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Invited Review

## Optimizing Osteoarthritis Care: A Review of Multimodal Physical Therapy on Long Term Patient's Outcome

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### Abstract

**Background:** Osteoarthritis (OA) is a prevalent, chronic musculoskeletal condition and a leading cause of pain, functional limitation, and reduced quality of life, especially among older adults. Traditional physical therapy (PT) for OA typically emphasizes exercise routines and symptom relief strategies. However, growing attention is being directed toward multimodal physical therapy (MPT)—an integrative approach that combines manual therapy, structured exercise, and patient education. This comprehensive model seeks to address not only the physical impairments associated with OA but also the behavioural and educational components that influence long-term disease management. **Method:** A systematic review was conducted using the Semantic Scholar database. Studies were included if they involved adult populations with OA, used MPT interventions, had a comparator group receiving standard PT or usual care, included a follow-up of at least six months, and reported outcomes related to pain, function, or quality of life. Ten eligible studies were identified, including randomized controlled trials and one systematic review. **Result:** Of the ten studies, five reported that MPT led to significant short-term improvements in pain and function compared to standard care. However, long-term findings were mixed. Only three studies showed sustained benefits beyond 12 months, while four reported no significant differences between MPT and standard PT over time. Manual therapy was found to be particularly effective in the short term but showed inconsistent long-term value across studies. **Conclusion:** MPT appears to offer superior short-term outcomes in OA management compared to standard PT. Nonetheless, its long-term benefits remain inconclusive. More high-quality, long-term studies with adherence tracking and patient subgroup analysis are needed to fully assess the sustained value of MPT and to determine which individuals are most likely to benefit from this multimodal approach.

Keywords: Osteoarthritis, Multimodal Physical Therapy, Physiotherapy Care, Long Term

### Introduction

Osteoarthritis (OA) is the most common joint disease and a significant contributor to disability, especially in aging populations (Heidari, 2011; Michael et al., 2010). The disease is characterized

by joint degeneration, pain, stiffness, and loss of function (Altman et al., 1986). Knee and hip OA are particularly debilitating, reducing mobility and quality of life (Garber et al., 2011).

Non-surgical management remains the first-line

treatment for OA, with physical therapy (PT) playing a central role. Standard PT typically emphasizes land-based exercise programs, pain management, and functional training. However, emerging evidence suggests that integrating manual therapy, structured exercise, and patient education—the three core components of multimodal physical therapy (MPT)—may yield better outcomes by targeting both biomechanical and behavioral contributors to OA (Fransen et al., 2015; Garber et al., 2011).

Manual therapy improves joint mobility and reduces pain via neurophysiological and biomechanical mechanisms (Becker, 2009; Deyle et al., 2005). Therapeutic exercise enhances muscle strength, proprioception, and cardiovascular fitness, all critical for managing OA symptoms (Juhl et al., 2014; Alkatan et al., 2016). Education improves patient self-efficacy and encourages adherence to long-term management strategies (Poulsen et al., 2013; Kan et al., 2019).

Although multimodal PT demonstrates clear short-term benefits, its long-term effectiveness remains less established. Several studies have shown early gains dissipating over time, possibly due to poor adherence or lack of sustained intervention (Runge et al., 2022; Pisters et al., 2010). Moreover, the cost and complexity of delivering multimodal care in routine practice may limit its implementation.

This review aims to evaluate whether MPT yields better long-term outcomes compared to standard PT in patients with OA, with a particular focus on sustained effects beyond 12 months.

## Methodology

This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, ensuring methodological transparency and reproducibility. The search strategy was applied across the Semantic Scholar corpus, a comprehensive academic database that includes over 126 million peer-reviewed articles from diverse disciplines. The central research question guiding

the review was: Does a multimodal physical therapy approach—including manual therapy, structured exercise, and patient education—produce superior long-term outcomes compared to standard physical therapy in individuals diagnosed with osteoarthritis (OA)?

Eligibility criteria were defined using the PICOS (Population, Intervention, Comparator, Outcomes, Study design) framework. Studies were included if they met the following criteria: (1) adult participants aged 18 years or older diagnosed with chronic, non-surgical OA of the hip or knee; (2) interventions explicitly described as multimodal physical therapy, comprising at least three components—manual therapy, structured therapeutic exercise, and patient education; (3) comparator group receiving standard physical therapy, usual care, or minimal intervention; (4) outcome measures assessing clinically relevant endpoints such as pain, physical function, health-related quality of life, return to activity, or patient-reported satisfaction; (5) randomized controlled trial (RCT), systematic review, or meta-analysis design; and (6) a minimum follow-up duration of six months to enable evaluation of long-term outcomes.

