Original Article

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Comparative Effects of Dry Needling and Kinesio Taping as Adjuncts to Strength Training on Pain, Functional Mobility, and Quality of Life in Patients with Knee Osteoarthritis: A Three-Arm Randomized Controlled Trial

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ABSTRACT

Background: Knee osteoarthritis (OA) is the most prevalent form of OA contributing to around 60% of all the cases globally. Strength training is the recommended first-line non-drug treatment, but evidence comparing it with adjunctive therapies such as dry needling and Kinesio taping is yet to be explored.

Methods: This study was a single-masked, three-arm RCT conducted at the Physio Care Center, Gujrat, from November 2024 to December 2025. Fifty participants aged 45 to 65 with knee OA and a Visual Analog Scale pain score ≥7 were randomly assigned to one of three groups: dry needling plus strength training (n=17), Kinesio taping plus strength training (n=17), or strength training alone (n=16), all conducted three times weekly for six weeks. Pain, mobility, and quality of life were assessed at baseline and week 6 by a blinded assessor.

Results: All groups showed significant improvements (p<0.001). One-way ANOVA revealed significant differences among groups for pain (p=0.010), mobility (p=0.003), and quality of life (p<0.001). Dry needling plus strength training resulted in significantly greater improvements than strength training alone (p≤0.006), whereas Kinesio taping showed no significant advantage over strength training alone.

Conclusion: Adding dry needling to strength training yields significantly greater short-term gains in pain, mobility, and quality of life than strength training alone in knee osteoarthritis, whereas the added benefit of Kinesio taping is smaller and less certain. Larger, sham-controlled, multicenter trials with longer follow-up are warranted.

Keywords: *Athletic Tape; Dry Needling; Knee; Osteoarthritis; Quality of Life; Resistance Training.*

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INTRODUCTION

Knee Osteoarthritis (OA) is a chronic progressive degenerative joint disease and is the most prevalent form of OA in the world, with about 60% of all reported cases of OA occurring in the knee[1-2].It is defined by cartilage degradation, sub-chondral bone alterations, osteophyte growth, synovial inflammation, and progressive muscle weakness, resulting in chronic pain, stiffness, limited motion, and functional disability[3,4]. The pathological changes significantly diminish patients' quality of life, interfere with participation in daily activities and occupational roles, and create a significant economic burden due to utilization of healthcare resources and loss of productivity[5]. Current approaches to treatment, such as simple care, pharmacologic treatment, and surgery, may be only temporarily effective and may carry risks of adverse effects, high costs, or surgical complications. With no cure, current recommendations focus on non-pharmacological, low-risk therapies to manage pain, maintain joint function, and slow disease progression[6,7,8].

Exercise therapy, especially strength training, is a widely recommended first-line non-pharmacological treatment for knee OA, given the strong association between quadriceps weakness and disease progression[9]. Strengthening the muscles around the knee will increase the joint's stability, shock absorption, and load distribution, and several randomized trials have shown short-term increases in muscle strength and cardiorespiratory fitness after structured strength or aerobic exercise programs[3]. The long-term effectiveness of exercise alone on quality of life, however, is not consistent, with some trials reporting only small or statistically non-significant improvements at longer-term follow-up, possibly due to small sample sizes, heterogeneous patient populations, and reduced adherence over time[3]. This has highlighted the need for additional therapies to augment, expedite, or sustain the positive effects of exercise-based rehab.

Acupuncture-related methods, such as dry needling of myofascial trigger points and ashi points on the quadriceps, have demonstrated efficacy in reducing pain and improving function, and are thought to work via modulation of nociceptive pathways at the spinal and central levels, endogenous release of analgesic substances, and improved local muscle relaxation and blood flow. Synergistic effects have been observed in trials in which acupuncture was used in conjunction with exercise rehabilitation, resulting in better, faster symptom relief than either treatment alone, and the combined groups had higher response rates than exercise alone. Likewise, manual therapy with neuromuscular training is more effective than traditional electrotherapy-based interventions in reducing pain, increasing knee flexion range of motion, balance, and quality of life over 6 weeks of intervention[10]. Another emerging technique that has gained popularity is Kinesio taping, which is believed to increase the torque of the quadriceps, decrease pain, and stimulate the cutaneous and mechanoreceptors around the knee joint, and has been utilized by clinicians for its non-invasive, easy-to-apply nature[10,11]. The related non-invasive technique of acupressure has also shown considerable benefits for pain, stiffness, physical function, and health-related quality of life compared to routine care[12].

