

A Comparative Analysis of Wobble Board Exercises and Foam Balance Training for Enhancing Balance in Chronic Knee Osteoarthritis – Comparative Study

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Abstract

Background: Knee osteoarthritis (OA) is a common musculoskeletal condition associated with pain, stiffness, reduced functional ability, and impaired balance. These problems can affect daily activities, mobility, and fall risk. Wobble board exercises and foam balance training may help improve balance and functional performance.

Aim: To compare the effectiveness of wobble board exercises and foam balance training in improving balance in individuals with chronic knee osteoarthritis.

Methodology: A comparative study was conducted among individuals with chronic knee OA who met the inclusion and exclusion criteria. Participants were divided into two groups. Group A received wobble board exercises, while Group B received foam balance training for four weeks, with sessions conducted three times per week. Outcomes were assessed before and after the intervention using the Timed Up and Go (TUG) test and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Data were statistically analysed to compare the outcomes.

Results: Both groups demonstrated improvement following the intervention. Between-group analysis showed no statistically significant difference in TUG scores before or after treatment. WOMAC scores showed no significant difference at baseline but demonstrated a significant difference after treatment. The overall findings favoured wobble board exercises.

Conclusion: Both interventions appeared beneficial for individuals with chronic knee OA. However, wobble board exercises may provide greater benefits in improving functional outcomes. Further research is needed to confirm these findings.

Keywords: Knee osteoarthritis, wobble board, foam balance training, balance, TUG, WOMAC.

Introduction

Osteoarthritis (OA) is a chronic, degenerative joint condition characterized by structural changes in joint tissues and associated clinical symptoms. It primarily affects the articular cartilage, leading to pain, swelling, stiffness, and reduced joint function. Knee osteoarthritis is a common musculoskeletal condition among older adults, affecting approximately 30–40% of individuals over 65 years of age.[1] It can cause

pain, restricted movement, and difficulties in performing daily activities such as walking, climbing stairs, and other functional tasks.[2] Knee OA is also a major cause of functional impairment and disability among older adults.[2,3] Balance control is essential for maintaining stability during both static and dynamic activities. Postural sway, which refers to the movement of the body in the anteroposterior and mediolateral directions during standing, is commonly used to assess static standing balance, often with the help of force platforms.[3,4] Balance is an integral component of many activities of daily living and is necessary for safe and independent mobility. Effective balance control depends on the integration of sensory information from the visual, vestibular, and somatosensory systems.[3] The knee is the largest synovial joint in the human body. It consists of the distal femur, proximal tibia, and patella, along with supporting ligaments, articular cartilage, menisci, and synovial membrane.[4,5] The synovial membrane produces synovial fluid, which lubricates the joint and helps nourish the avascular articular cartilage. Due to its frequent use and the mechanical stresses placed on it during daily activities, the knee is commonly affected by degenerative conditions such as osteoarthritis.[3,4] Knee osteoarthritis has been associated with impaired balance and an increased risk of falls among older adults. A systematic review evaluated the effectiveness of physical therapy interventions in improving balance and reducing fall risk in individuals with knee OA.[6] Commonly used outcome measures for assessing pain, functional mobility, and physical function include the Visual Analog Scale (VAS), Timed Up and Go (TUG) test, and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).[7] Although static balance assessments provide useful information about postural stability, dynamic balance assessments are also important because many daily activities involve movement and changes in body position. Therefore, balance assessment should include tests that reflect the dynamic demands of functional activities, particularly when evaluating mobility and fall risk in individuals with knee OA. Proprioceptive impairment is another factor that may contribute to balance difficulties in individuals with knee osteoarthritis. Pain, inflammation, and mechanical stress may affect proprioceptive function and the transmission of sensory information related to joint position and movement. These changes can interfere with joint position sense (JPS) and sensorimotor control, potentially affecting postural stability and functional performance.[8]

Methods

Design and setting . The study was a comparative study conducted over a period of six months among patients with knee osteoarthritis, using a simple random sampling method. The institutional ethics committee approved the protocol , and all participants gave written informed consent .