The initial search yielded approximately 50 studies. A multi-stage screening process was employed. First, titles and abstracts were screened to exclude irrelevant or duplicate studies. Next, full texts of potentially eligible studies were reviewed for methodological quality, relevance, and alignment with the inclusion criteria. Ultimately, ten studies were included in the final synthesis. These included high-quality RCTs such as those by Deyle et al. (2005), Abbott et al. (2013, 2015), Fitzgerald et al. (2016), Wang et al. (2016), Poulsen et al. (2013), and Pisters et al. (2010), as well as one systematic review conducted by Runge et al. (2022).

Data were systematically extracted using a predefined extraction matrix that captured study characteristics (authors, year, sample size, demographics), intervention components, control conditions, duration of follow-up, and outcome measures. Key clinical metrics included the Western Ontario and McMaster Universities

Osteoarthritis Index (WOMAC), Numeric Rating Scale (NRS) for pain, Hip disability and Osteoarthritis Outcome Score (HOOS), and functional performance indicators. Outcomes were categorized based on timeframes, with short-term defined as outcomes measured within three months post-intervention, and long-term as outcomes assessed at twelve months or beyond. Attention was also given to adherence rates, implementation fidelity, and whether booster sessions or reinforcement mechanisms were utilized in the multimodal programs. Quality appraisal was performed informally through cross-comparison of sample size, blinding, attrition rates, and reporting transparency, although formal risk of bias tools were not applied.

## Results

This review included ten eligible studies—nine randomized controlled trials (RCTs) and one systematic review—investigating the comparative effectiveness of multimodal physical therapy (MPT) versus standard physical therapy (PT) or usual care in managing osteoarthritis (OA). Of these studies, six specifically targeted knee OA, one focused solely on hip OA, and the remaining three included mixed cohorts with both hip and knee involvement. The included trials were conducted across diverse clinical settings in Europe, North America, and Asia, enhancing the external validity of the findings.

Sample sizes ranged from 75 to 350 participants, with most trials enrolling adults aged 50 years and above, reflecting the typical age distribution of OA. All studies compared MPT interventions—which incorporated manual therapy, therapeutic exercise, and patient education—to standard PT (exercise alone), minimal intervention (advice or home-based activity), or sham therapy. The majority used the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) as a primary outcome measure, alongside secondary measures such as the Numeric Rating Scale (NRS) for pain, the Hip disability and Osteoarthritis Outcome Score (HOOS), and objective physical performance tests (e.g., timed up and go, stair climbing test). Follow-up durations varied from a

minimum of 6 months to as long as 60 months, enabling both short-term and long-term effect assessment.

### Short-Term Outcomes

Five out of ten studies reported that MPT led to significantly greater improvements in pain relief, physical function, and patient satisfaction during the short-term follow-up period (typically within 4 to 12 weeks post-intervention). For instance, Deyle et al. (2005) demonstrated a 52% improvement in total WOMAC scores after a 4-week MPT program, in contrast to only 26% improvement observed in the standard care group. Similarly, Fitzgerald et al. (2016) reported that the addition of manual therapy to exercise-based rehabilitation resulted in earlier and greater symptom relief at 3-month follow-up (Table 1).

Poulsen et al. (2013) found that patients receiving a combined regimen of education, exercise, and manual mobilization achieved more rapid functional recovery and pain reduction compared to those receiving exercise alone. Runge et al. (2022), in a comprehensive systematic review, confirmed that short-term benefits were more consistent and clinically meaningful when MPT included structured therapist-led components. These findings suggest that the synergy of manual techniques and active movement strategies can produce meaningful outcomes within the first three months of treatment (Table 2).

### Long-Term Outcomes

Long-term outcomes (defined as  $\geq 12$  months post-intervention) revealed a more heterogeneous pattern. Only three studies—Abbott et al. (2013), Abbott et al. (2015), and Poulsen et al. (2013)—reported sustained superiority of MPT over standard PT at one-year follow-up. Notably, Abbott et al. (2015) observed substantial reductions in WOMAC total scores:  $-46.0$  in the group receiving booster sessions, and  $-37.5$  in the manual therapy group, both significantly greater than the  $-23.0$  improvement seen in the exercise-only group (Table 2).

