

Comparison of Wobble Board and Trampoline Training as an Adjunct on Proprioception, Kinesiophobia and Risk of Fall in Patients with Knee Osteoarthritis: A Randomised Clinical Trial Protocol

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ABSTRACT

Introduction: Knee Osteoarthritis (KOA) is chronic degenerative, age-related disorder leading to physical decline, balance and gait disturbance along with deformities. Patients with KOA exhibit impaired joint position sense, fear of movement, poor proprioception and elevated fall risk which contributes to poor postural control, increased sway and higher risk of fall.

Need of the study: Proprioception training using unstable surface is essential component of rehabilitation. Wobble board training is commonly used to improve balance and neuromuscular control, whereas trampoline training provides a dynamic, multidirectional challenge which might provide more better functional demand. However, evidence comparing these two modalities as an adjunct in KOA is limited.

Aim: To compare the effect of wobble board and trampoline training as an adjunct to conventional therapy on proprioception, kinesiophobia and risk of fall in patients with KOA.

Materials and Methods: The present Randomised Clinical Trial (RCT) will be conducted in MM Super Specialty Hospital, Mullana, Ambala, Haryana, India, from March 2026 to March 2027. A total of 36 patients with bilateral KOA of grade 2 and 3 (Kellgren-Lawrence grade) will be recruited based on predefined inclusion and exclusion criteria. Group A will receive wobble board training with conventional therapy, and Group B will receive trampoline training with conventional therapy for three sessions per week for four weeks. Primary outcome measures include knee joint proprioception, Tampa Scale for Kinesiophobia, Fall Efficacy Scale-International (FES-I) and secondary outcome includes Knee injury and Osteoarthritis Outcome Score (KOOS) and Numeric Rating Scale (NRS). A paired t-test will be performed for within group comparison for normally distributed using Independent t-test and Wilcoxon Signed-Rank Test for not normally distributed data.

Keywords: Accidental falls, Gait, Healthcare, Humans, Postural balance

INTRODUCTION

Osteoarthritis (OA) is a chronic, non-inflammatory disease in which there is gradual breakdown of articular cartilage and subsequent development of bony outgrowths (osteophytes) [1]. Epidemiologically, various endogenous (age, sex, genetic and post-menopausal women) and exogenous (increased BMI, various microtrauma or microtrauma and poor lifestyle like alcohol abuse) risk factors may lead to OA [2]. Ageing, illness and flaring of chronic disease act as physical stressor that challenges body's normal function. It is of two types: "Primary" which may be idiopathic or non-traumatic and "Secondary" due to any previous trauma, infection and obesity [3]. Symptoms like persistent joint pain that worsen after weight bearing, visible swelling, bone deformity, a "crackling" or grinding sensation known as crepitus, stiffness and restricted range of motion [4,5]. It is one of the most common diseases affecting most of the population of 45-74 years of age or older [1].

Individuals with KOA exhibit significantly increased static postural sway indicating compromised postural instability, reduced knee joint proprioceptive acuity and impaired sensory feedback. This leads to the cycle of physical decline, starting from pain around knee joint due to decreased joint space, restricted range of motion, muscles weakness (quadriceps muscles) leading to balance problem, gait instability and deformity [4]. Globally, the prevalence of OA is 9.6% in men and 18% in women. While in India, women aged between 30-60 years have more prevalence rate of 21.6% due to increased sedentary lifestyle and menopausal hormonal shift [2]. In older men

with age group of 60-64 years, KOA is found more prevalent in right knee (23%) then in left knee (16.3%). However, in women the prevalence of KOA is found to be more symmetrical, with equal prevalence in the right (24.2%) and left knee (24.7%) [2].

Trampoline training also called as rebound exercise, is one of the promising therapeutic modalities used for dynamic feedback [6,7]. It involves rhythmic jumping and controlled movement performed on elastic surface [6]. The mini-trampoline exercise follows a multicomponent training approach which results in the improvement of various physical factors such as muscular strength, postural stability, neuromuscular coordination, joint range of motion, and spatial orientation [8]. Moving to different target population, a trampoline-based program can lead to improved postural balance and overall performance [7].