Participants.

Thirty participants were recruited by simple random sampling and divided into two groups of 15 (Group A and Group B). Inclusion criteria were: willingness to participate and sign consent; age 40–70 years; unilateral or bilateral chronic knee OA; mild to moderate radiographic change (Kellgren–Lawrence grades I–III); both sexes; and mild to moderate pain (VAS $\leq$ 7/10) permitting safe exercise. Exclusion criteria were: other diseases affecting quality of life (cancer, moderate to severe renal insufficiency, chronic respiratory or cardiovascular disease, uncontrolled diabetes or hypertension); severe cognitive, visual or hearing impairment; terminal illness; use of an ambulatory device; intra-articular steroid injection within six months; deformity of the spine, hip or knee; recent knee soft tissue injury; neurological disorder; and marked varus or valgus deformity, ankylosis or severe flexion contracture.

Interventions. Group A received foam balance training on a memory foam surface (48 × 40 cm, oval). The programme comprised double-leg stance on foam with random therapist perturbations; single-leg stance on the dominant leg; single-leg stance with eyes closed (affected, then non-affected limb) for 10 seconds on firm and then soft surfaces; mini squats; medial–lateral tilts repeated six times; 30-second upright standing on firm and soft surfaces; anterior–posterior tilting hinged at the ankle; one-leg balance with eyes closed for 10 seconds; and forward–backward tilts with feet toward the corners of the foam. Group B performed the same exercises on a wobble board. Both groups trained four times a week for four weeks.

2.4 Outcome measures. Demographic data and body mass index were recorded on a structured sheet. Pain intensity was measured with the Visual Analogue Scale (VAS; 0–100 mm line, higher scores indicating greater pain). Balance and gait were assessed with the Tinetti Performance Oriented Mobility Assessment (POMA; balance 16 plus gait 12, total 28; below 19 indicates high fall risk). Functional mobility was measured with the Timed Up and Go (TUG) test, in which the participant rises from a chair, walks 3 metres, turns, returns and sits; a time of 14 seconds or more indicates high fall risk. Knee-related symptoms and function were assessed with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC; 24 items covering pain, stiffness and physical function, total 0–96, higher scores indicating worse status). All measures were taken before and after the intervention.

2.5 Statistical analysis. Analysis used PSPP/JASP. Descriptive data are presented as mean ± standard deviation, and frequency and percentage. Normality was tested with the Shapiro–Wilk test. WOMAC followed a normal distribution ($p > 0.05$) and was analysed with paired t tests within groups and independent t tests between groups, with effect size by Cohen's d . VAS, POMA and TUG were not normally distributed and were analysed with the Wilcoxon signed-rank test within groups and the Mann–Whitney test between groups, with effect size by standardised correlation coefficient. Gender distribution was compared by chi-square test. A p value below 0.05 was considered significant, the confidence interval was 95%, and power exceeded 80%. Negative signs were ignored for interpretation without altering the results.