Conversely, Deyle et al. (2005), Wang et al. (2016), and Fitzgerald et al. (2016) found no statistically significant differences between MPT and control groups at 12-month follow-up. Pisters et al. (2010), the only study with a five-year follow-up, found no long-term functional advantage of MPT over standard care, suggesting that without sustained

engagement, initial gains may diminish over time. The variation in findings may be attributable to differences in intervention fidelity, presence or absence of reinforcement (booster) sessions, or inconsistencies in therapist training and protocol delivery (Table 2).

Table 1: Short term Outcome ( $\leq 3$  months)

Study	Outcome Measure	Multimodal Physical Therapy Results	Standard Physical Therapy Results	Between-Group Differences
Deyle et al., 2005	Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), 6-minute walk	52% WOMAC improvement at 4 weeks; ~10% increase in walk distance	26% WOMAC improvement at 4 weeks; ~10% increase in walk distance	Multimodal physical therapy doubled WOMAC improvement at 4 weeks; both improved at 1 year
Abbott et al., 2015	WOMAC	No mention found for short-term	No mention found for short-term	No mention found
Abbott et al., 2013	WOMAC	No mention found for short-term	No mention found for short-term	No mention found
Wang et al., 2016	WOMAC pain subscale	Significant pain and function improvement at 12 weeks	Significant pain and function improvement at 12 weeks	No significant difference
Williams et al., 2015 Poulsen et al., 2013	No mention found Numeric Rating Scale (NRS) pain	No mention found Patient education plus manual therapy: -1.9 points at 6 weeks	No mention found Minimal control: 0.0	No mention found Patient education plus manual therapy superior to control; patient education alone not superior
Fitzgerald et al., 2016	WOMAC	Short-term benefit for manual therapy at 9 weeks	No mention found	Manual therapy group better WOMAC at 9 weeks
Runge et al., 2022	WOMAC, pain	Manual therapy plus exercise superior for short-term pain and WOMAC	Exercise alone	Short-term benefit for manual therapy plus exercise (low-moderate certainty)
Mohomed, 2000	WOMAC, 6-minute walk	Improved function (abstract only)	No mention found	No mention found
Pisters et al., 2010	Hip disability and Osteoarthritis Outcome Score (HOOS), pain	Behavioral graded activity superior at 3-9 months in hip osteoarthritis	Usual care	Short-term benefit for behavioral graded activity in hip osteoarthritis

### Component-Specific Effects

Analysis of individual components within the multimodal approach revealed that manual therapy was the most consistently beneficial element in the short term. Studies by Deyle et al. (2005) and Runge et al. (2022) emphasized the added value of hands-on techniques in improving

joint mobility, reducing pain sensitivity, and facilitating neuromuscular re-education. However, only two studies, Abbott et al. (2013, 2015), demonstrated that manual therapy effects persisted beyond 12 months.

Therapeutic exercise alone was effective in improving physical performance in both MPT and

standard PT groups. However, it did not consistently lead to better long-term outcomes unless combined with reinforcement strategies. Education, when used in isolation, did not

significantly improve outcomes, as seen in the Poulsen et al. (2013) study. Yet, when integrated into a multimodal model, it appeared to enhance patient self-efficacy and adherence.

Table 1: Long term Outcome ( $\geq 1$  years)

Study	Outcome Measure	Multimodal Physical Therapy Results	Standard Physical Therapy Results	Maintenance of Effects
Deyle et al., 2005	WOMAC, 6-minute walk	Both groups substantially improved at 1 year	Both groups substantially improved at 1 year	No significant difference at 1 year
Abbott et al., 2015	WOMAC	Booster sessions: -46.0; manual therapy: -37.5 at 1 year	Exercise alone	Booster/manual therapy superior to exercise alone; combined not superior
Abbott et al., 2013	WOMAC	Manual therapy: -28.5 versus usual care at 1 year	Usual care	Manual therapy superior to usual care; no added benefit from combining therapies
Wang et al., 2016	WOMAC pain subscale	Maintained improvement at 1 year	Maintained improvement at 1 year	No significant difference
Williams et al., 2015	No mention found	No mention found	No mention found	No mention found
Poulsen et al., 2013	NRS pain	Patient education plus manual therapy-maintained benefit at 1 year	Minimal control	Patient education plus manual therapy superior to control at 1 year; patient education alone not superior
Fitzgerald et al., 2016	WOMAC	No difference at 1 year	No difference at 1 year	No difference: booster sessions may improve responder status
Runge et al., 2022	WOMAC, pain	No long-term benefit for manual therapy plus exercise	Exercise alone	No long-term benefit (high-certainty evidence)
Mohomed, 2000	WOMAC, 6-minute walk	Improved function at 1 year (abstract only)	No mention found	No mention found
Pisters et al., 2010	HOOS, pain	No long-term difference at 5 years	Usual care	No long-term difference

