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Research Article

Effect of Maitland mobilisation versus ultrasound therapy on pain and range of motion in patients with knee osteoarthritis: a quasi-experimental study

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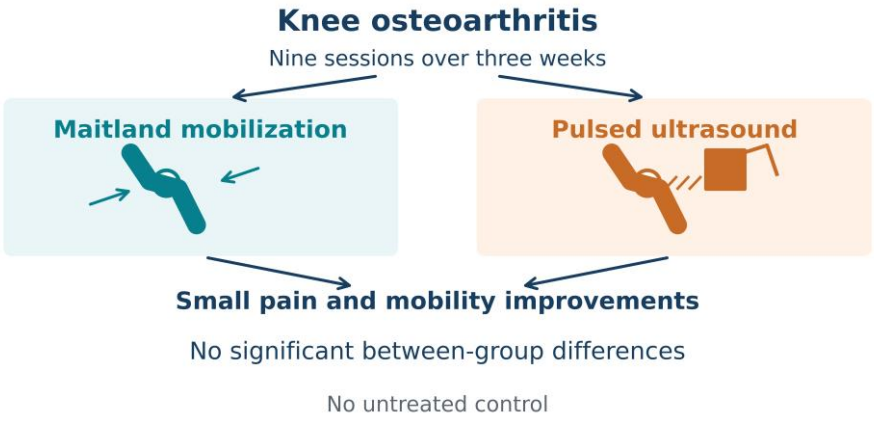
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ABSTRACT

To compare Maitland mobilization and pulsed therapeutic ultrasound for pain and knee range of motion (ROM) in knee osteoarthritis. Methods: Adults aged 40–60 years were allocated by convenience to nine treatment sessions over three weeks. Pain and knee flexion ROM were measured before and after treatment. Pain analyses included 38 and 23 participants; ROM analyses included 36 and 22, respectively. Pain decreased by 0.58 ± 0.55 and 0.52 ± 0.51 points; ROM increased by 1.86° ± 2.27° and 1.32° ± 1.17° (all $p < 0.001$). Between-group differences were nonsignificant (pain, $p = 0.67$; ROM, $p = 0.31$). Mean changes were below published minimal clinically important differences. Both treatments were followed by small improvements, with no significant difference between treatments. Without a control group, improvements cannot be attributed to the interventions.



Keywords: Osteoarthritis, Knee, Musculoskeletal manipulations, Ultrasonic therapy, Pain measurement, Range of motion, Articular.

INTRODUCTION

Knee osteoarthritis (OA) is a chronic degenerative joint disease that involves the articular cartilage, subchondral bone, synovium and periarticular tissues, and is a leading cause of pain and disability in older adults [1]. Population ageing and rising obesity have increased its burden in India [2]. Its typical features are activity-related joint pain, brief morning stiffness, crepitus, muscle weakness and progressive loss of range of motion (ROM) [3]. Management aims to control pain and preserve function, and guidelines place non-pharmacological care at its centre [4].

Recent syntheses support the use of structured exercise in the management of OA of the knee. Another network meta-analysis in 2025 also supports exercise for pain and function. A 2026 rehabilitation review finds exercise effective and variable effects for electrotherapy. The results support the inclusion of passive modalities in the larger picture of active rehabilitation [5,6].

Manual therapy combined with exercise has been shown to relieve pain and improve function in knee OA [7, 8]. Maitland mobilisation is a method of treating pain and stiffness by graded passive movements of joints. A systematic review describes its application in knee OA, noting variation across treatment approaches [9]. Reduced pain sensitivity and improved function-related outcomes have been reported in recent trials of end-range Maitland mobilisation [10,11].

Therapeutic ultrasound is an electrophysical modality that transfers mechanical energy to the tissue. In pulsed mode, tissue heating is minimal, and the proposed effects are non-thermal, such as acoustic streaming and modified cell membrane permeability. A meta-analysis suggests that ultrasound may reduce pain and improve function in knee OA [12], and a randomised trial found that continuous ultrasound added to exercise improved pain, mobility and function [13]. An updated synthesis in 2024 also reported possible benefit, but treatment regimens and effect estimates varied across trials [14].

Comparative trials have compared manual therapy to electrotherapy or other mobilisation techniques [15,16]. Direct evidence of the particular stand-alone protocols used here is, however, still limited. Thus, the present study compared Maitland mobilisation and pulsed therapeutic ultrasound on pain and knee ROM in patients with knee OA.