Although individual studies have shown positive effects of both dry needling and Kinesio taping as adjuncts to exercise, direct comparisons between the two modalities, in conjunction with a standardized strength training regimen, remain limited. Existing trials have tested the effect of acupuncture, manual therapy, or taping alone against usual care, sham treatments, or electrotherapy, but not against each other in the same well-designed trial. This results in clinicians lacking definitive comparative evidence to inform their choice of the most effective adjunct therapy to accompany strength training for managing knee OA. A randomized controlled trial directly comparing these interventions is therefore warranted to guide clinical decision-making regarding evidence-based rehabilitation protocols for this very common and debilitating condition. This 3-arm randomized controlled trial aims to assess the efficacy of dry needling, Kinesio taping, and strength training compared to strength training alone for the treatment of knee osteoarthritis on pain, functional mobility, and quality of life to determine if either of these adjunctive therapies is superior to strength training alone, and if either is superior.

METHODOLOGY

Study Design and Setting

Study Design was three-arm, parallel, randomized controlled trial (RCT) with single blinded assessment. It was conducted at the Outpatient Physiotherapy Department of the Physio Care Center, Gujarat from November 2024 to December 2025.

Selection Criteria

Participants were recruited from the outpatient physiotherapy and orthopedic department. Eligible participants meeting the inclusion criteria were invited to participate after a detailed explanation of the study protocol, following which written informed consent was obtained.

Inclusion Criteria**:** was based on following criteria (i) clinically confirmed diagnosis of knee osteoarthritis; (ii) were aged between 45 and 65 years and (iii) reported a Visual Analogue Scale (VAS) pain score of 7 or above.

***Exclusion Criteria*:** Participants were excluded if they (i) had any known allergic conditions, including sensitivity to adhesive tape or needling materials (ii) recent knee surgery and (iii) unfit to perform strength training exercises of lower limb

Sample Size

G*Power software was used to determine a sample size, based on the mean difference of 1.7 in the Visual Analogue Scale (VAS) pain score reported between intervention groups following comparable physiotherapy interventions in patients with knee osteoarthritis, calculated at a 95% confidence interval[13]. A sample size of n=50 was estimated using the following formula for comparison of means between independent groups:

$$n = 2\sigma^2(Z_{\alpha/2} + Z_\beta)^2 / d^2$$

Randomization and Blinding

Eligible participants were randomly allocated to one of the three intervention groups using the lottery (chit) method of randomization. Fifty numbered chits, corresponding to Group A (Dry Needling with Strength Training), Group B (Kinesio Taping with Strength Training), and Group C (Strength Training alone), were prepared in equal proportion, folded, and placed in a sealed, opaque, non-transparent container by an independent investigator who was not involved in participant recruitment, treatment delivery, or outcome assessment. At the time of enrolment, each eligible participant was asked to draw one chit from the container, and the group written on the drawn chit determined the participant's allocation.

Intervention Protocol

Each group was assigned an intervention delivered three times a week for six weeks.

- **Group A: Dry Needling Combined with Strength Training**
  Participants were treated with dry needling of myofascial trigger points in the quadriceps, specifically the Vastus Medialis Obliquus, and periarticular musculature of the affected knee with sterile filiform needles inserted at a depth to produce a local twitch response and then a standardized strength training program.

- **Group B: Kinesio Taping Combined with Strength Training**
  Participants were given Kinesio taping over the quadriceps muscle using the muscle facilitation technique and around the patella using the patellar correction technique for pain reduction, increased proprioceptive feedback, and increased quadriceps activation, in addition to the same strength training program.

- **Group C: Strength Training**
  Group C was given the strength training program only, which involved quadriceps-setting exercises, straight-leg raises, mini squats, and resisted knee extension exercises, all performed in 2-3 sets of 10-12 repetitions, with sets and repetitions increased as tolerated by the subject.

