs led to significant pain reduction compared to placebo, peaking at two weeks (SMD -0.43, 95% CI -0.48 to -0.38), though this effect diminished after eight weeks.[32] Both non-selective NSAIDs and COX-2 inhibitors provide similar improvements in pain and function.[20] GI adverse effects were significantly higher with oral NSAIDs than placebo, but most were mild and transient.[32] Although COX-2 inhibitors are associated with lower GI risks than non-selective NSAIDs, this benefit may be outweighed by their higher cardiovascular risks.[33]

Oral NSAIDs are also more effective for pain and function than paracetamol for most people.[20] Opioids are strongly discouraged due to marginal benefits and significant long-term safety risks.[10, 12, 20, 25, 30, 34-36]

Duloxetine has been recommended by reference guidelines as a third-line pharmacological option and has been demonstrated by multiple systematic reviews and meta-analyses of RCTs to provide small improvements in pain, function and quality of life compared to placebo. However, they may not be clinically significant.[37, 38] There are also no studies comparing duloxetine to NSAIDs for knee OA. Furthermore, the use of duloxetine will be considered off-label, as it is not registered for OA locally.

Certainty of evidence	Values and preferences
Topical NSAIDs: Moderate certainty, downgraded due to small effect size and some inconsistency.[39] Oral NSAIDs: Moderate-to-high certainty.[32]	Both topical and oral NSAIDs can improve pain and function in patients with knee OA, which are outcomes important to them.[8] Patients' preference to avoid adverse effects should be considered, supporting the preferential use of topical NSAIDs over oral ones.
Resources and feasibility	**Acceptability and other considerations**
Topical NSAIDs like diclofenac and ketoprofen gel are available for subsidy on the Standard Drug List (SDL), but are not on the list of whitelisted medications for HealthierSG. However, healthcare institutions currently view paracetamol as the first-line pharmacological option before topical NSAIDs.[40-42] This recommendation may drive changes in clinical approach, but poses no significant concerns with feasibility given the wide availability of and clinical familiarity with NSAIDs. Oral NSAIDs like ibuprofen, diclofenac, mefenamic acid, piroxicam, celecoxib and etoricoxib are subsidised via SDL, and diclofenac and etoricoxib are on the HealthierSG Medication List. Prescription of oral NSAIDs will require clinicians to monitor patient response to treatment and adverse effects, and discontinue treatment when appropriate.	Topical NSAIDs are among the most preferred treatments by patients with knee OA due to its benefits and fewer side effects.[27, 43] Oral NSAIDs may be less preferred by patients compared to non-pharmacological approaches due to their adverse effects.[27] Clinicians will have to carefully assess cardiovascular, GI and renal risk factors when prescribing oral NSAIDs.
EG deliberation of the above factors	
The EG noted that the purpose of pharmacological treatment should be to support adherence to mainstay strategies. They agreed it was appropriate to offer topical NSAIDs first and only consider oral NSAIDs if topical NSAIDs are ineffective or unsuitable.	

Recommendation 4: Consider referring patients with knee OA to relevant allied health professionals for additional non-pharmacological strategies (e.g. supervised exercise, walking aids).

Strength of recommendation: Strong **Conditional**

Summary: Referral to allied health professionals (AHPs) can be considered for some patients who could benefit from additional non-pharmacological strategies, balanced against limited healthcare resources and patient preferences.

Balance of benefits and harms

Referral to physiotherapists is recommended by reference guidelines for patients requiring support with exercise adherence.[9, 11, 12, 16, 20, 25, 30] This approach is particularly relevant for patients with functional limitations, muscle weakness or limited range of motion, who overseas expert opinion suggests may derive greater benefit from physiotherapy intervention. Through supervised exercise and tailored advice, physiotherapists can promote long-term treatment adherence. The effectiveness of this approach is supported by a recent meta-analysis of RCTs demonstrating that while both supervised and home-based exercises are effective, supervised physiotherapist-led exercises resulted in larger improvements in pain and disability.[44]

Evidence-based assistive devices (e.g. walking aids, knee braces etc.) are recommended by reference guidelines to provide additional stability and decrease weight burden.[10, 12, 20, 25, 30] However, such assistive devices may cause blistering and pressure damage, depending on the type of device.[25] Physiotherapists or occupational therapists are well-positioned to recommend appropriate devices and advise on proper use.

Cognitive behavioural therapy (CBT) is recommended by some reference guidelines, especially for patients with psychosocial factors.[10, 20] A recent systematic review of RCTs supports this position by demonstrating improved pain and function from adding CBT to mainstay treatments.[45] Referral to psychologists may be especially beneficial for patients with psychosocial factors.

For patients requiring weight management support, dietitians can provide individualised advice for dietary interventions, which have been demonstrated by a recent systematic review of RCTs to improve pain and function for patients with OA.[46]

No significant harms are expected from supervised exercise, assistive devices, CBT or dietary interventions.