### Adherence and Implementation Factors

Adherence and implementation fidelity were underreported across most studies, limiting confidence in real-world applicability. Only one study (Wang et al., 2016) provided explicit adherence data, noting that participants in the MPT group exhibited high compliance, which may have contributed to observed short-term benefits. The lack of consistent monitoring of adherence or standardized delivery protocols across studies makes it difficult to disentangle whether null findings were due to true treatment failure or suboptimal implementation.

The systematic review by Runge et al. (2022) specifically highlighted the considerable variability in therapist training, intervention intensity, and supervision levels across the included RCTs. This heterogeneity introduces potential bias and limits generalizability. Furthermore, few studies included booster or maintenance sessions, which may have affected the durability of therapeutic effects.

### Discussion

The findings of this systematic review confirm that multimodal physical therapy (MPT), when incorporating manual therapy, structured exercise, and patient education, yields consistent short-term

improvements in pain reduction and functional capacity in patients with knee or hip osteoarthritis. Studies such as those by Deyle et al. (2005) and Fitzgerald et al. (2016) demonstrate clinically significant improvements in WOMAC scores within four to twelve weeks, supporting previous meta-analyses that emphasize the early benefits of combined physiotherapy strategies (Fransen et al., 2015; Juhl et al., 2014). These outcomes align with the biomechanical rationale of MPT, which emphasizes joint mobilization, neuromuscular re-education, and behavior change as synergistic mechanisms for symptom relief.

However, while short-term efficacy is well-established, the long-term effectiveness of MPT is less consistent. Only three studies (Abbott et al., 2013; Abbott et al., 2015; Poulsen et al., 2013) reported superior long-term outcomes at or beyond 12 months. This is comparable to findings in earlier work by Fransen et al. (2007), which showed benefits of aquatic and Tai Chi programs at six months but not at one year. Similarly, Runge et al. (2022), in their systematic review, concluded that although manual therapy adds measurable short-term benefit, there is insufficient high-certainty evidence for long-term superiority over exercise alone. These discrepancies raise questions about the durability of multimodal interventions and the role of ongoing support or booster sessions in sustaining clinical gains.

One potential explanation for the decline in long-term efficacy is patient adherence. Most studies included in this review did not rigorously track adherence beyond the intervention phase. Only Wang et al. (2016) explicitly reported high compliance, which may explain the maintenance of treatment effects in that study. Consistent with this, a systematic review by Kan et al. (2019) identified adherence as a critical factor in long-term OA management yet noted that few trials adequately monitor or reinforce long-term behavioural change. Garber et al. (2011) similarly stress the need for exercise prescriptions that consider patient preferences, motivation, and barriers to compliance to maintain long-term functional outcomes.

Additionally, the heterogeneity in intervention protocols and therapist training may limit the generalizability of MPT outcomes. Runge et al. (2022) emphasized the wide variability in intervention content and therapist expertise across RCTs, which may influence both the fidelity and effectiveness of the treatment. This observation is supported by Foley et al. (2003), who noted that hydrotherapy-based strengthening programs performed by skilled therapists produced superior results compared to unsupervised land-based exercise. Thus, standardizing therapist training and delivery protocols may be a prerequisite for ensuring consistent and replicable outcomes across clinical settings.

In contrast to our review, some studies examining alternative interventions such as Tai Chi, aquatic therapy, and yoga have reported promising long-term benefits for pain and function. For example, Wang et al. (2009) demonstrated that a 12-week Tai Chi program produced significant improvements in physical function and reduced depression in older adults with knee OA, with sustained effects observed at 24 weeks. Similarly, Cheung et al. (2014) found that yoga improved both physical and psychosocial outcomes in older women with OA. While these interventions differ in structure from MPT, their emphasis on movement, mindfulness, and patient engagement may explain their prolonged benefits and highlight the value of holistic approaches.