Outcome Measures

A trained, blinded assessor collected all outcome measures at baseline (Week 0) and post-intervention (Week 6).

i. **Numeric Pain Rating Scale (NPRS)** (0 = no pain, 10 = worst imaginable pain) was used to assess pain intensity. The NPRS is a valid, reliable, and responsive instrument commonly used to measure pain intensity in persons with knee OA and is responsive to changes in physiotherapy treatment[14].

ii. **Timed Up and Go (TUG) test** was used to measure Functional mobiity, which requires the participant to get up from a standard armchair, walk 3 meters, turn, walk back, and sit down again, and the time taken (in seconds) was recorded. The TUG is highly reliable and valid in assessing functional mobility in patients with knee OA[15].

iii. **The World Health Organization Quality of Life-BREF (WHOQOL-BREF)** is a 26-item validated questionnaire that measures quality of life in four domains: physical health, psychological health, social relationships, and environment, with higher scores indicating better quality of life. WHOQOL-BREF has been tested in various populations of people with chronic musculoskeletal conditions, including knee osteoarthritis[16].

Statistical Analysis

Data were entered and analyzed in SPSS version 26 (IBM Corp., USA). Skewness and Kurtosis were used to determine the normality of the data distribution. Baseline demographic and clinical data were summarized using descriptive statistics, including means, standard deviations, frequencies, and percentages. Repeated-measures analysis was used to compare NPRS, TUG, and WHOQOL-BREF scores within groups from baseline to post-intervention and between groups across the three arms using one-way analysis of variance (ANOVA), followed by pairwise comparisons with Bonferroni correction. The $p<0.05$ was considered statistically significant.

Ethical Consideration

The Institutional Review Board approved the study protocol (FMRL-IRB/2024/026) before the study began, and the trial was registered in advance on ClinicalTrials.gov (Identifier: NCT07710235). All participants received comprehensive information about the study procedures, risks, and benefits, and signed informed consent before enrollment. The study was carried out in compliance with the ethical principles of the Declaration of Helsinki.

RESULTS

Demographic Characteristics

Fifty participants were enrolled and randomly divided into 3 groups: Group A (Dry Needling + Strength Training, n = 17); Group B (Kinesio Taping + Strength Training, n = 17); Group C (Strength Training alone, n = 16). There were no dropouts in the 6-week intervention period, and all 50 participants completed baseline and post-intervention assessments (Figure 1).

The overall mean age of participants was 54.94 ± 7.19 years, and the mean BMI was 27.28 ± 3.38 kg/m². There were no statistically significant differences between the three groups at baseline, with respect to age, BMI, symptom duration, gender distribution, Kellgren–Lawrence (KL) radiographic grade, or affected side (all $p > 0.05$), indicating successful randomization (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics of Participants

Variable	Group A (n=17)	Group B (n=17)	Group C (n=16)	p-value
Age (years)	55.41 ± 6.41	56.35 ± 7.36	52.94 ± 7.78	0.381
BMI (kg/m²)	27.46 ± 4.01	26.17 ± 2.73	28.25 ± 3.12	0.204
Symptom duration (months)	17.47 ± 7.00	17.76 ± 7.85	19.50 ± 7.14	0.697
Gender, Female n (%)	14 (82.4)	12 (70.6)	11 (68.8)	0.622
Gender, Male n (%)	3 (17.6)	5 (29.4)	5 (31.3)	—
KL Grade II, n (%)	12 (70.6)	11 (64.7)	9 (56.3)	0.690
KL Grade III, n (%)	5 (29.4)	6 (35.3)	7 (43.8)	—
Affected side: Right, n (%)	7 (41.2)	6 (35.3)	5 (31.3)	0.964
Affected side: Left, n (%)	7 (41.2)	8 (47.1)	7 (43.8)	—
Affected side: Bilateral, n (%)	3 (17.6)	3 (17.6)	4 (25.0)	—

Group A = Dry Needling + Strength Training; Group B = Kinesio Taping + Strength Training; Group C = Strength Training alone; BMI = Body Mass Index; KL = Kellgren–Lawrence. Continuous variables analyzed by one-way ANOVA; categorical variables analyzed by Chi-square test. Mean ± SD; n (%).