Certainty of evidence	Values and preferences
Direct comparative trials on AHP referrals versus non-referral pathways are lacking. However, the recommendation of such referrals by reference guidelines reflects	Referral to AHPs can improve patients' pain, function and QoL.

high consensus among expert panels and supports this recommendation.	
Resources and feasibility	**Acceptability and other considerations**
AHP referrals may be limited by availability of manpower and facilities. Nonetheless, established referral pathways under the HealthierSG care protocol for body mass index (BMI) control exist for patients requiring weight management support with dietitians, with referral criteria based on BMI and the presence of metabolic conditions.	Patient preferences may be mixed for such referrals. Some may prefer them if the referral pathway provides easy access to treatment and long-term positive effects,[43] but others may perceive the associated costs, time and effort as deterrents.[20]
EG deliberation of the above factors	
The EG agreed on a conditional recommendation for AHP referrals and suggested positioning them as concurrent options alongside pharmacological treatment, rather than as sequential interventions to be considered only after pharmacological treatment has been attempted, so that patients who can benefit from them are referred early. The EG also agreed that AHP referrals should be made on a case-by-case basis to prevent unnecessary service burden, recognising that certain patient groups may benefit more. Given the diverse patient populations involved, and services provided by different AHPs, information about patient types and AHP-led interventions should be included in the supporting text rather than within the recommendation itself.	

Recommendation 5: Consider intra-articular corticosteroid injections for short-term symptom relief alongside mainstay strategies for knee OA if symptoms persist despite NSAID treatment and/or allied health professional support.

Strength of recommendation: Strong **Conditional**

Summary: Intra-articular corticosteroids (IA CS) can be considered if symptoms persist after treatment with NSAIDs and/or by AHPs. Its use should be balanced against its benefit-risk profile and resource limitations.

Balance of benefits and harms

IA CS injections are positioned by guidelines as an option after treatment with NSAIDs and/or by AHPs has proven ineffective for managing symptoms.[9, 10, 12, 20, 25, 30] An NMA of intra-articular therapies for OA demonstrated that triamcinolone had the highest probability of achieving clinically meaningful pain relief compared to placebo.[47] A meta-analysis of 11 RCTs showed that IA CS offered clinically significant pain relief and functional improvement at short term (≤3 months) compared to placebo injections.[48] However, physiotherapy demonstrated larger benefits for functional improvement than IA CS in the long term (≥ 24 weeks).[49] IA CS are also associated with adverse effects like elevated blood glucose levels, adrenal suppression and reduction in bone mineral density.[50] There is also mixed evidence associating multiple IA CS injections with knee cartilage loss.[34, 51] Therefore, IA CS should be positioned as temporary pain relief in conjunction with exercise, instead of a standalone treatment.

Certainty of evidence	**Values and preferences**
Very low-to-low certainty, downgraded due to risk of bias and inconsistency.[11, 20, 48, 52]	Patients experienced pain relief, less joint stiffness and an opportunity to return to activities meaningful to them with IA CS, and perceived it as an effective alternative to undesirable treatments like strong analgesics or surgical options.[53]
Resources and feasibility	**Acceptability and other considerations**
Although methylprednisolone and triamcinolone are subsidised via the SDL, they are not on the HealthierSG Medication List. IA CS injections also incur higher costs to patients and the healthcare system per treatment episode than oral medications, due to sterility considerations and specialised training. This recommendation may also lead to increased specialist referrals as many primary care clinicians seek additional support for IA CS administration.[53]	Some clinicians may be reluctant to prescribe IA CS due to its uncertain evidence base and long-term safety data.[53]

EG deliberation of the above factors
The EG agreed to a conditional recommendation for IA CS. Notwithstanding the resource constraints for administering IA CS in the primary care settings, the EG agreed that flexibility to administer IA CS in primary care or specialist settings is important. They also agreed that resource limitations may not pose a significant problem as IA CS should not be administered frequently.

Recommendation 6: Consider acupuncture as adjunctive therapy for patients with knee OA who have not responded adequately to conventional therapies (e.g. exercise, NSAIDs) or prefer alternative treatments.

Strength of recommendation: ~~Strong~~ **Conditional**

Summary: Acupuncture can be considered as adjunctive therapy, given its favourable benefit-risk profile when added to exercise or medications, but must be balanced against uncertain impacts on resources and feasibility, and mixed patient preferences.

Balance of benefits and harms

An internal systematic review of 20 RCTs conducted by ACE to examine the updated evidence for efficacy and safety of acupuncture demonstrated benefits for pain relief and function compared to sham acupuncture or no treatment (Appendix A).[54, 55] Two meta-analyses of RCTs demonstrated that the combinations of acupuncture and exercise, and acupuncture and analgesics, significantly improved pain and function compared to acupuncture or analgesics alone, respectively.[56, 57]

While acupuncture is generally safe, minor temporary adverse events such as pain during needle insertion, soreness and pain following needle insertion, and local bruising may occur.

