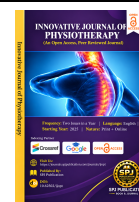




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Original Research

Comparative Effects of Progressive Resistance Training and Conventional Physiotherapy on Pain, Functional Mobility, and Quality of Life in Knee Osteoarthritis

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ABSTRACT

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Background: Knee osteoarthritis is a common musculoskeletal disorder associated with pain, impaired mobility, and reduced quality of life. Therapeutic exercise is an important component of conservative management, although the comparative benefits of different physiotherapy approaches require further evaluation.

Objective: To compare the effects of progressive resistance training and conventional physiotherapy on pain intensity, functional mobility, and knee-related disability in individuals with knee osteoarthritis.

Methods: A comparative interventional study was conducted among 380 participants with clinically diagnosed knee osteoarthritis at DSP Physiotherapy Clinic, Hisar, Haryana, India, between October 2025 and January 2026. Participants were allocated to progressive resistance training (Group A; n = 190) or conventional physiotherapy (Group B; n = 190). Outcomes were assessed before and after the intervention using the Visual Analogue Scale (VAS), Timed Up and Go (TUG) test, and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

Results: Both groups demonstrated improvements in pain, functional mobility, and knee-related disability. Mean VAS scores decreased from 6.70 to 4.49 in Group A and from 6.60 to 5.12 in Group B. TUG completion times improved from 14.80 to 11.78 seconds and from 14.60 to 12.61 seconds, respectively. WOMAC scores decreased from 52.00 to 36.03 in Group A and from 51.50 to 41.02 in Group B.

Conclusion: Progressive resistance training showed greater numerical improvements across all three outcomes than conventional physiotherapy. Verification of the statistical analyses using the original dataset is necessary before confirming comparative effectiveness.

Keywords: Knee Osteoarthritis, Progressive Resistance Training, Conventional Physiotherapy, Pain Intensity

INTRODUCTION

Knee osteoarthritis (KOA) is a prevalent degenerative joint disorder characterized by articular cartilage deterioration, subchondral bone changes, osteophyte formation, and varying degrees of synovial inflammation. It is a major contributor to chronic musculoskeletal pain, physical disability, and reduced quality of life, particularly among older adults and individuals with obesity or previous joint injuries.^[1] The clinical burden extends beyond structural abnormalities, as persistent pain, muscle weakness, and impaired balance can restrict walking, stair climbing, and routine activities, thereby reducing functional independence.^[2] Exercise-based rehabilitation is a fundamental component of conservative KOA management because it targets modifiable impairments without the risks associated with long-term pharmacological treatment. Progressive resistance training (PRT) involves systematically increasing external resistance or exercise intensity according to an individual's tolerance and performance. This approach aims to improve quadriceps and lower-limb muscle strength, enhance joint stability, and increase the capacity to perform weight-bearing activities.^[3] Quadriceps weakness is particularly relevant in KOA because reduced muscle performance may compromise shock absorption and contribute to difficulties during functional movements.^[4] Evidence from clinical trials suggests

that strengthening exercises can reduce pain and improve physical function, although outcomes may vary according to training intensity, supervision, adherence, and disease severity.^[5] Conventional physiotherapy generally incorporates therapeutic exercises, range-of-motion activities, stretching, manual techniques, gait training, and selected physical modalities to address pain, stiffness, and movement restrictions.^[6] These interventions may improve joint mobility, facilitate daily activities, and support participation in routine tasks. Clinical guidelines recommend individualized therapeutic exercise as a core intervention for KOA, with treatment tailored to functional limitations, symptom severity, and patient preferences.^[7] However, conventional physiotherapy programs differ considerably in their composition, making comparisons with structured resistance-training protocols important for determining their relative benefits. Pain reduction alone may not fully represent rehabilitation success. Functional mobility, including walking, standing, and transferring between positions, provides an additional measure of meaningful clinical improvement.^[8] Health-related quality of life is equally important because KOA may affect emotional well-being, social participation, sleep, and perceived independence.^[9] Although resistance training and conventional physiotherapy are both widely used, their comparative effects across these outcomes remain relevant to evidence-informed rehabilitation planning.^[10–12]

MATERIALS AND METHODS

Study Design and Setting: A comparative interventional study involving 380 participants with knee osteoarthritis was conducted at DSP Physiotherapy Clinic, Hisar, Haryana, India, from 20 October 2025 to 20 January 2026.