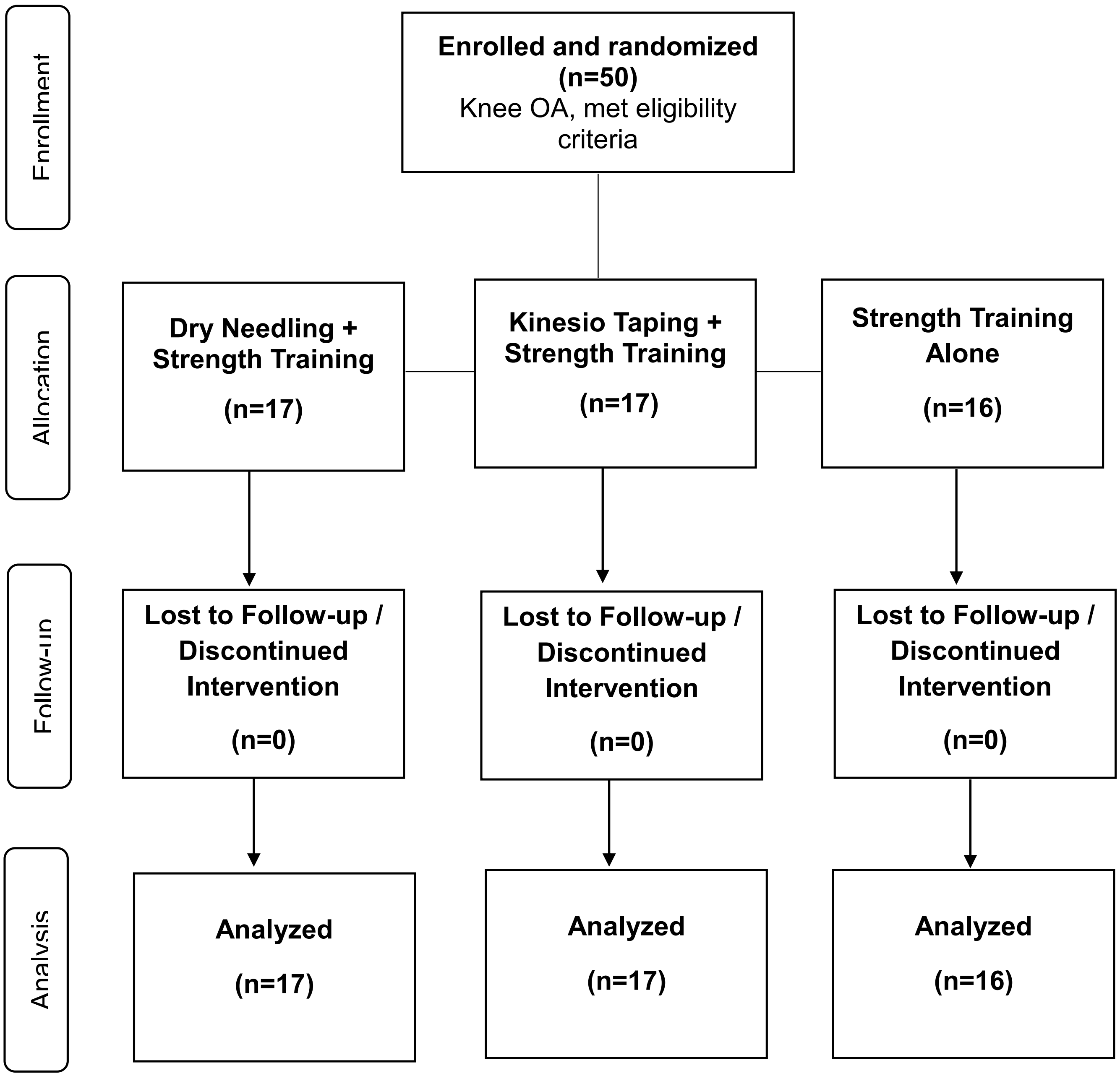

Figure 1. CONSORT flow diagram of participant enrollment, allocation, follow-up, and analysis

Adverse Events

There were no serious adverse events in any of the three groups in the six weeks of the intervention. A small number of participants in Group A reported soreness after the needle insertions and minor bruising at the sites where the needles were inserted. In contrast, a small number of participants in Group B were slightly irritated by the Kinesio tape; this irritation was minor, self-limited, and managed with conservative treatment by the treating physiotherapist; no participant required treatment modification, medical referral, or withdrawal from the study as a result.