This rebound exercise employs gravity to maximise results and at the same time minimise the effort [7]. The dynamic nature of trampoline training leads to several muscles groups working at the same time which overall results in greater muscular endurance and stronger core stability [9]. Review of clinical studies has demonstrated that trampoline training significantly contributes to the improvement of balance and muscle strength in the elderly population as well as individuals with neuromuscular disorders [9].

Wobble board is an unstable platform used for dynamic balance stability, postural control and overall physical performance [10]. It is widely used in rehabilitation that helps to improve proprioception, single leg stance, postural sway and restoring the normal

neuromuscular feedback loop. There is a clear connection between proprioception and joint function, suggesting that the targeted proprioceptive training can lead to functional improvement mostly in knee and ankle injuries [11].

Wobble board performance may attribute to enhance feed-forward and feed-backward postural control mechanism [12]. Feed-forward control anticipates the known external disruption and prepares the ideal path but at the same time, feed-backward control neutralises the internal modelling error and ensure any deviation from that path are corrected [13]. It allows multiplanar movement and along with that increase the participation of trunk muscle which enhance feedback to joint mechanoreceptor during balance exercise [14,15]. Thus, refines body's proprioceptive accuracy, making this device very effective in regaining balance after knee and ankle injuries [15,16].

Therefore, the main purpose of the study is to focus on improving proprioception and kinesiophobia and decreasing the risk of fall through two different dynamic devices as an adjunct to conventional therapy among individuals with KOA.

Hypothesis

Null hypothesis (H_0): There will be no significant difference between wobble board and trampoline training as an adjunct to conventional therapy in patients with KOA.

Alternative hypothesis (H_1): There will be significant difference between wobble board and trampoline training as an adjunct to conventional therapy in patients with KOA.

REVIEW OF LITERATURE

Knee joint is one of the most common joint for OA that get affected in individuals with more than 45 years, is associated with restricting range of motion, muscular weakness, pain, discomfort and alteration in gait leading to risk of fall [17]. Reduced joint proprioceptive accuracy has recently been suggested as a possible local factor contributing to the development and progression of OA [18]. Prasanna VV et al., conducted a randomised controlled trial which concluded that wobble board balance exercise along with progressive resistance training and pain shield ultrasound therapy was more effective than aerobic balance exercise with progressive resistance training and pain shield ultrasound therapy in reducing pain, improving balance and functional ability in individuals with unilateral KOA. The experimental group showed lower pain score as compared to control group and showed higher berg balance score indicating better improvement in balance. Along with this 30 second sit to stand test also indicated better lower limb strength and functional mobility in these individuals [12]. Kaur D, included 40 subjects with age group of 40 to 70 years and randomly allocate into wobble board group and foam balance activity group. Each group showed improvement but wobble board group showed significantly high improvement assessed via berg balance scale, functional reach test and WOMAC [19]. Kotteswaran K et al., supports wobble board training as an effective training intervention that improves balance and functional outcome. It also provides evidences that unstable surface training or dynamic balance training enhance more effectively than stability training [4].

MATERIALS AND METHODS

The present study will be a randomised clinical trial and will be conducted in MM Super Specialty Hospital, Mullana, Ambala, Haryana, India between March 2026 and March 2027. The study follows Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) guidelines. [Table/Fig-1] shows SPIRIT flow diagram and time points of recording.

The study had received the Ethical Clearance from Institutional Ethical committee on 28th March 2026 with project number of IEC-PT-26/100. Registration for this study has been completed with the 'Clinical Trial Registry-India' (CTRI/2026/06/111545) on 01/06/2026.

	Enrolment	Allocation	Post allocation	
Time point	-t1	0	Baseline	4 th Week
Enrolment				
Eligibility screen	X			
Informed consent	X			
Allocation		X		
Interventions			→	
Wobble board + Conventional			X	X
Trampoline + Conventional			X	X
Assessment				
Tampa Scale for Kinesiophobia (TSK)			X	X
Fall Efficacy Scale-International (FES-I)			X	X
Knee joint proprioception			X	X
Knee injury and Osteoarthritis Outcome Score (KOOS)			X	X
Numeric Rating Scale (NRS)			X	X

[Table/Fig-1]: SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) flow diagram and time points of recording.

X denotes the activity that takes place at the designated time point

After completion of the study the result will be disseminated through publication and trial registry. Data monitoring committee comprising of experts, clinicians, academicians, and members of research advisory committee will ensure patient safety and monitor data integrity throughout the trial period.