MATERIAL AND METHOD

Study design

This was a two-group, pre–post quasi-experimental study done in the physiotherapy outpatient department of a university teaching hospital. Recruitment of participants took place from September 2023 to March 2024. The study protocol was approved by the Institutional Ethics Committee (Protocol no: YEC-1/2023/187) on 30th September 2023 and the study was conducted according to the Declaration of Helsinki and ICMR guidelines on biomedical research involving human participants. All subjects provided written informed consent before enrolment.

Participants

Eligible patients were aged between 40 and 60 years, diagnosed with knee OA, and had an anteroposterior or lateral knee radiograph on file. Patients were excluded if they had had previous knee surgery, other knee disorders or congenital deformity, previous knee trauma, obesity, or pregnancy.

Sample size and allocation

The sample size was calculated using G*Power with an effect size of 0.8 for an independent-samples t test, 80% power and two-sided 5% significance level. This was 26 participants per group (52 total) and was increased by 10% to allow for non-response, resulting in a target of 58. The participants were recruited by convenience sampling and were assigned in a non-random manner to one of two treatment groups. Participants and the treating therapist could not be blinded to the treatment received.

Interventions

All treatments were delivered and supervised by one physiotherapist trained in both techniques. Both groups received nine sessions, three per week for three weeks. Participants in Group 1 received Maitland mobilization in the form of sustained manual glides of the tibia. The glide direction that produced the least pain was selected for each participant. Each session consisted of three sets of ten repetitions and lasted about 15 minutes. Participants in Group 2 received pulsed therapeutic ultrasound at 1 MHz and 0.8 W/cm² through a sound head reported as 5 cm with an effective radiating area of 3.5–5 cm². The head was moved in circular strokes over the medial and lateral aspects of the knee for 10 minutes, with the participant sitting with the leg extended or lying supine. Participants in both groups were allowed to continue the medication prescribed by their physician, and no home exercise was given. Treatment was to be stopped if it caused harm.

Outcome measures

Pain intensity was recorded on the numerical pain rating scale (NPRS), an 11-point scale on which 0 means no pain and 10 the worst imaginable pain [17]. Active knee ROM was measured with a standard goniometer with the participant supine; knee flexion is reported. The inter-rater reliability of goniometric measurement varies and may be low [18]. Both outcomes were recorded at baseline and after the ninth session (end of week 3).

Statistics

Values are expressed as mean ± SD. The paired t test was used to assess changes from baseline within each group. The groups were compared at baseline using the independent-samples t test. The independent-samples t test was used to compare change scores between groups. Participants with data at both time points were analysed. Mean differences are reported with 95% confidence intervals (CI) and standardised effect sizes as Cohen's d. All tests were two-tailed, with significance set at $p < 0.05$. To assess clinical significance, mean changes were compared with minimal clinically important differences (MCID) of 1–2 points for NPRS [17] and 6–8° for knee ROM [19].

RESULTS

Pain scores were available at both time points for 38 participants in Group 1 and 23 in Group 2. Knee flexion ROM was available for 36 and 22 participants respectively. At baseline the groups were comparable in pain (6.87 ± 1.12 vs 7.04 ± 1.15; $p = 0.57$) and ROM (89.28° ± 15.32° vs 88.27° ± 16.13°; $p = 0.81$).

Pain fell significantly in both groups (Table 1). In Group 1 the mean NPRS score decreased from 6.87 ± 1.12 to 6.29 ± 1.21 (mean change 0.58, 95% CI 0.40–0.76; $p < 0.001$). In Group 2 it decreased from 7.04 ± 1.15 to 6.52 ± 1.16 (mean change 0.52, 95% CI 0.30–0.74; $p < 0.001$). Knee flexion ROM increased significantly in both groups: by 1.86° (95% CI 1.09°–2.63°; $p < 0.001$) in Group 1 and by 1.32° (95% CI 0.80°–1.84°; $p < 0.001$) in Group 2.