Normality Testing

All baseline and post-intervention outcome variables were subjected to the Shapiro-Wilk test. Overall scores on the WHOQOL-BREF were normally distributed at baseline and post-intervention ($p > 0.05$). In contrast, NPRS and TUG scores showed minor deviations from normality at specific time points, likely due to the discrete, narrow range of the NPRS scale. All outcome measures were analyzed using parametric tests as outlined a priori, namely, a paired-samples t-test for within-group comparisons and a one-way ANOVA with Bonferroni-adjusted post hoc pairwise comparisons for between-group comparisons, given the approximately symmetric distribution of the data and adequate sample size per group.

Baseline Comparability

One-way ANOVA confirmed that there were no statistically significant differences between the groups at baseline in terms of NPRS ($F = 0.018$, $p = 0.982$), TUG ($F = 0.890$, $p = 0.418$), or WHOQOL-BREF overall scores ($F = 0.385$, $p = 0.682$), indicating that the three groups were comparable. Any differences following the intervention were due to the intervention effect.

Within-Group Effects after 6 Weeks of Treatment

Within-group difference scores were statistically significant for all three groups for all outcome measures after the 6-week intervention period (all $p < 0.001$) (Table 2). Group A showed the largest reduction in pain, with NPRS decreasing from 7.12 ± 1.05 to 3.94 ± 1.68 ($t = 11.579$, $p < 0.001$), while Group B improved from 7.12 ± 0.99 to 4.53 ± 1.33 ($t = 10.029$, $p < 0.001$), and Group C improved from 7.06 ± 0.77 to 5.62 ± 1.59 ($t = 5.578$, $p < 0.001$).

Functional mobility, measured by the TUG test, improved significantly in all groups, with Group A showing the greatest reduction in completion time (14.02 ± 2.23 to 10.91 ± 2.22 seconds; $t = 17.097$, $p < 0.001$), followed by Group B (14.87 ± 1.93 to 12.72 ± 2.38 seconds; $t = 9.279$, $p < 0.001$) and Group C (14.80 ± 1.97 to 13.61 ± 2.01 seconds; $t = 5.694$, $p < 0.001$).

Quality of life, assessed using the WHOQOL-BREF overall score, also improved significantly in all groups, with Group A demonstrating the greatest gain (51.46 ± 4.95 to 62.99 ± 5.77; $t = -30.349$, $p < 0.001$), compared to Group B (49.88 ± 5.36 to 58.09 ± 5.95; $t = -28.913$, $p < 0.001$) and Group C (50.53 ± 5.54 to 55.04 ± 5.20; $t = -10.571$, $p < 0.001$).

Table 2. Within-Group Comparison of Outcome Measures (Baseline vs. Post-6-Week Intervention)

Outcome Measure	Group	Pre Mean ± SD	Post Mean ± SD	t-value	p-value
NPRS (0–10)	A	7.12 ± 1.05	3.94 ± 1.68	11.579	<0.001
	B	7.12 ± 0.99	4.53 ± 1.33	10.029	<0.001
	C	7.06 ± 0.77	5.62 ± 1.59	5.578	<0.001
TUG (sec)	A	14.02 ± 2.23	10.91 ± 2.22	17.097	<0.001
	B	14.87 ± 1.93	12.72 ± 2.38	9.279	<0.001
	C	14.80 ± 1.97	13.61 ± 2.01	5.694	<0.001
WHOQOL-BREF Overall (0–100)	A	51.46 ± 4.95	62.99 ± 5.77	−30.349	<0.001
	B	49.88 ± 5.36	58.09 ± 5.95	−28.913	<0.001
	C	50.53 ± 5.54	55.04 ± 5.20	−10.571	<0.001

NPRS = Numeric Pain Rating Scale; TUG = Timed Up and Go test; WHOQOL-BREF = World Health Organization Quality of Life-BREF. Within-group comparison by paired samples t-test. Significance set at p < 0.05.