Study population: The study population will include diagnosed bilateral KOA cases. Participants will be included on the basis of defined eligibility criteria. If the participant meets the eligibility criteria, then the written informed consent form will be signed from the recruited patients for their voluntary participation by primary investigator after a detailed explanation of the treatment protocol, including potential risks and benefits, in their native language. The entire demographic characteristic will be noted. The eligible participants will undergo a baseline assessment to measure the outcome variables.

Inclusion criteria: Participants of either gender, age group of 45 to 65 years, NRS score ≥ 8 in terms of pain [20], radiological evidence of bilateral KOA of grade 2 and 3 to Kellgren-Lawrence grading system [12] will be included. Participants should also able to follow verbal command.

Exclusion criteria: Participants who have recent history of trauma, injury or any recent fracture in lower limb, using lower limb assistive aids will be excluded. Participants diagnosed with motor or sensory impairment, cognitive impairment, neurological impairment in lower limb, or any ligament or meniscal injury in knee joint will also be excluded.

Sample size calculation: The sample size of this study is calculated by using G*Power 3.1.9.4 with an effect size of 1.044 for FES-I, alpha error probability of 0.05, and power of 80% yielding 32 participants [21]. After accounting for an anticipated 10% dropout rate, the final sample size is increased to 36 i.e., 18 participants in each group.

Randomisation, Concealment and Blinding

The study will be RCT. Number of eligible participants will be assigned randomly to either Group A and Group B via computer-generated random numbers. The random allocation concealment sequence will be generated by an independent researcher (1:1) who will be not involved in participant recruitment, assessment and intervention. The allocation concealment will be placed in sequentially numbered, sealed and opaque envelopes. After baseline assessment, participants sequence number will be revealed to determine the group allocation. This study will follow a single-blinded design in which the outcome assessor will be blinded.

Study Procedure

Based on the eligibility criteria 36 participants will be randomly allocated in two different groups i.e., 18 participants in each group. Participants will be interviewed and encouraged to asked questions regarding the study procedure. Along with informed consent participants will receive information sheet about the training with detailed explanation. Assessment will be done at baseline and 4th week (postintervention) of all outcome measures.

Participants may continue their usual medical management but will be prohibited from receiving any other physiotherapy or experimental intervention during the study period. The therapist will supervise all the session to ensure patients safety. Exercise intensity and progression were guided by the patient tolerance, safety consideration and overall performance.

Participant retention will be promoted by sending appointment reminders and encouraging the participants to complete all the assessments and documenting the reasons for withdrawal.

Intervention

Group A: Wobble board training and **Group B:** Trampoline training. Along with Wobble board and Trampoline training, conventional therapy is also included in both the intervention groups.

Group A: Wobble board training: Participants that are allocated in wobble board group will receive approximately 25-30 minutes of training, with conventional therapy of approximately 30 minutes, for 12 sessions. Patient will be instructed to remove their shoes and stand on the wobble board [Table/Fig-2] with feet wide apart and follow the treatment protocol. To ensure standardised intervention and to reduce the risk of any injury, each session will be fully supervised by the therapist.



[Table/Fig-2]: Wobble board.

1. Stand with feet parallel on the board, rock the board forward and backward for 30 second, six times with rest time of 10 second [16].
2. Stand with feet parallel on the board rock the board from side to side for 30 second, six times with rest time of 10 second.
3. Stand with feet wide apart on the board and rock the front of the board from side to side in a clockwise rotation for 10 times, repeat it for three sets with rest time of 10 seconds after every set. After that do it in anticlockwise direction.
4. Repeat exercises 1 to 3 but with knees slightly bent and hands on buttocks.
Continue exercises 1-4 for 30 seconds, rest for 10 seconds and repeat it for six times.
5. Stand on the single leg and keep the board level for 10 seconds, repeat six times, rest for 10 seconds

If in stage 5 balance can be maintained without losing stability of the board, then complete with the eyes closed.