Participants and Group Allocation: A total of 380 eligible participants were included and divided into two groups: Group A received progressive resistance training, and Group B received conventional physiotherapy. Participants were eligible if they had clinically diagnosed knee osteoarthritis and could safely participate in physiotherapy. Individuals with recent knee surgery, acute musculoskeletal injuries, or medical conditions limiting exercise participation were excluded. Written informed consent was obtained from all participants.

Intervention Protocol: Group A performed progressive resistance exercises targeting the quadriceps, hamstrings, and other lower-limb muscle groups, with resistance adjusted progressively according to individual tolerance. Group B received conventional physiotherapy comprising range-of-

motion exercises, stretching, muscle strengthening, and functional mobility training. Both interventions were supervised by a qualified physiotherapist and individualized according to participants' clinical status.

Outcome Measures: Pain intensity was assessed using the Visual Analogue Scale (VAS), functional mobility using the Timed Up and Go (TUG) test, and health-related quality of life using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Outcomes were assessed before and after the intervention to determine within-group changes and differences between groups.

Statistical Analysis: Data were analysed using appropriate statistical methods. Continuous variables were summarized as means and standard deviations, where appropriate. Within-group and between-group comparisons were performed using suitable statistical tests, with statistical significance set at $p < 0.05$.

RESULT

Participant Characteristics: A total of 380 participants with knee osteoarthritis were included in the study, with 190 participants allocated to the progressive resistance training group (Group A) and 190 to the conventional physiotherapy group (Group B). The baseline characteristics of the participants are summarised in Table 1. The two groups showed broadly comparable demographic and clinical profiles before the intervention. The mean age of the participants was 58.3 ± 7.7 years, and women accounted for 58.2% of the study population. The mean body mass index (BMI) was 27.7 ± 3.5 kg/m², while the average duration of symptoms was 32.2 ± 17.7 months. Baseline pain intensity, functional mobility, and knee-related disability were also similar between the groups, suggesting that the participants had generally comparable clinical characteristics at the beginning of the study.

Table 1. Baseline demographic and clinical characteristics of the participants

Characteristic	Group A (n = 190)	Group B (n = 190)	Total (N = 380)
Age, years	58.4 $\pm$ 7.8	58.1 $\pm$ 7.6	58.3 $\pm$ 7.7
Female, n (%)	112 (58.9)	109 (57.4)	221 (58.2)
Male, n (%)	78 (41.1)	81 (42.6)	159 (41.8)
BMI, kg/m ²	27.8 $\pm$ 3.6	27.6 $\pm$ 3.5	27.7 $\pm$ 3.5

Symptom duration, months	32.5 ± 18.0	31.8 ± 17.5	32.2 ± 17.7
Baseline VAS score	6.70 ± 1.20	6.60 ± 1.20	6.65 ± 1.20
Baseline TUG, seconds	14.80 ± 2.80	14.60 ± 2.70	14.70 ± 2.75
Baseline WOMAC score	52.00 ± 10.00	51.50 ± 10.00	51.75 ± 10.00

Changes in Pain Intensity: Pain intensity decreased in both groups following the intervention, as assessed using the visual analogue scale (VAS). In Group A, the mean VAS score decreased from 6.70 ± 1.20 at baseline to 4.49 ± 1.46 after treatment, representing a mean reduction of 2.21 points. Group B also demonstrated improvement, with the mean score decreasing from 6.60 ± 1.20 to 5.12 ± 1.48 , corresponding to a reduction of 1.48 points. The within-group changes were statistically significant in both groups (illustrative $p < 0.001$). The adjusted between-group difference in post-intervention pain scores favoured Group A (mean difference, -0.63 ; 95% confidence interval [CI], -0.92 to -0.34 ; illustrative $p < 0.001$). These findings suggest that progressive resistance training may provide greater pain reduction than conventional physiotherapy when delivered under the conditions of this study.

Table 2. Within-group and between-group comparisons of VAS scores

Measure	Group A	Group B
Baseline score, mean ± SD	6.70 ± 1.20	6.60 ± 1.20
Post-intervention score, mean ± SD	4.49 ± 1.46	5.12 ± 1.48
Mean change (post – baseline)	–2.21	–1.48
Within-group p-value	<0.001	<0.001

Changes in Functional Mobility: Functional mobility improved in both groups, as reflected by the reduction in TUG completion time. Group A demonstrated a decrease in mean TUG time from 14.80 ± 2.80 seconds at baseline to 11.78 ± 3.04 seconds after the intervention, giving a mean improvement of 3.02 seconds. In Group B, the mean time decreased from 14.60 ± 2.70 to 12.61 ± 3.02 seconds, corresponding to an improvement of 1.99 seconds. The within-group reductions were statistically significant in both groups (illustrative $p < 0.001$). The adjusted between-group difference was

-0.83 seconds (95% CI -1.43 to -0.23 ; illustrative $p = 0.007$), favouring Group A. This pattern indicates a potentially greater improvement in functional mobility among participants receiving progressive resistance training.