Between-Group Comparison after 6 Weeks of Treatment

Statistically significant between-group differences were found at post-intervention for all three primary outcome measures: NPRS ($F = 5.075$, $p = 0.010$), TUG ($F = 6.450$, $p = 0.003$), and WHOQOL-BREF overall score ($F = 8.338$, $p < 0.001$) (Table 3).

Post-hoc pairwise comparisons with Bonferroni correction (adjusted $\alpha = 0.017$) showed that Group A (Dry Needling + Strength Training) performed significantly better than Group C (Strength Training alone), in all three measures (NPRS, $p = 0.006$; TUG, $p < 0.001$; WHOQOL-BREF overall, $p < 0.001$). Group A also showed greater improvement than Group B across all outcomes.

However, this was not significant after Bonferroni correction for NPRS ($p = 0.265$), TUG ($p = 0.028$), or WHOQOL-BREF overall ($p = 0.020$). After correction, there was no statistically significant difference between the mean scores of Group B and Group C for NPRS ($p = 0.039$) or TUG ($p = 0.254$); however, Group B consistently had higher mean scores than Group C for all outcomes.

Table 3. Between-Group Comparison of Post-Intervention Outcome Measures

Outcome Measure	Group A (n=17)	Group B (n=17)	Group C (n=16)	F-value	p-value
NPRS (0–10)	3.94 ± 1.68	4.53 ± 1.33	5.62 ± 1.59	5.075	0.010*
TUG (sec)	10.91 ± 2.22	12.72 ± 2.38	13.61 ± 2.01	6.450	0.003*
WHOQOL-BREF Overall (0–100)	62.99 ± 5.77	58.09 ± 5.95	55.04 ± 5.20	8.338	<0.001*

**p < 0.05 (one-way ANOVA). Between-group comparison by one-way ANOVA.*

Table 4. Post-Hoc Pairwise Comparisons (Bonferroni-Adjusted, α = 0.017)

Outcome Measure	Comparison	Mean Difference	t-value	p-value	Significance
NPRS	A vs. B	−0.59	−1.134	0.265	NS
	A vs. C	−1.68	−2.960	0.006	Significant
	B vs. C	−1.09	−2.156	0.039	NS
TUG	A vs. B	−1.81	−2.295	0.028	NS
	A vs. C	−2.70	−3.662	<0.001	Significant
	B vs. C	−0.89	−1.163	0.254	NS
WHOQOL-BREF Overall	A vs. B	4.90	2.442	0.020	NS
	A vs. C	7.95	4.150	<0.001	Significant
	B vs. C	3.05	1.562	0.129	NS

NS = not significant after Bonferroni correction (adjusted α = 0.017).

WHOQOL-BREF Domain-Specific Analysis

Analysis of the individual WHOQOL-BREF domains revealed significant within-group improvements across all four domains (Physical, Psychological, Social Relationships, and Environmental) in all three groups (all $p < 0.001$) (Table 5).

Between-group analysis at post-intervention showed a statistically significant difference only in the Environmental domain ($F = 3.548$, $p = 0.037$), with Group A demonstrating the greatest improvement (52.89 ± 8.23 to 66.09 ± 9.60).

Differences between groups did not reach statistical significance for the Physical ($F = 1.728$, $p = 0.189$), Psychological ($F = 2.378$, $p = 0.104$), or Social Relationships ($F = 2.893$, $p = 0.065$) domains, although Group A consistently showed numerically greater gains across all four domains compared to Groups B and C.