Group B: Trampoline training: Participants in trampoline training group will also receive training of 25-30 minutes, for 12 sessions. In this trampoline training participants will receive a brief repeated management on mini trampoline [Table/Fig-3] by various exercises which is described below. Patient will be instructed to remove their shoes and stand on trampoline placed on level, stable surface. They should follow verbal command by trained and experienced instructor regarding correct technique and safe use of equipment with therapist guarding after a warm up. This trampoline training will be fully supervised for participants. Along with this conventional therapy will be also provided in this group.



[Table/Fig-3]: Trampoline.

1. Walking in place for 30 seconds, six times with 10 seconds rest [21].
2. Two-legged stance for 30 seconds, three times with 10 seconds rest.
3. Shifting weight while standing for 10 seconds, six times.
4. Semi-tandem stance for 30 seconds, three times with 10 sec rest.
5. Lunges, 10 reps, two set
6. Tandem stance for 30 seconds, six time with 10 seconds rest.
7. Heel stance for 30 seconds, six time with 10 seconds rest.
8. A structured warm up and cool down period were also added before and after exercise which include gentle mobility and stretching exercises of both upper and lower limbs [22].

Conventional Therapy

Patient assigned in both the group will receive 20 minutes of hot pack application followed by 10-12 minutes of exercise. After completion of conventional therapy, participants will undergo their allocated intervention under the supervision of therapist. The exercises that are included in conventional therapy are [23]:

Isometric quadriceps -three reps with 30 seconds hold and 10 seconds rest * two sets

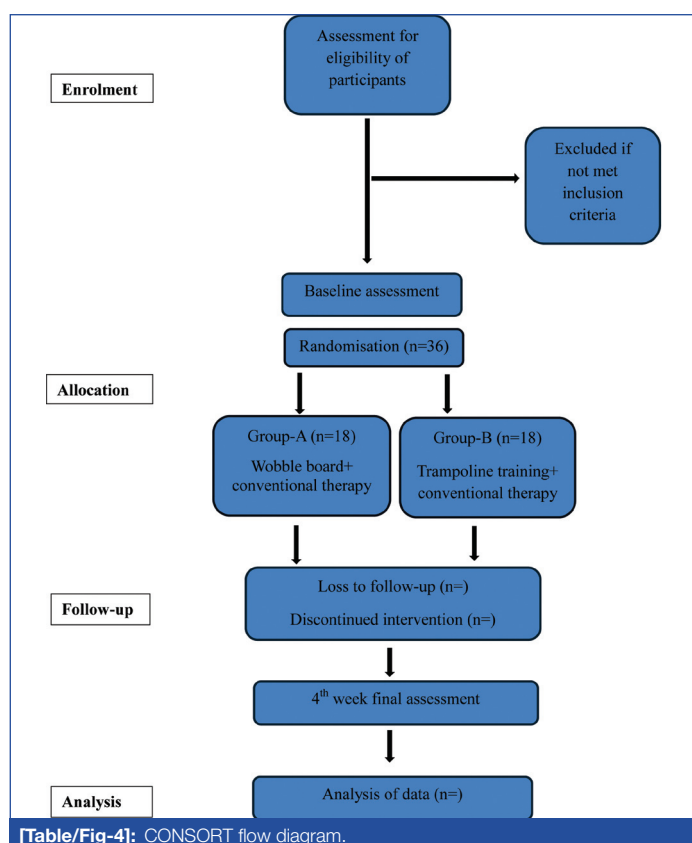
Isometric hamstring - three reps with 30 seconds hold and 10 seconds rest * two sets

Isometric glutes - three reps with 30 seconds hold and 10 seconds rest * two sets

Both interventions will be delivered by the qualified physiotherapist. Participant adherence will be monitored by attendance records which will be maintained by the therapist and a diary documenting the dates and no. of sessions will be maintained by participants. Progress of phase and randomisation of trial explained in consort flow diagram [Table/Fig-4].

Adverse Effects

Either intervention used in this study is considered as low risk as they are fully supervised. Though specific exercise protocol will be



given, exercise progression will be based on participant tolerance, pain response, and ability to complete the previous level safely. Exercises will be stopped if pain increases by more than two points on NRS, dizziness occurs, or balance cannot be maintained safely.

Handling Missing Data

Missing data will be minimised through regular follow-up and proper monitoring. Missing data will be addressed for its extent and pattern prior to analysis using appropriate methods. Depending on the extend and pattern of missing data, along with the method to manage them will be reported transparently in the final study.