Certainty of evidence	**Values and preferences**
Low-to-moderate certainty (due to inconsistency and imprecision), with more recent RCTs having lower risks of bias.[55, 58]	Acupuncture can further improve pain and functional capacity for patients who have already tried conventional therapies.
Resources and feasibility	**Acceptability and other considerations**
Acupuncture may be cost-effective as an add-on treatment to exercise and education compared to exercise and education alone (incremental cost-effectiveness ratio [ICER] £3,889/quality-adjusted life year [QALY]),[59, 60] but the clinical heterogeneity across these studies limits the relevance of these findings to local healthcare contexts. Limited health insurance coverage for acupuncture may present barriers. Additionally, licensed local acupuncturists who can perform acupuncture at an acceptable standard in compliance with sterility requirements may be limited.	Patient preferences and values may heavily influence their willingness to accept acupuncture. Some may not accept acupuncture as a treatment option because they are sceptical of its benefits or are afraid of the pain of needling, while others seeking effective non-pharmacological options with minimal adverse events may accept acupuncture, especially if recommended by others who have benefitted from it.[27, 61]

EG deliberation of the above factors

The EG agreed on a conditional recommendation for acupuncture and acknowledged that its juxtaposition against the term ‘conventional therapy’ in the recommendation implies that acupuncture is considered as unconventional therapy, despite evidence supporting its use.

Recommendation 7: For patients with knee OA whose persistent symptoms significantly impact function and quality of life, discuss referral options for surgical or advanced pain management.

Strength of recommendation: **Strong** Conditional

Summary: Providing both surgical and advanced non-surgical options to patients who have exhausted conservative management is beneficial to patients, with no significant feasibility concerns identified.

Balance of benefits and harms

Referrals for surgical management are strongly recommended by reference guidelines if patients' symptoms persist and significantly diminishes QoL despite conservative management.[9, 11, 25] Such referrals allow patients to access surgical management which can offer symptom relief not achievable with conservative management.

For patients who have exhausted conservative approaches but are ineligible for or prefer to avoid surgical management, referrals to pain specialists offer an alternative. Patients reporting significant and persistent knee pain may benefit from specialised therapies like genicular nerve block or radiofrequency ablation, which provides an alternative for improving pain and function.[62, 63]

Certainty of evidence

Direct comparative trials on referring versus not referring are lacking. However, such recommendations in reference guidelines reflects expert consensus to provide this option when patients do not experience symptom relief with conservative management.[9, 11, 25]

Values and preferences

Patients who experience worsening symptoms despite receiving conservative management may perceive surgery as the most effective option for long-lasting symptom relief and/or appreciate the linear pathway for surgical management (as opposed to multiple referrals to and appointments with AHPs).[64]

Providing an option for advanced non-surgical approaches may be preferable for patients who prefer to avoid surgical management, are unsuitable for it or are awaiting surgery.

Resources and feasibility

In primary care, there are existing local referral pathways for surgical or advanced pain management.

Acceptability and other considerations

When discussing potential surgical referral, patients should be informed on potential surgical risks and appropriate expectations for symptom relief to help them manage expectations and minimise post-surgery disappointment.[65]

	No significant concerns were identified for referring patients for advanced pain management.
EG deliberation of the above factors	
The EG agreed that is more appropriate to provide both surgical and advanced non-surgical options to patients who have exhausted conservative management, rather than offering surgical management as the sole option. This would allow the clinician to tailor their referral to the appropriate specialist based on patients' values and preferences.	

Implementation/Uptake of recommendations

Systematic implementation of these evidence-based recommendations can substantially enhance the management of knee OA by ensuring comprehensive patient assessment and prioritising non-surgical management strategies (mainstay non-pharmacological strategies supported by pharmacotherapy, AHP referrals and/or complementary and alternative treatments) before considering surgical or other interventions. Such efforts can help delay disease progression and improve clinical outcomes and patients' QoL.

To drive sustainable behaviour change and reduce practice variation, multi-faceted implementation strategies addressing capability, opportunity, and motivation barriers should be considered:

- **Integration into clinical pathways:** Embed recommendations within existing national care protocols, organisational protocols, and clinical pathways, ensuring alignment with current workflows and resource considerations.
- **Education and training:** Incorporate guideline content into clinical meetings and training programmes, emphasising comprehensive assessment and non-surgical management strategies. Clinicians should use shared decision-making to collaboratively determine whether treatments are effectively managing symptoms and meeting individual patients' goals, recognising that treatment effectiveness and patient priorities may change over time.
- **Community physiotherapy programmes awareness:** Increase primary care physician awareness of subsidised community physiotherapy programmes available through means-testing to improve referral rates.
- **Documentation practices:** Encourage clinicians to document the provision of patient education, exercise programmes, and weight management in clinical records, and record patient feedback on these mainstay treatments so that potential issues and misconceptions can be identified and addressed.

- **Digital support tools:** Explore feasibility of incorporating digital tools in clinical decision support systems to guide point-of-care management.
- **Patient empowerment:** Provide educational materials that dispel misconceptions about exercising (e.g. exercise worsens knee OA symptoms) and practical resources demonstrating how patients with knee OA can exercise safely.