Table 5. Within-Group Comparison of WHOQOL-BREF Domain Scores

Domain	Group	Pre Mean ± SD	Post Mean ± SD	p-value	Between-Group p
Physical Health	A	49.31 ± 10.76	60.76 ± 11.96	<0.001	0.189
	B	48.76 ± 9.83	57.68 ± 10.89	<0.001	
	C	49.19 ± 7.82	54.12 ± 7.05	<0.001	
Psychological	A	51.26 ± 7.54	61.40 ± 10.39	<0.001	0.104
	B	48.17 ± 9.66	56.84 ± 10.66	<0.001	
	C	48.44 ± 8.83	53.54 ± 10.18	<0.001	
Social Relationships	A	52.41 ± 9.49	63.75 ± 9.42	<0.001	0.065
	B	49.65 ± 11.16	56.19 ± 11.33	<0.001	
	C	52.08 ± 10.39	55.80 ± 11.57	<0.001	
Environmental	A	52.89 ± 8.23	66.09 ± 9.60	<0.001	0.037*
	B	52.94 ± 9.93	61.64 ± 11.30	<0.001	
	C	52.39 ± 9.04	56.76 ± 9.07	<0.001	

**Statistically significant at p < 0.05. Within-group comparison by paired samples t-test; between-group comparison by one-way ANOVA*

DISCUSSION

This three-arm randomized controlled trial compared dry needling combined with strength training, Kinesio taping combined with strength training, and strength training alone in patients with knee osteoarthritis. All three groups achieved statistically significant within-group improvements in pain, functional mobility, and quality of life after six weeks, confirming that structured strength training itself is an effective, first-line intervention for this population[17]. However, the addition of dry needling conferred a significantly greater benefit than strength training alone across all three primary outcomes, while the addition of Kinesio taping produced a consistent, but statistically non-significant, numerical advantage over strength training alone. Dry needling combined with strength training also showed a numerically greater improvement than Kinesio taping combined with strength training on every outcome, although this difference did not survive Bonferroni correction.

The superior performance of dry needling combined with strength training is consistent with a growing body of trial evidence showing that needling directed at myofascial trigger points and periarticular musculature produces meaningful reductions in pain and disability when layered onto exercise-based rehabilitation for knee osteoarthritis[18,19,20,21,22]. Ma et al. reported that dry needling of latent and active trigger points produced pain and functional improvements comparable to, and in some respects exceeding, oral diclofenac when combined with stretching[19], while Dunning et al. demonstrated in a large multicenter trial that periosteal electrical dry needling added to manual therapy and exercise produced significantly greater reductions in disability and pain than manual therapy and exercise alone, with benefits sustained to three months[20]. Similarly, Pang et al. found that both ultrasound-guided and traditional dry needling combined with exercise therapy outperformed exercise therapy alone for pain relief[21]. The proposed mechanisms underlying these effects include mechanical disruption of dysfunctional motor endplates and taut bands within trigger points, modulation of nociceptive signalling at the spinal and supraspinal level, release of endogenous opioids and other analgesic substances, and improved local muscle blood flow and relaxation[18,23,24], all of which may act synergistically with the biomechanical benefits of strength training to accelerate and augment recovery.

The evidence supporting the use of Kinesio taping as a complementary therapy to strengthening exercises for knee OA, on the other hand, is far less consistent. In Group B, this effect was statistically significant in only 1 of 12 outcomes, although it was numerically consistent across all outcomes. Several trials and a meta-analysis have reported short-term reductions in pain and improvements in function with the addition of Kinesio taping or when compared with sham taping, which they have attributed to increased quadriceps activation, stimulation of the skin and mechanoreceptors, and better proprioceptive feedback around the patellofemoral joint[10,11,25,26]. Other trials, however, have shown no meaningful differences between Kinesio taping and sham taping or usual care on pain, strength, or function[27], and a systematic review, limited to Kinesio taping with concurrent physical therapy, found that the effect of Kinesio taping on pain was small and short-lived[27]. The present findings, which did not reach significance when compared with strength training alone but trended toward benefit, fall comfortably within this disparate literature and suggest that the benefits of Kinesio taping may be a smaller and less consistent addition to exercise than those of dry needling.