Table 1: Pain (NPRS) and knee flexion range of motion before and after treatment, by group

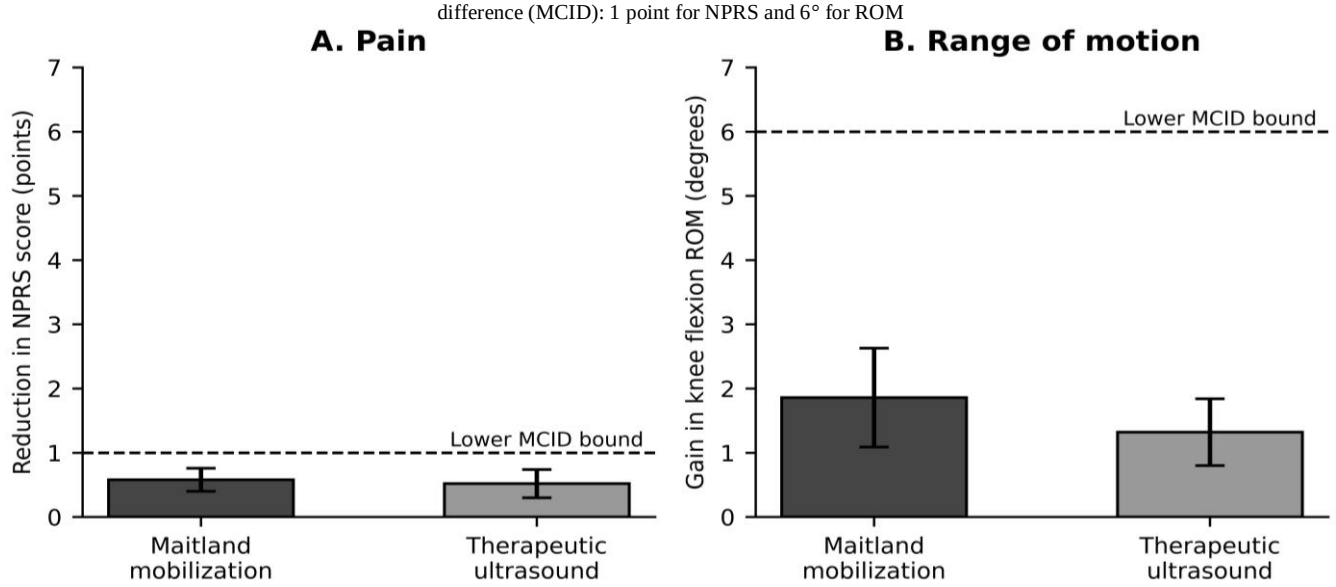
Outcome	Group	n	Baseline (mean ± SD)	Post-treatment (mean ± SD)	Mean change (95% CI)	t	p
Pain (NPRS, 0–10)	1	38	6.87 ± 1.12	6.29 ± 1.21	0.58 (0.40–0.76)	6.47	<0.001
	2	23	7.04 ± 1.15	6.52 ± 1.16	0.52 (0.30–0.74)	4.90	<0.001
Knee flexion ROM (°)	1	36	89.28 ± 15.32	91.14 ± 15.28	1.86 (1.09–2.63)	4.92	<0.001
	2	22	88.27 ± 16.13	89.59 ± 16.66	1.32 (0.80–1.84)	5.28	<0.001

Table 2: Between-group comparison of change from baseline

Outcome	Group 1 change (mean ± SD)	Group 2 change (mean ± SD)	Difference (95% CI)	t	p	Cohen's d
Pain reduction (NPRS points)	0.58 ± 0.55 (n = 38)	0.52 ± 0.51 (n = 23)	0.06 (−0.22 to 0.34)	0.42	0.67	0.11
Knee flexion ROM gain (°)	1.86 ± 2.27 (n = 36)	1.32 ± 1.17 (n = 22)	0.54 (−0.51 to 1.59)	1.03	0.31	0.28

Independent-samples t test. Group 1, Maitland mobilization; Group 2, therapeutic ultrasound. Differences are Group 1 minus Group 2.

Figure 1: Mean change from baseline (error bars, 95% confidence interval) in (A) pain on the numerical pain rating scale (NPRS) and (B) knee flexion range of motion (ROM) after Maitland mobilization and therapeutic ultrasound. Dashed lines show the lower bound of the published minimal clinically important difference (MCID): 1 point for NPRS and 6° for ROM



Group 1, Maitland mobilization; Group 2, therapeutic ultrasound. NPRS, numerical pain rating scale; ROM, range of motion; SD, standard deviation; CI, confidence interval—within-group comparison by paired t test. A positive change indicates reduced pain or increased ROM.

Neither outcome differed significantly between the groups (Table 2; Figure 1). The difference in pain reduction was 0.06 points (95% CI −0.22 to 0.34; p = 0.67; d = 0.11), and the difference in ROM gain was 0.54° (95% CI −0.51° to 1.59°; p = 0.31; d = 0.28). Both favoured Maitland mobilization numerically.

The mean improvements were smaller than the lower MCID bound for both outcomes (1 point for NPRS and 6° for ROM). The largest individual pain reduction was 2 points in Group 1 and 1 point in Group 2. The largest individual ROM gain was 8° in Group 1 and 4° in Group 2, and some participants in Group 1 lost up to 4°.