Conclusion

This EtR framework summarises the evidence base, rationale, and expert deliberations that underpin the ACG recommendations for managing knee OA. The recommendations are applicable across all care settings but are especially relevant to primary care, where most knee OA cases present and can be managed holistically. They aim to optimise management by empowering primary care physicians to conduct comprehensive assessments, offer evidence-based interventions, and minimise unnecessary specialist referrals.

While primary care physicians are central to managing knee OA, multi-disciplinary management involving AHPs, specialists, and other healthcare professionals enables comprehensive care delivery and promotes patient adherence. Successful implementation requires a coordinated, multi-faceted approach that systematically addresses barriers related to capability, opportunity, and motivation.

Collectively, these strategies can foster consistent, evidence-based care that significantly improves patient outcomes and QoL, encourages appropriate care placement and reduces unnecessary surgical interventions for individuals with knee OA.

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We thank Dr Michelle Koo for medical writing support and editorial review, and Dr Sharmini Rathakrishnan and Dr Muhammad Taufeeq Wahab for their assistance with data analysis and scoping of this ACG.

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April 2026
Agency for Care Effectiveness (ACE), MOH

Appendix A: ACE's critical appraisal of published evidence on effectiveness and safety of acupuncture for adults with knee osteoarthritis

Characteristics of included studies

Twenty randomised controlled trials (RCTs) (n=2,829 participants across all studies) evaluated the effectiveness of acupuncture vs controls on adults with knee osteoarthritis (OA).

Eighteen relevant RCTs were extracted from a recent 2025 systematic review and network analysis.[1] The review searched the following databases Cochrane Library, Embase, PubMed, Web of Science, Chinese Biomedical Database (CBM), VIP, Chinese National Knowledge Infrastructure (CNKI), and *Wanfang* databases from inception until 1 October, 2024. Grey literature, reference catalogues and related systematic reviews were searched as well. ACE supplemented this search from 2024 to 2025 across PubMed, Embase, and Cochrane library, and two additional RCTs were added to data from the initial systematic review and analysed together, totalling to a review of 20 studies.[2,3]

RCTs included double-armed trials, three-armed trials, and multi-centre trials, of which patients had an age range of 40-75 years old, with females having a higher prevalence (66%) across the studies. Most studies included patients diagnosed with knee OA without a specific definitive diagnostic criterion. Exclusion criteria for study patients included: other inflammatory diseases, local skin damage, poor skin conditions or coagulant dysfunctions, knee pain attributed to conditions such as rheumatic joints, gout, infection, tumour, autoimmune diseases, trauma or other causes of knee pain or knee deformities, recent arthroscopic examination or surgery, intra-articular injections, or acupuncture treatment within between 1 month to a year (depending on study), presence of severe acute or chronic organic disease, serious mental illness, coagulation dysfunction, metal allergy, fear of needles, pregnancy, or breastfeeding, or other deemed unsuitability for participation due to health, social, or psychological factors such as frequent changes of residence or mental disorders.

Acupuncture treatment sessions ranged between 2 to 8 weeks, with follow-ups up to 24 weeks. Acupuncturists had specific clinical experience in acupuncture and underwent training in standardised operating procedures for acupuncture point localisation and needling techniques. Interventions of interest in this review include manual acupuncture (6 studies), warming acupuncture (manual acupuncture with moxibustion; 5 studies), and electroacupuncture (9 studies). Outcomes of interest include the Visual Analog Scale (VAS); Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Pain and Function scale, and the Lysholm Knee Scoring Scale. For the network analysis, a surface under the cumulative ranking curve (SUCRA) was used (larger percentage = intervention has highest probability of becoming the preferred option, 0% = intervention completely ineffective) to compare treatment types. Adverse reactions were also examined. Further details can be found in Tables 1 and 2.

Table 1. Intervention types as defined by Wang et al. 2025

Study	Description
Conventional Medicine	All drugs must be approved by the U.S. Food and Drug Administration or China's National Drug Administration and meet guidelines or expert consensus recommendations for the treatment of knee osteoarthritis. In order to reduce heterogeneity, only nonsteroidal anti-inflammatory drugs (NASIDs) are included in conventional drugs.
Electroacupuncture (EA)	EA is a method of preventing and treating disease by combining needle and electrical stimulation by passing a trace current close to the body's bioelectricity through the needle tool after the needle has been inserted into the acupoint to obtain Qi.
Manual Acupuncture (MA)	This is one of the most commonly used acupuncture treatments. After penetrating the skin with acupuncture needles, lifting, inserting, twisting and other techniques are used to achieve the purpose of obtaining Qi.
Moxibustion (MB)	MB is a treatment method that uses moxa leaves to make moxa sticks, moxa pillars, which produce moxa heat to stimulate acupuncture points or specific areas of the body for the purpose of preventing and treating disease.

Sham Intervention (SI)	A sham intervention has no therapeutic effect and has a substitution and comforting effect.
Warming Acupuncture (WA)	Warming acupuncture is the application of acupuncture with warm stimulation. After gas is injected into the needle, mugwort or moxa is placed on the needle handle to make heat pass through the needle into the body.