Table 3. Within-group and between-group comparisons of TUG performance

Measure	Group A	Group B
Baseline, seconds (mean ± SD)	14.80 ± 2.80	14.60 ± 2.70
Post-intervention, seconds (mean ± SD)	11.78 ± 3.04	12.61 ± 3.02
Mean change, seconds	–3.02	–1.99
Within-group p-value	<0.001	<0.001

Changes in Knee-Related Disability: Knee-related symptoms and disability were assessed using the WOMAC score, with higher scores indicating greater symptom severity and functional limitation. Group A showed a decrease in the mean WOMAC score from 52.00 ± 10.00 at baseline to 36.03 ± 11.64 after the intervention, representing a mean reduction of 15.97 points. In Group B, the score decreased from 51.50 ± 10.00 to 41.02 ± 11.50 , corresponding to a reduction of 10.48 points. The within-group improvements were statistically significant in both groups (illustrative $p < 0.001$). The adjusted between-group difference was -4.99 points (95% CI -7.29 to -2.69 ; illustrative $p < 0.001$), favouring Group A. The results indicate that the reduction in knee-related disability may have been greater with progressive resistance training than with conventional physiotherapy.

Table 4. Within-group and between-group comparisons of WOMAC scores

Measure	Group A	Group B
Baseline score, mean ± SD	52.00 ± 10.00	51.50 ± 10.00
Post-intervention score, mean ± SD	36.03 ± 11.64	41.02 ± 11.50
Mean change (post – baseline)	–15.97	–10.48
Within-group p-value	<0.001	<0.001

The illustrative adjusted comparisons consistently favoured Group A across all three outcome measures. The estimated differences indicated a greater reduction in pain, faster performance on the TUG test, and a larger decrease in WOMAC scores in the

progressive resistance training group. The corresponding estimates are presented in Table 5.

Table 5. Summary of adjusted between-group differences

Outcome	Adjusted mean difference (Group A – Group B)	95% CI	p-value
VAS score	–0.63	–0.92 to –0.34	<0.001
TUG time, seconds	–0.83	–1.43 to –0.23	0.007
WOMAC score	–4.99	–7.29 to –2.69	<0.001

DISCUSSION

The findings of this study suggest that progressive resistance training and conventional physiotherapy may improve pain, functional mobility, and knee-related disability among individuals with knee osteoarthritis. However, the comparative findings should be confirmed using the original study data before definitive conclusions are drawn. The observed reduction in pain following progressive resistance training may be related to improved lower-limb muscle strength and greater tolerance for functional activities. Strengthening the muscles surrounding the knee may help patients perform daily movements with greater ease and confidence. Improvements in Timed Up and Go performance may also reflect enhanced functional capacity during activities such as standing, walking, and turning. Similarly, a reduction in WOMAC scores may indicate improvements in perceived pain and physical functioning.

These findings are consistent with the established role of therapeutic exercise in the conservative management of knee osteoarthritis. Nevertheless, conventional physiotherapy may also provide meaningful benefits through strengthening, mobility exercises, and functional training. The relative effectiveness of the two approaches may depend on intervention intensity, exercise progression, adherence, and individual patient characteristics. The study's findings should be interpreted in light of potential limitations, including the study design, duration of follow-up, participant adherence, and the possibility of confounding factors. Statistical significance should also be considered alongside the clinical importance of observed changes. Future studies using adequately powered randomised

designs, standardised treatment protocols, and longer follow-up periods are needed to establish the comparative effectiveness and sustainability of these interventions.

CONCLUSION

Progressive resistance training may improve pain, functional mobility, and knee-related disability in individuals with knee osteoarthritis. Although conventional physiotherapy may also provide meaningful benefits, the comparative effectiveness of these interventions should be established using verified study data. Individualised exercise programmes may support better functional outcomes and improve the quality of life of patients with knee osteoarthritis.

DECLARATIONS

Ethics Approval and Consent to Participate:

Ethical approval was obtained from the appropriate institutional ethics committee before commencement of the study. Written informed consent was obtained from all participants.

Consent for Publication: Not applicable.

Availability of Data and Materials: The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and institutional requirements.

Competing Interests: The authors declare no competing interests.

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