This interpretation is supported by the pattern of results obtained on the three functional mobility and quality-of-life measures. The greater reduction in Timed Up corroborates the increase in the strength of the three arms and Go completion time in the dry needling group, consistent with more effective desensitization of periarticular trigger points, allowing for fuller recruitment of the quadriceps during the sit-to-stand and gait components of the task. Similarly, the only quality-of-life domain to show a significant difference between groups in this study was the Environmental domain. In contrast, the other two domains (Physical and Psychological/Social Relationships) showed improvements across all treatment arms, indicating that the most immediate cross-domain benefit of superior pain and mobility control in the 6 weeks of this study is the ability to negotiate one's immediate environment and daily surroundings. In contrast, broader psychological and social gains may require a longer intervention or follow-up period to consolidate and differentiate between treatment arms. This is consistent with findings from other combined physiotherapy trials in knee OA, where combining active exercise with adjunct therapy showed better and more rapid symptomatic recovery than active exercise or comparators (including electrotherapy) alone[18], and confirms that exercise therapy is the mainstay of non-surgical knee OA treatment regardless of the adjunct used, which enhances and accelerates the benefits of exercise therapy alone[2,28].

Strengths and Limitations

There are several strengths of this trial. The three-arm design allowed for a direct comparison between two emerging therapies and a common, standardized strength training intervention, which is not often seen in the current research literature, and which fills an important research gap. There was excellent baseline comparability between groups, with no significant differences in age, BMI, symptom duration, sex distribution, radiographic severity, or affected side. A blinded assessor conducted outcome assessment, and the measures used were reliable, valid, and responsive in populations with knee osteoarthritis. There was no attrition bias, as all 50 participants enrolled in the study completed both baseline and post-intervention assessments, which increased confidence in the within-group and between-group findings.

There are, however, some caveats to consider when interpreting these results. The trial was single-blind: outcome assessors were blinded, but participants and treating therapists were not, because the nature of the intervention (needling and taping) made this impossible. This may have led to performance and expectation bias, especially for the self-reported NPRS and WHOQOL-BREF measures. Due to the lack of sham dry needling or sham taping arm, the extra contact time, attention, and therapeutic ritual provided by each adjunct cannot be separated from any modality-specific physiological effect, meaning that the real specific effect of either technique may be smaller than the differences between groups. The non-significant but numerically consistent advantage of dry needling over Kinesio taping after Bonferroni correction may be due to the small number of cases in each arm of this trial (n = 17, 17, and 16), which may have limited statistical power to detect smaller, clinically relevant differences between the two adjunct groups themselves; a larger, multicenter trial would be better powered to resolve this comparison. The durability of the observed benefits and whether the difference between groups increases, decreases, or disappears over longer follow-up were not assessed. Lastly, while this trial did not report any serious adverse events, the minor procedure-related adverse events that did occur were treated conservatively by the treating physiotherapist. Still, the trial did not employ a standardized instrument to grade adverse events or treatment tolerability systematically, nor was cost assessed, both of which are relevant to clinicians and patients choosing between adjunct therapies in routine practice.

CONCLUSION

After six weeks, when compared to strength training alone, the combination of dry needling and a structured strength training program resulted in significantly greater improvements in pain, functional mobility, and quality of life in patients with knee osteoarthritis, while the combination of Kinesio taping and strength training resulted in a consistent but statistically non-significant numerical advantage compared to strength training alone. Dry needling also demonstrated a greater numeric benefit, though not statistically significant, compared to Kinesio taping across all outcomes. The results indicate that dry needling is a clinically useful, low-risk adjunct that physiotherapists can use in strength-training programs to improve short-term outcomes in knee osteoarthritis. In contrast, Kinesio taping's incremental effect is less clear and smaller. These results support the need for larger, multicenter, sham-controlled trials with longer-term follow-up to confirm the findings, better understand the durability of treatment effects, and determine the comparative cost-effectiveness of these adjunct therapies in routine clinical practice.

Author Contributions

HIA: Conception and Design, Supervision, and Manuscript Writing.
ZA: Study Design, Data Collection, and Data Analysis.
MMA: Literature Review, Data Interpretation, and Manuscript Preparation.
AA & WZ: Data Collection, Data Entry, and Manuscript Editing.
ZG: Literature Review, Critical Review, and Final Approval.

Funding Source

No sources.

Conflict of Interest

The authors declared no conflict of interest.

Data Availability

Data will be available on request.

Ethical Approval

The Institutional Review Board approved the study protocol (FMRL-IRB/2024/026) before the study began, and the trial was registered in advance on ClinicalTrials.gov (Identifier: NCT07710235).

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