Moreover, the educational component of MPT warrants deeper evaluation. Although education alone was not shown to significantly affect long-term outcomes in studies like Poulsen et al. (2013), its integration within a broader multimodal framework may enhance self-efficacy and promote sustained activity. Patient education rooted in behavior-change theories can improve health literacy and empower individuals to manage symptoms independently (Altman et al., 1986; Heidari, 2011). Future interventions should consider tailoring educational content to individual learning styles and cultural contexts to optimize its impact.

Cost-effectiveness and accessibility are also critical factors in evaluating the clinical utility of MPT. Despite its benefits, the resource-intensive nature of MPT—requiring trained therapists, equipment, and structured programs—may limit scalability, particularly in under-resourced settings. A review by Kan et al. (2019) pointed out that standard exercise-based PT is often more feasible and widely available. Therefore, hybrid models that blend in-person MPT with telehealth follow-ups or digital health platforms could offer a promising compromise, maintaining patient engagement while reducing costs and logistical barriers (Liu et al., 2019).

While MPT delivers robust short-term gains in osteoarthritis management, its long-term effectiveness is highly dependent on patient adherence, therapist fidelity, and systemic support. Comparisons with other modalities such as Tai Chi and hydrotherapy suggest that incorporating mindfulness, education, and individualized support may enhance sustained outcomes. To solidify MPT's role in long-term OA care, future research must focus on long-duration trials with standardized delivery, enhanced adherence tracking, and cost-benefit analyses across diverse healthcare contexts.

### **Clinical Implications and Future Directions**

The results of this systematic review highlight the practical value of implementing multimodal physical therapy (MPT) early in the clinical management of knee and hip osteoarthritis. Clinicians should prioritize MPT in treatment plans to achieve superior short-term improvements in pain relief, physical function, and mobility. Combining manual therapy with structured, therapist-guided exercise appears to deliver enhanced outcomes compared to either modality alone, particularly when initiated during the early stages of symptom progression. Moreover, the integration of patient education within the MPT framework—while limited in effect when applied in isolation—can play a vital supportive role in fostering self-efficacy, encouraging active participation, and improving adherence to long-

term rehabilitation plans.

To prolong therapeutic benefits, structured follow-up strategies are essential. These may include periodic booster sessions, remote or home-based programs, and digital health interventions that reinforce behavioural change and maintain physical activity levels. Customization of MPT to individual patient profiles—accounting for functional status, comorbidities, motivation, and accessibility—remains critical to optimizing outcomes and promoting equitable care delivery. Additionally, interdisciplinary collaboration between physiotherapists, primary care providers, and community health programs may further enhance patient engagement and continuity of care.

Looking forward, future research should focus on evaluating the long-term sustainability of MPT outcomes through extended follow-up periods and real-world implementation studies. Large-scale randomized controlled trials with robust adherence monitoring and standardized intervention protocols are needed to clarify which components and delivery formats of MPT yield the most durable benefits. Moreover, cost-effectiveness analyses and health system evaluations will be instrumental in informing policy decisions and resource allocation. Exploring the integration of technology—such as tele-rehabilitation, mobile health applications, and wearable feedback devices—may offer scalable solutions to improve access and adherence, especially in underserved populations. Ultimately, advancing the evidence base on multimodal interventions will support more effective, individualized, and sustainable care models for people living with osteoarthritis.

### **Conclusion**

This systematic review affirms that multimodal physical therapy (MPT)—encompassing manual therapy, therapeutic exercise, and patient education—delivers consistent and clinically meaningful improvements in pain and physical function for individuals with osteoarthritis, particularly in the short term. Most included studies

reported superior outcomes within the first three months of treatment compared to standard physical therapy or usual care. However, the evidence for long-term effectiveness is mixed, with only a subset of trials demonstrating sustained benefits at one year or beyond. Variability in intervention design, therapist delivery, patient adherence, and follow-up strategies likely contribute to this inconsistency.

Overall, while MPT presents a promising, patient-centered approach to osteoarthritis management, its durability over time remains uncertain. Further high-quality randomized trials are needed to evaluate its long-term benefits, optimal intervention components, and cost-effectiveness, especially in real-world clinical environments

## Data Availability Statement

The authors will transparently provide the primary data underpinning the findings or conclusions of this article, without any unjustified reluctance. If need from editorial team.

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## Conflicts of Interest

The authors declare no potential conflicts of interest related to the research, writing, or publication of this work.

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