Table 2. Summary tables.

Included Studies	Mean age/years		Sample size (m/f)		Mean disease duration		Interventions		Duration/ week	Follow-up/ week	Outcome measures
	T	C	T	C	T	C	T	C			
Manual Acupuncture (n=757)											
Li WD 2014	60 ± 6	62 ± 4	16/34	20/30	13.7 ± 8.4M	12.6 ± 9.6M	MA	EA	4	24	1,2,3,5
Lin LL 2018	59.5 ± 7.5	60.0 ± 7.3	4/17	1/20	60.0 ± 45.9	63.1 ± 45.4M	MA	SI	8	8,18	1,2,3,5
Liu XY 2024	60.9 ± 7.1	61.3 ± 6.7 59.9 ± 6.9	5/30	5/31 11/28	11.3 ± 9.9M	13.8 ± 10.5M 12.2 ± 8.1M	MA	ER AER	2	8	1,2
Sun JS 2025*	59.10 ± 9.81	60.74 ± 974 59.93 ± 10.15 58.49 ± 9.19 59.98 ± 8.88 59.11 ± 10.00	16/43	8/49 17/40 41/18 11/42 12/42	NR	NR	MA	EA WA MM SA CM	4	12,24	1,3
Wang GX 2020	44.5 ± 5.1	46.8 ± 3.1	13/20	15/17	1.7 ± 0.3Y	1.9 ± 0.4Y	MA	CM	4	NR	1,5
Wang KX 2020	56.87 ± 7.94	58.69 ± 7.32	17/34	22/28	5.28 ± 2.61Y	4.86 ± 1.38Y	MA	CM	5	12	5
Warming Acupuncture (Acupuncture + Moxibustion) (n=441)											
Li Y 2022	58 ± 8	59 ± 9	17/15	15/18	50.13 ± 31.88M	48.70 ± 33.24M	WA	MA	4	NR	2,3
Lin Y 2021	63.01 ± 2.41	63.51 ± 2.74	28/25	30/23	6.10 ± 1.25Y	6.20 ± 1.04Y	WA	MA	2	NR	4
Sun GF 2021	60 ± 9	57 ± 8	14/32	15/30	5.79 ± 1.53Y	5.25 ± 1.48Y	WA	CM	4	NR	1,2,3,5
Xia Z 2022	59.87 ± 1.46	60.10 ± 1.86	33/28	31/30	5.61 ± 3.52Y	5.32 ± 3.47Y	WA	CM	4	NR	1,4
Zhang F 2022	63.73 ± 5.13	63.65 ± 6.23	12/16	10/19	44.37 ± 19.54M	45.15 ± 19.87M	WA	CM	4	NR	1,5
Electroacupuncture (n=1,631)											
Fu MY 2013	57.41 ± 10.98	59.36 ± 11.30 58.13 ± 11.52	34/36	30/38 39/31	52.33 ± 44.31M	50.46 ± 43.32M 55.27 ± 45.37M	EA	MA CM	4	9	2,3,5
Ji LL 2012	56.73 ± 10.08	58.77 ± 7.98	12/18	11/19	38.17 ± 23.99M	39.23 ± 25.54M	EA	WA	4	NR	1,2,3
Ju ZY 2017	60 ± 10	64 ± 6	6/24	7/23	29.89 ± 29.74M	32.74 ± 31.43M	EA	CM	2	NR	1,2,3
Liu Y 2022	58 ± 7	56 ± 6 62 ± 8	7/23	8/22 10/20	5.9 ± 3.1Y	6.6 ± 3.2Y 5.8 ± 2.8Y	EA	MA CM	3	NR	1,5
Lv ZT 2019	64.6 ± 10.2	63.7 ± 9.3	39/106	15/60	NR	NR	EA	SI	2	NR	1,5
Shi GX 2020	52~78	52~78	28	30	69.93 ± 56.69M	69.93 ± 56.69M	EA	MA	8	4,8	1,2,3,5
Tu JF 2021	62.7 ± 6.6	63.0 ± 7.2 62.8 ± 7.6	32/119	31/111 40/106	6.0 ± 5.3Y	6.0 ± 5.6Y 7.5 ± 6.1Y	EA	MA SI	8	8,18	2,3,5
Wang TQ 2020	58.89 ± 6.75	59.70 ± 7.36	5/23	9/21	69.93 ± 56.69M	73.20 ± 56.71M	EA	MA	4	4,8,12	1,2,3,5
Yang S 2022	58.26 ± 9.32	54.95 ± 11.26	69/154	65/160	1~50Y	1~47Y	EA	TT	2	4	1,5

**A comparative efficacy study was conducted on different acupuncture techniques for knee OA instead of a specific acupuncture treatment versus controls.*

AER, acupuncture and exercise rehabilitation; C, control; CM, conventional medicine; EA, electroacupuncture; ER, exercise rehabilitation; M, months; MA, manual acupuncture; NR, not recorded; SI, sham intervention; T, treatment; TT, Tuina therapy; WA, warming acupuncture; Y, years [1]VAS, visual analog scale; [2]WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index Pain; [3]WOMAC Function, [4]Lysholm Knee Scoring Scale, [5]adverse reaction.