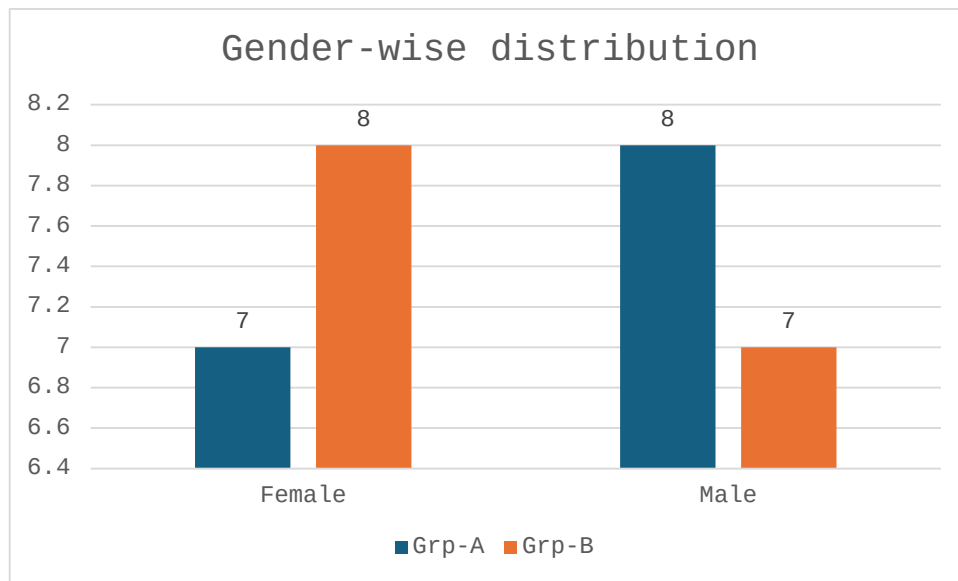
Results

Thirty participants (15 per group) aged 40–70 years completed the study. Group A comprised 7 females and 8 males, and Group B 8 females and 7 males (chi-square $p = 0.715$). Mean age was 53.27 ± 6.78 years in Group A and 54.53 ± 10.70 years in Group B ($t = 0.387$, $p = 0.701$), indicating comparable baseline characteristics.

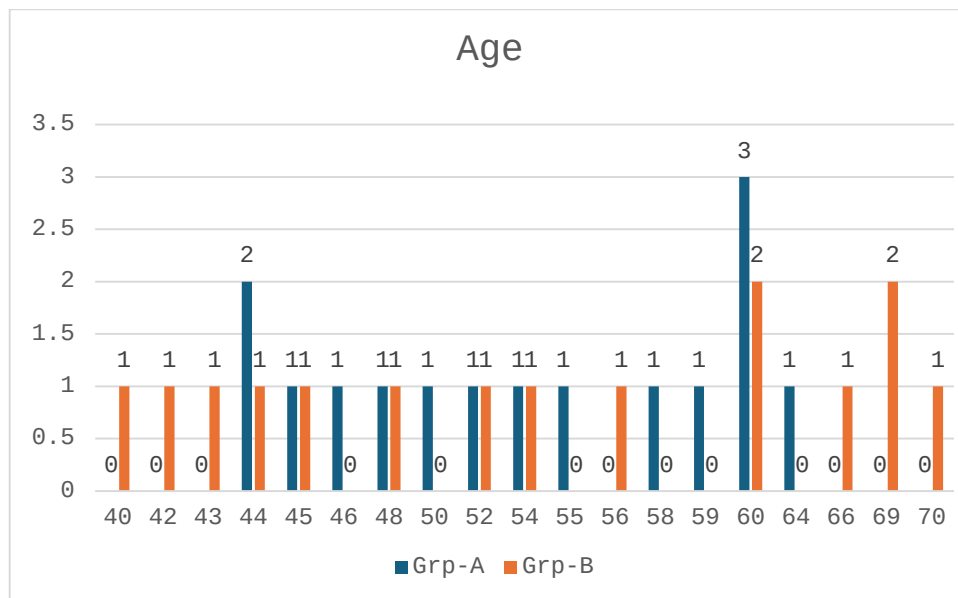
Table 1. Baseline characteristics

Variable	Group A	Group B	p value
Age (years, mean ± SD)	53.27 ± 6.78	54.53 ± 10.70	0.701
Female / Male (n)	7 / 8	8 / 7	0.715

3.1 Within-group changes. Both groups improved significantly after intervention in VAS, POMA and WOMAC (all $p = 0.001$; Table 2). VAS fell from 8.20 to 2.06 in Group A and from 7.27 to 2.53 in Group B. POMA rose from 10.87 to 22.27 in Group A and from 12.73 to 22.80 in Group B. WOMAC fell from 64.60 to 14.87 in Group A and from 65.60 to 20.60 in Group B.