DISCUSSION

Both Maitland mobilisation and pulsed ultrasound significantly improved pain and knee flexion ROM. The improvement was small and not significantly different between the two treatments. Mean change scores fell below cited MCID thresholds. Interpret these small changes in ROM cautiously due to variable inter-rater reliability [18]. It is important to point out that statistical significance of within-group changes should not be interpreted as evidence of clinical benefit. However, the MCID for ROM was derived in stroke patients and may not fully transfer to knee OA [19], so its use here is exploratory. The between-group differences' confidence intervals were −0.22 to 0.34 points for pain and −0.51° to 1.59° for ROM. These estimates do not imply equivalence of treatments.

Unlike trials where mobilisation was combined with exercise [15,20] or compared to sham treatment [21], the benefit of manual therapy was not observed in this study. Maitland and Mulligan techniques seem to be equally effective immediately post-treatment [16]. There are some features of the present design that may explain the modest effects. The treatment was short (9 sessions), no exercise was added, and glides were applied in the least painful direction rather than at end range, as was the approach in trials reporting benefit [10,11]. The integer-valued NPRS may also be insensitive to small changes. Baseline pain was moderate to severe.

The 2024 meta-analysis of ultrasounds involved 21 randomised trials with 1,315 participants. It showed improvement in pain (standardised mean difference −0.64, 95% CI −0.88 to −0.40) and total WOMAC score (−0.45, 95% CI −0.69 to −0.20), but

heterogeneity was substantial (I^2 = 71% and 67%, respectively). The different regimens and comparators preclude direct applicability to the current nine-session protocol. Reported subgroup differences in dose and duration are hypothesis-generating rather than proof of an optimal regimen. Therefore, the pooled benefits do not demonstrate that the small changes within groups in this study were caused by ultrasound [14].

A recent mobilisation with movement review published online in 2025 and in a 2026 issue of a journal found pooled pain reduction across 22 randomised trials (Hedges' g −0.98, 95% CI −1.38 to −0.59) with high heterogeneity (I2 approximately 87%). This indicates potential analgesic benefit, but substantial inconsistency between studies. Mobilisation with movement is a technique different to the sustained tibial glides used here and both isolated and combined treatment were included in the review. Therefore, its findings cannot establish the effectiveness of the present Maitland protocol or its superiority to ultrasound [22].

In the 2025 exercise network meta-analysis, there were 217 randomised trials and 15,684 participants. Evidence for aerobic exercise was of moderate certainty for pain, function, gait performance and quality of life. Rankings of exercise types could not be interpreted due to indirect comparisons. Similarly, a rehabilitation review in 2026 found that exercise was effective for knee OA and that the effects of electrotherapy were inconsistent. In sum, these findings support investigating mobilisation and ultrasound as possible adjuncts to active rehabilitation. A structured exercise program and a control group were not part of the current study and so it is not possible to establish the additional benefits of these compared to exercise or usual care [5,6].

Joint mobilisation can have a neurophysiological pain modulatory effect [23] and an effect on joint stiffness [24]. Pulsed ultrasound has non-thermal effects, and the clinical relevance of these effects is not clear [12]. The current data cannot disentangle such mechanisms, as outcomes were only measured pre- and post-treatment.

Limitations of the study. Allocation was not random; the groups were unequal in size, and there was no control group, so that part or all of the improvement may be due to natural fluctuation of symptoms, concurrent medication and regression to the mean. The study was performed at one centre, outcomes were measured once soon after treatment, and the disease was not graded radiologically. Functional outcomes were not measured, only pain and ROM. The sample was powered to detect a large effect (d = 0.8) and could not rule out smaller differences. Future randomised sham- or exercise controlled trials require longer treatment, graded disease severity, functional outcomes and follow-up.

CONCLUSION

Maitland mobilisation and pulsed therapeutic ultrasound both produced small statistically significant reductions in pain and gains in knee flexion ROM in patients with knee OA but the changes were below published minimal clinically important differences and the two treatments were no different. The study aimed to compare the two treatments and on the present evidence neither can be considered superior.

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Declarations

Authors' contributions: G. J. Anicattil conceived and designed the study, delivered the interventions, collected and analysed the data and drafted the manuscript. I. Lourdhuraj supervised the study and critically revised the manuscript. All authors approved the final version and consent to its publication.

Conflict of interest

There was no conflict of interest for this study.

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