Outcomes

Visual Analog Scale (VAS) scores

Electroacupuncture has highest efficacy in reducing VAS pain scores compared to manual acupuncture or warming acupuncture. The network analysis showed that EA showed better efficacy than WA (SMD = -0.64, 95% CI [-1.25, -0.03]), MB (SMD = -0.85, 95% CI [-1.53, -0.18]), and MA (SMD = -0.96, 95% CI [-1.42, -0.50]) in reducing VAS scores. EA scored the highest in effectiveness in reducing VAS score (SUCRA = 90.2%), followed by WA (SUCRA = 44.5%), MB (SUCRA = 33.4%), MA (SUCRA = 26.2%), CM (SUCRA = 6.9%), and SI (SUCRA = 5.4%). This was supported by another trial where EA had highest efficacy across all other acupuncture treatments, SA, and CM, in reducing VAS scores (1.14; 95% CI [0.55, 1.72]; P < 0.01).[2] Despite not having the same efficacy as EA, both WA and MA are still consistently effective as interventions, with MA leading to lower VAS scores compared to a sham acupuncture group[2] or exercise rehabilitation at 4 weeks.[3]

WOMAC scores

Electroacupuncture has higher efficacy in reducing WOMAC pain scores compared to manual acupuncture. The network analysis showed that EA was a better intervention than MA (SMD = -2.01, 95% CI [-3.36, -0.67]), with a 79% probability of being a top intervention compared to other interventions like WA (SUCRA = 45.0%), MA (SUCRA = 34.0%), CM (SUCRA = 7.0%), and SI (SUCRA = 5.8%). While MA independently improved WOMAC pain scores, the trial on acupuncture and exercise rehabilitation showed highest efficacy at 8 weeks, showing possible combined effects of both treatments.[3]

Warming acupuncture and electroacupuncture have higher efficacy in improving WOMAC function scores compared to manual acupuncture. The network analysis showed that WA was more effective in decreasing WOMAC function scores when compared with MA and SI ($p < 0.05$), with higher treatment probabilities for WA (SUCRA = 72.6%), followed by EA (SUCRA = 37.3%), MA (SUCRA = 23.5%), SI (SUCRA = 16.9%), and CM (SUCRA = 0.1%). However, in another trial, EA showed the highest efficacy across all other acupuncture treatments, SA, and CM, in improving WOMAC function scores (14.81; 95% CI [5.69, 23.93]; P < 0.01), displaying mixed results when comparing WA and EA, but both still showing higher efficacy than manual acupuncture.[2]

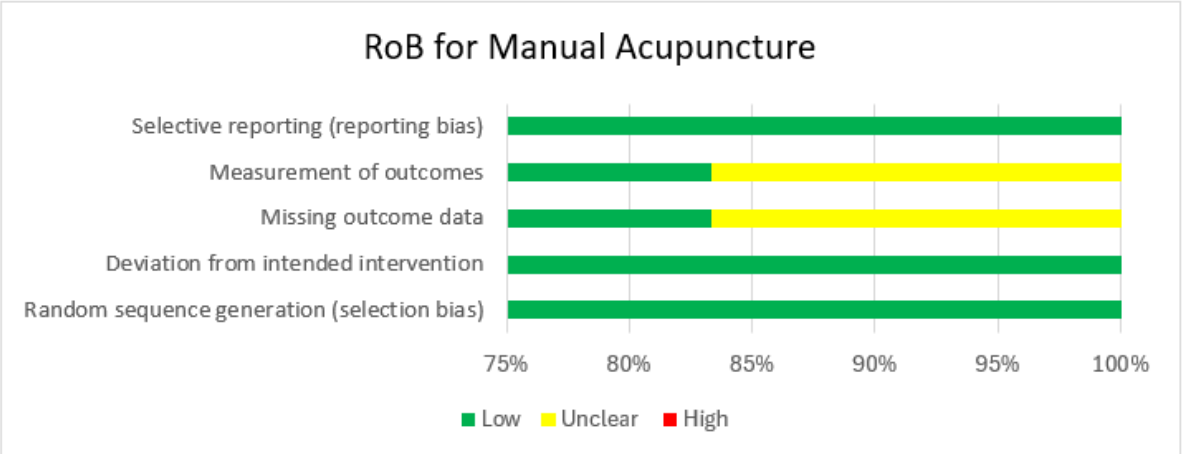
Lysholm scores

Warming acupuncture has higher efficacy in increasing Lysholm scores compared to manual acupuncture. The network analysis showed that WA (SMD = 12.84, 95% CI [5.62, 20.06]) was superior to SI in terms of improving Lysholm ($p < 0.05$). WA significantly increased the Lysholm scores compared to MA ($p < 0.05$), with an 83.2% probability of being a top intervention compared to other interventions like EA (SUCRA = 30.3%), MA (SUCRA = 24.7%), CM (SUCRA = 10.7%) in improving Lysholm scores.