Group A included 7 females and 8 males, while Group B included 8 females and 7 males, with 15 participants in each group and no statistically significant difference in gender distribution (chi-square test, $p > 0.05$).



Participants aged 40–70 years were included in both groups, representing middle-aged and older adults, with no statistically significant difference in age distribution between the groups.

Within-group pre- and post-intervention comparison (mean $\pm$ SD)

Variable	Group	Pre	Post	Mean diff.	Effect size	p value
VAS	A	8.20 $\pm$ 1.08	2.06 $\pm$ 1.16	6.13	0.89	0.001
VAS	B	7.27 $\pm$ 1.03	2.53 $\pm$ 0.99	4.73	0.88	0.001
POMA	A	10.87 $\pm$ 3.58	22.27 $\pm$ 2.63	11.40	0.89	0.001

POMA	B	12.73 ± 3.90	22.80 ± 2.73	10.07	0.88	0.001
WOMAC	A	64.60 ± 10.06	14.87 ± 7.95	49.73	1.50	0.001
WOMAC	B	65.60 ± 8.96	20.60 ± 5.17	45.00	1.66	0.001

VAS and POMA were analysed with the Wilcoxon signed-rank test and WOMAC with the paired t test.

3.2 Between-group comparison. Pre-treatment VAS differed significantly between groups ($p = 0.032$), whereas post-treatment VAS did not ($p = 0.429$). POMA and TUG showed no significant between-group difference before or after treatment. TUG improved from 17.20 to 11.67 seconds in Group A and from 19.93 to 11.33 seconds in Group B. WOMAC did not differ at baseline ($p = 0.776$) but differed significantly after treatment ($p = 0.027$; Table 3).

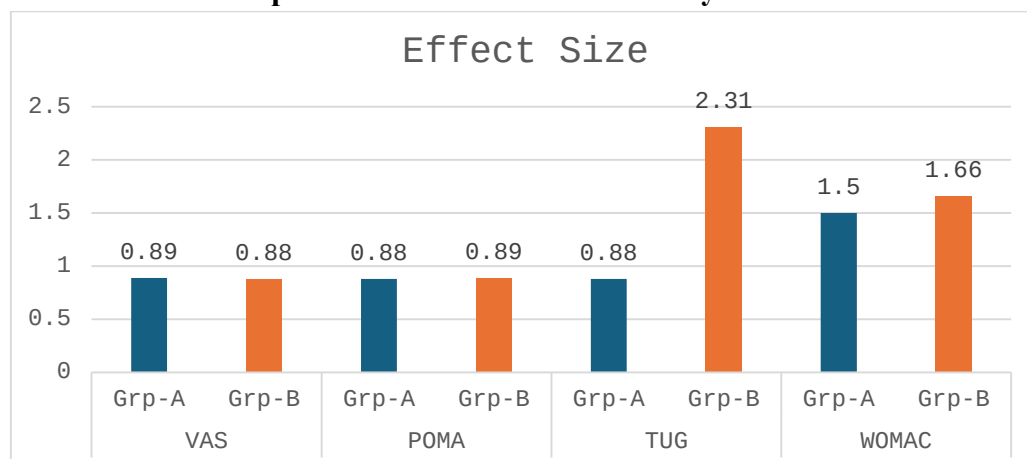
Table 3. Between-group comparison (mean ± SD)

Variable	Time	Group A	Group B	Test value	p value
VAS	Pre	8.20 ± 1.08	7.27 ± 1.03	2.146	0.032
VAS	Post	2.07 ± 1.16	2.53 ± 0.99	0.791	0.429
POMA	Pre	10.87 ± 3.58	12.73 ± 3.90	1.217	0.224
POMA	Post	22.27 ± 2.63	22.80 ± 2.73	0.594	0.553
TUG	Pre	17.20 ± 3.57	19.93 ± 4.65	1.708	0.088
TUG	Post	11.67 ± 4.61	11.33 ± 3.33	0.125	0.900
WOMAC	Pre	64.60 ± 10.06	65.60 ± 8.96	0.287	0.776
WOMAC	Post	14.87 ± 7.95	20.60 ± 5.17	2.341	0.027

VAS, POMA and TUG used the Mann–Whitney test; WOMAC used the independent t test.