Outcome Measures

The outcome measure assessment will be done at baseline and 4th week of the study. The assessment will be done by the primary investigator.

Primary outcome measure:

- a) **Tampa Scale for Kinesiophobia (TSK):** Kinesiophobia is characterised by severe, irrational, and disabling fear of bodily movement and physical activity. Due to this, there is avoidance of movement and physical activity and is commonly observed in chronic pain [24,25]. Tampa scale for kinesiophobia is 17-item self-reported questionnaire which is a gold standard equipment used to assess kinesiophobia.

The score ranges from 17 to 68, higher the score greater the fear of movement [26]. The Tampa scale for kinesiophobia have good internal consistency ($\alpha=0.90$) and high test-retest reliability (ICC=0.934) [27].

- b) **Fall Efficacy Scale-International (FES-I):** In the individuals with KOA, risk of fall is the one of common cause for disability as it led to functional decline and limitation of physical activity [28]. In this study FES-I in KOA patient will be used. The FES-I is a 16-item self-reported questionnaire filled by the individuals with score ranging from 16 to 64 based on four-point Likert scale [29,30]. The ICC value of FES-I scale is 0.94 and internal consistency, Cronbach alpha = 0.93 [31].
- c) **Knee proprioception using universal goniometer:** Proprioception is the sense of position of one's own body part [32]. The joint position sense will be measure by using universal goniometer [32]. It will be assessed by both active and passive joint positioning. The participant will be blindfolded to eliminate visual cue and seated on high chair or couch with their lower leg freely over edge. The outcome assessor will perform all baseline and postintervention assessment. The universal goniometer will be attached to the lateral aspect of the lower leg. The examiner passively extends the knee to 30° and asks the patient to hold it for 10 second and then return it to starting position. Then participants will be asked to actively reach the test angle. Similarly same procedure will be repeated for another test angle i.e., 45° and 60° of knee extension [32,33]. Each target angle will be measured one time by active and passive method.

Secondary outcome measure:

- a) **Knee injury and Osteoarthritis Outcome Score (KOOS):** The KOOS is a knee specific, patient reported outcome measure which is used to evaluate the knee joint conditions and related functional limitations. This questionnaire consists of set of 42 questions divided into five subscale which include pain, symptoms, activity of daily living, function in sport and recreation and knee- related quality of life. Score range from 0 to 100 in which "0" represents extreme knee problem and "100" represents no knee problem [34].
- b) **Numeric Rating Scale (NRS):** It is an 11-pointer scale which is used to measure pain intensity. In this scale, "0" represents "no pain" whereas "10" represents "unbearable pain". During the time of assessment participant will report the numeric value that represent their pain and that number will indicate participants pain intensity. The 1-5 will demonstrate mild pain, 6-7 demonstrate moderate pain and ≥ 8 suggest severe pain [20].

The outcome will be assessed at baseline and postintervention by an independent physiotherapist who is not involved in this study. Participants were instructed to not reveal their intervention and group allocation to the outcome assessor during assessment period. In case of any accidental unblinding the occurrence will be documented and if possible, further assessment will be carried out by another blinded outcome assessor. A visual time line in the form of GANTT chart is also provided [Table/Fig-5].

S. No.	Research phase	2025		2026				2027		
		Nov	Dec	Jan-Mar	Apr-June	Jul-Sept	Oct-Dec	January	February	March
1.	Title submission									
2.	SPC meeting									
3.	Ethical committee submission									
4.	Data collection									
5.	Data analysis									
6.	Submission									

[Table/Fig-5]: GANTT chart.

Data Management

The participants data will be kept confidential in an excel file for analysis and will be provided on reasonable request.

STATISTICAL ANALYSIS

Data will be analysed using Statistical Package for the Social Sciences (SPSS) 27.0 software package. Level of significance will be set at 0.05. Normality will be assessed using Shapiro Wilk test. A paired t-test will be performed for within group comparison if data are normally distributed and if data is not found to be normally distributed then Wilcoxon Signed-Rank Test will be performed. For between group comparison, normally distributed data will be analysed using independent t-test and for not normally distributed data Mann-Whitney U test will be used. The results of the study will be shared through publication in peer reviewed journals and presentations and scientific meetings.

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