Risk of bias

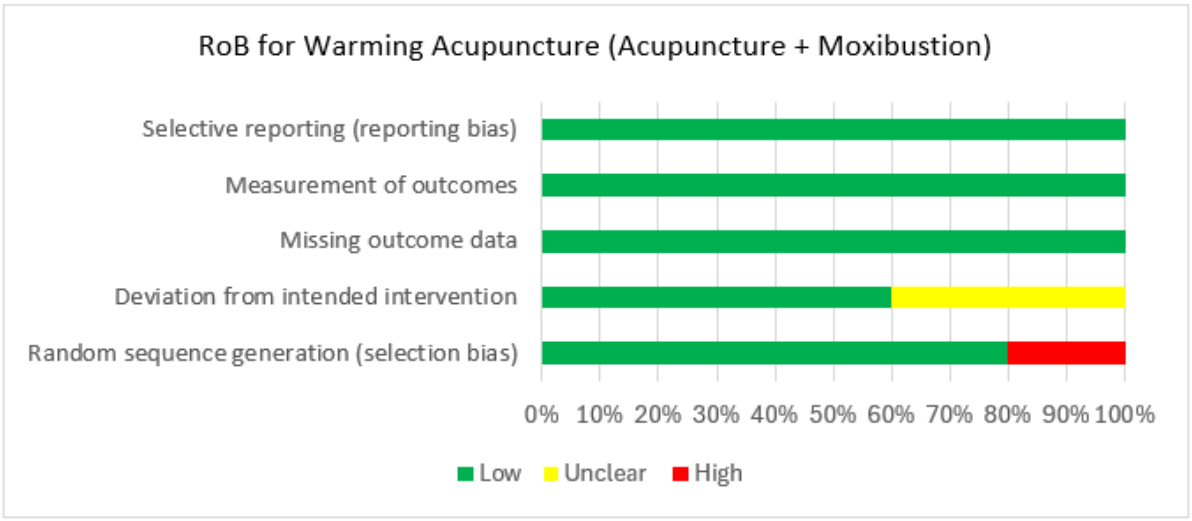
Manual acupuncture

Manual acupuncture	Random sequence generation (selection bias)	Deviation from intended intervention	Missing outcome data	Measurement of outcomes	Selective reporting (reporting bias)		Overall
Li WD 2014	+	+	+	+	+		+
Lin LL 2018	+	+	+	+	+		+
Liu XY 2024	+	+	?	+	+		?
Sun JS 2025	+	+	+	+	+		+
Wang GX 2020	+	+	+	+	+		+
Wang KX 2020	+	+	+	?	+		?



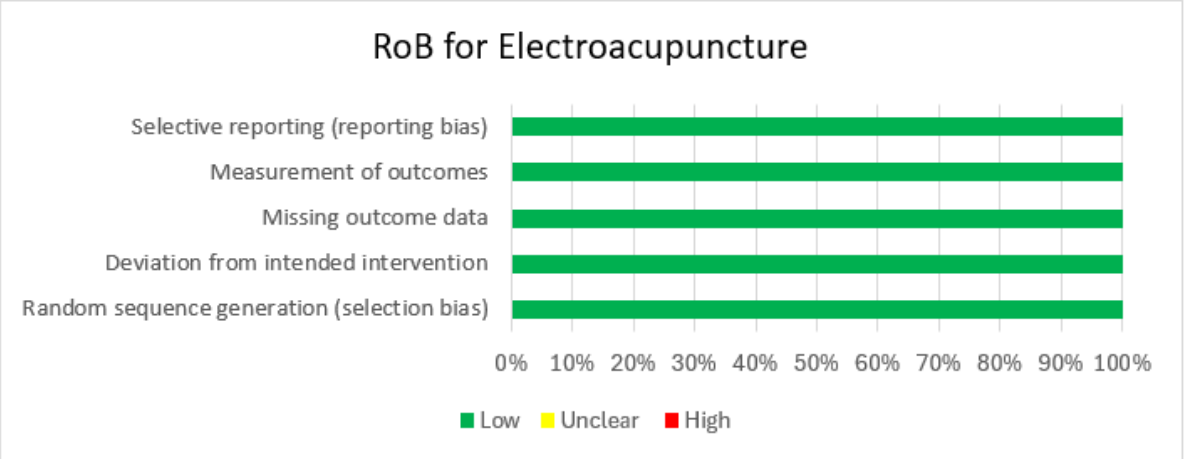
Warming acupuncture

Warming Acupuncture (Acupuncture + Moxibustion)	Random sequence generation (selection bias)	Deviation from intended intervention	Missing outcome data	Measurement of outcomes	Selective reporting (reporting bias)		**Overall**
Li Y 2022	+	+	+	+	+		+
Lin Y 2021	-	?	+	+	+		-
Sun GF 2021	+	?	+	+	+		?
Xia Z 2022	+	+	+	+	+		+
Zhang F 2022	+	+	+	+	+		+