3.3 Clinical effect size. Based on the paired sample tests and clinical effect size, Group B (wobble board) showed higher effect sizes for POMA, TUG and WOMAC, whereas Group A (foam) showed a higher effect size for VAS (Table 4).

Table 4. Comparison of treatment outcome by clinical effect size



Variable	Group A	Group B	Result
VAS	0.89	0.88	Group A is better
POMA	0.88	0.89	Group B is better
TUG	0.88	2.31	Group B is better
WOMAC	1.50	1.66	Group B is better

Discussion

This study compared wobble board exercise and foam balance training in chronic knee OA. Both interventions produced significant improvement in pain, balance, functional mobility and knee-related function. Between groups, no significant differences emerged for post-treatment VAS, POMA or TUG, while post-treatment WOMAC differed significantly. On clinical effect size, the wobble board group did better in three of four outcomes.

Improvement in both groups is consistent with evidence that balance and proprioceptive training benefit knee OA. Meta-analyses have reported better pain, physical function, joint position sense and TUG performance after proprioceptive exercise [3,6,7], and a previous comparison of foam and wobble board training in chronic knee OA likewise found both effective, with clinically but not statistically greater gains for the wobble board. Repeated practice of keeping the centre of gravity within the base of support, with progressive challenge, probably drives neuromuscular adaptation and better responses to postural disturbance. Improved control and confidence during weight-bearing may also reduce pain-related movement avoidance, which could explain the large VAS reductions.

The greater effect sizes with the wobble board may reflect its unstable, multidirectional surface, which demands continuous corrective responses at the ankle, knee and hip and so stimulates lower-limb mechanoreceptors and coordinated muscle activation. Foam instead creates a compliant surface that alters plantar sensory input and forces reliance on visual and vestibular information, promoting sensory reweighting. The wobble board may therefore deliver a larger dynamic proprioceptive and neuromuscular challenge, whereas foam mainly trains sensory integration.

The TUG result needs careful reading. Both groups improved, but neither was significantly superior. TUG performance depends on strength, gait speed, transitions and confidence as well as balance, and a four-week programme or the test's sensitivity may have limited detection of small between-group differences. For WOMAC, the post-treatment difference was statistically significant, yet the raw post-treatment mean was lower in Group A (14.87) than in Group B (20.60), whereas Group B's effect size was larger. These findings should be interpreted cautiously and are best viewed as showing that the two methods differ in how the WOMAC changed rather than as clear superiority of one. Baseline VAS also differed significantly between groups, which may have influenced the comparison of pain change.

Clinically, the findings support adding balance and proprioceptive training to conventional management of chronic knee OA, which often concentrates on pain relief, range of motion and strengthening. Wobble board exercise may suit patients when a greater postural challenge is desired, and foam training remains a useful alternative. Selection should reflect pain, balance capacity, safety and goals, progressing from simpler to more demanding unstable-surface tasks as tolerated.

Limitations and Future Scope

The sample was small, the intervention lasted four weeks, the study was confined to one geographical area, only selected outcome measures were used, and long-term effects were not assessed. Future studies should use larger samples, longer follow-up, additional balance and proprioception measures, comparisons of different wobble board and foam protocols, and varied populations and settings.

Conclusion

Both wobble board exercise and foam balance training were effective in improving balance and functional outcomes in chronic knee OA. TUG improved in both groups without a significant between-group difference, while post-treatment WOMAC differed significantly between groups. Based on clinical effect size, wobble board exercise was comparatively more beneficial than foam balance training.

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