Electroacupuncture

Electroacupuncture	Random sequence generation (selection	Deviation from intended intervention	Missing outcome data	Measurement of outcomes	Selective reporting (reporting bias)		**Overall**
Fu MY 2013	+	+	+	+	+		+
Ji LL 2012	+	+	+	+	+		+
Ju ZY 2017	+	+	+	+	+		+
Liu Y 2022	+	+	+	+	+		+
Lv ZT 2019	+	+	+	+	+		+
Shi GX 2020	+	+	+	+	+		+
Tu JF 2021	+	+	+	+	+		+
Wang TQ 2020	+	+	+	+	+		+
Yang S 2022	+	+	+	+	+		+



Safety and adverse events

The overall safety profile across all studies demonstrates that manual acupuncture, electroacupuncture, and warming acupuncture are generally safe and well tolerated, with predominantly mild, transient local reactions and very low rates of serious adverse events. Most common adverse event occurrences reported across acupuncture types were pain during needle insertion, soreness and pain following

needle insertion, and subcutaneous bruising or haematoma. Some patients experienced fainting, sweating, or dizziness. Events were described as mild and resolved quickly after needle removal or within a few days. One trial found that acupuncture-related adverse events had a lower incidence rate of 5.96% than administration of drug treatment (celecoxib [Celebrex]) with incidence rate of 9.26%.[2] The trials mainly assessed the effects immediately post-intervention, up to a 24-week period, and long-term safety data beyond 6 months is lacking.

Quality of the evidence (ROB & GRADE)

The included RCTs were assessed to have low-to-moderate risk of bias (ROB) for manual acupuncture, warming acupuncture except for one trial, and low risk of bias for electroacupuncture. Most unclear ROB domains related to protocol deviation or missing outcome data. The strength of the evidence was mainly limited by small sample sizes (<50 for most studies), limiting the power to detect the significant difference in the reported outcomes. Other limitations included heterogeneity, such as potential variations to PICOs of the primary studies, limited durations of the studies, some imprecision in the effect estimates due to wide confident intervals, limiting the interpretability of evaluated evidence. When applying the GRADE assessment, the RCTs were assessed to have low-to-moderate evidence quality.

Values and preferences

Patients appear to value familiarity, the alternative option of a non-pharmacological treatment, and relief from pain. Patient expectations include pain control or relief and improved physical function. In specific contexts like China where acupuncture is an established form of treatment, patients have strong expectations of its effectiveness, which may affect their expectations towards treatment. Evidence also shows that patients from these trials seem to value the holistic experience of the therapy, including patient-practitioner interaction and the treatment environment. Patients with long-term medication concerns may view this non-pharmacological treatment option more favourably. Clinicians appear to value evidence-based practice, clinically meaningful outcomes, and the option to select the most effective treatment protocols for patients. Clinicians have called for researchers to provide more standardised protocols and robust RCTs to enhance evidence-based practices. They value clinically meaningful outcomes where statistically significant results should translate to minimal clinically important differences (MCID). Clinicians also appear to value different techniques that allow them to continue tailoring treatment to specific patient goals.

Resource use

Manual acupuncture is the foundational technique and primarily requires sterile needles and a skilled practitioner. Electroacupuncture builds on manual acupuncture by adding electrical stimulation. Warming acupuncture combines manual acupuncture with heat therapy using moxibustion. In general, resources needed include sterile disposable acupuncture needles, trained acupuncturists who can identify specific acupoints, specialised electroacupuncture apparatus and electrodes, and moxa cones.

Conclusion

All three acupuncture techniques of interest in this review (manual acupuncture, electroacupuncture, and warming acupuncture) demonstrate efficacy in reducing pain and improving physical function when compared to sham acupuncture or no treatment.[1,2,4-21] However, there are clear distinctions in their relative effectiveness for specific outcomes.

For pain relief (VAS and WOMAC Pain scores): Electroacupuncture consistently emerges as the most effective intervention for pain relief.[1,2] Multiple studies, including an RCT and a network meta-analysis, conclude that EA provides superior pain reduction when compared with both manual acupuncture and warming acupuncture. One trial also found it to be more effective than celecoxib (Celebrex [NSAID]).[2] While manual and warming acupuncture provide statistically significant pain relief, they are consistently ranked at lower efficacy compared to EA.

For functional improvement (WOMAC Function scores, Lysholm scores): The evidence for functional improvement is more varied, where the network meta-analysis concluded that warming acupuncture ranked higher than electroacupuncture and manual acupuncture for functional improvements on WOMAC and Lysholm.[1] Separately, an RCT found that electroacupuncture had higher efficacy in improving WOMAC physical function scores compared to warming acupuncture or manual acupuncture.[2] Manual acupuncture, while effective compared to baseline, is generally the least effective of the three for improving function.[1,2]

For patients with knee osteoarthritis, electroacupuncture is the most consistently effective option for managing pain. For improving physical function, both warming acupuncture and electroacupuncture are strong therapeutic choices, with different analyses favouring one over the other. Manual acupuncture is a viable and effective treatment but is generally outperformed by electroacupuncture and warming acupuncture for both pain and function.

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