

EFFECTIVENESS OF BALANCE EXERCISE PROGRAM IN TOTAL KNEE ARTHROPLASTY: META-ANALYSIS

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ABSTRACT

Background: Balance is essential for maintaining postural stability while performing functional activities and for falls avoidance in patients with TKA. There are very few RCTs done to assess functional improvement after TKA. Hence, this study was undertaken to find out evidence on physiotherapy treatment in TKA and analyze it. **Methods:** We searched Medline, CINAHL, PEDro from the year 2001 to 2015 for RCT involving evaluations of physiotherapy exercise in adults with a knee replacement. Search criteria's were pain, stiffness, adherence and attrition. The inclusion criteria were studies which included physiotherapy exercise for balance specific exercises which compared various functional training and functional training with balance exercise in TKA. **Result:** Searches identified 20 randomized trials related to TKA and physiotherapy. Only three were fulfilled the inclusion criteria. Functional training with balance exercises found to be effective in patients with total knee arthroplasty. **Conclusion:** After total knee replacement, interventions including physiotherapy along with balance exercises showed improvement in pain, stiffness and functional performance in mobility.

Keywords: Osteoarthritis; Balance; Total knee arthroplasty physiotherapy.

INTRODUCTION

Knee osteoarthritis (OA) is a progressive degenerative disease and a leading cause of disability among the elderly. Prevalence of knee OA is higher among women and increases with age [1]. Patients with knee osteoarthritis experience impaired mobility and limited function in their activities of daily living because of inflammation of joint which leads to knee pain. Postural deficits and deficits in the gait pattern are evident, such as a decrease in gait velocity and stride length; in addition, patients show abnormal movement patterns when ascending and descending stairs [2]. Total knee arthroplasty (TKA) is a commonly accepted surgical procedure recommended for severe OA characterized by radiographic evidence of joint damage, moderate to severe persistent pain, and clinically significant functional limitations affecting the quality of life when conservative treatments such as nonsteroidal anti-inflammatory drugs, physical therapy, and intra-articular corticosteroid injections fail [1]. It is the most effective therapy for patients with severe knee osteoarthritis; as it relieves symptoms of knee osteoarthritis such as knee pain and stiffness.

Joint replacement (arthroplasty) is a surgical option for end stage arthritis now is advancing and millions of people across the world are benefited. Indian Society of Hip and Knee Surgeons (ISHKS) have a data of 34,478 Total Knee Arthroplastys (TKA) and 3604 Total Hip

Arthroplastys (THA) contributed by 42 surgeons of India. Data of 34,478 TKAs was assessed. These included 8612 males (25%) and 25,866 females (75%). Average age was 64.4 years (Osteoarthritic range: 45-88 years; Rheumatoid arthritis range: 22 to 74 years). Average body mass index was 29.1 (Range: 18.1 to 42.9). The indication for TKA was osteoarthritis in 33,444 (97%) and rheumatoid arthritis in 759 (2.2%) [3].

Balance is essential for maintaining postural stability while performing functional activities and for prevention of falls. Balance (dynamic and static) is a complex function which is the integration of sensory information regarding the position of the body and the ability to make appropriate motor response to body movement. It primarily depends on sensory inputs from somato-sensory (proprioception), visual and vestibular systems, as well as, response of muscles. Static balance refers to maintaining equilibrium while standing in one place, whereas dynamic balance involves motion and is defined as maintaining equilibrium during locomotion. Falls and loss of balance most commonly occur during movement-related tasks such as walking and less frequently during static activities [4]. Physiological factors such as muscle weakness and impaired postural control and balance has strong association with risk of falls in older people and these may be impaired further with lower limb osteoarthritis. Falls can lead to reduced independence and function, reduced mobility, loss of confidence in mobility and reduced quality of life. For people with advanced lower limb arthritis, including those who planned for joint replacement surgery, a fall may further exacerbate mobility impairment and dependence, and possibly necessitate a delay in planned surgery, and in some cases may negatively impact on subsequent outcomes post-surgery [5]. The cost of falling is high, both to the individual (physical and psychological trauma)



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and the health-care system (financial burden related to surgery and rehabilitation). At the same time, costs related to the patient's inability to care for them and/or to be discharged to their home environment present additional burdens for the patient, their family, and the health-care system [6].

One most common complaint after TKA is balance impairments, which could increase fall risk in these patients. Indeed, the fall rate has been reported to be as high as 7% to 40% postoperatively. Understanding balance problems in patients after TKA is necessary [7]. However, while total knee arthroplasty (TKA) aims to relieve pain, correct deformities and restore loco-motor function, it is not with the evidences whether it has an effect on patient's balance and falls incidences. The literature suggests that patients with knee OA undergoing TKA will often present with a substantial loss of balance control and proprioceptive acuity that is frequently precipitated by a lack of confidence. Despite the high incidence of falls in this population, there are very few investigations in the literature focusing on the risk of falls and subsequent impairments in function for patients with knee OA after undergoing TKA [5].

Previous research in balance assessment for patients with TKA mainly involved advanced technology and sophisticated equipment in laboratory settings such as virtual or real obstacle avoidance, stabilogram analysis, kinematic and electromyographic analysis and computerized dynamic posturography, a Biodex Stability System which might not be available and feasible in real clinical situations. Although the Berg Balance Scale (BBS) is a common tool for balance assessment and can be considered as a reference standard for assessing balance in patients with TKA clinically. First, it mainly assesses static balance and has been shown to have considerable ceiling effects in various patient populations. Balance in important dynamic tasks, such as walking, but is not addressed in the BBS. Second, maintaining body equilibrium involves many different balance control systems. The BBS has limited ability to identify what balance systems are impaired and thus direct treatment [6].

Most patients undergo physiotherapy in the form of exercises during the first few months after surgery. Physiotherapy aims to maximize or restore physical function essential to everyday life. Physiotherapy generally focuses on strengthening exercises and functional performance-based trainings. Balance and proprioception work are usually included in training programs, but to a lesser extent. However, the recovery and enhancement of these aspects may be a determining factor, since good balance abilities positively influence the capacity to perform basic functional tasks [8]. During hospital stay, physiotherapy targets mobilization and achievement of functional goals relating to hospital discharge. Further post discharge physiotherapy and exercise best interventions promote retraining and functional improvement [9]. Although there is general agreement that exercises completed after major surgery such as TKA promote walking and independence in activities of daily living, the relative advantages of clinic-based and home-based rehabilitation programs in this population have not been documented extensively [10]. Reduction in pain and improvement in physical function and quality of life (QOL) are the main expected outcomes of pa-

tients after total knee arthroplasty. Scientific and clinical evidence supports the success of TKA for the relief of knee pain and symptoms of osteoarthritis (OA), as well as a high rate of patient satisfaction. However, the functional benefits of this surgical procedure of TKA are not as convincing, because quantitative evaluations of knee function have shown that large functional impairment persist 1 year after surgery and even longer [11]. Gstoettner et al. [12] suggested that balance and proprioceptive training is effective in improving standing balance, can avoid pathological gait patterns and falls, and proposed that further investigations were needed in order to give consistency to the findings. Later, Hubber et al. [13] and Villadsenet al. [14] evaluated the effects of a preoperative neuromuscular training program. As there are few RCTs are done to assess the functional improvement after TKA, our objective will remain to find out related articles on physiotherapy treatment in TKA and analyze it.

MATERIAL AND METHODOLOGY

Study design: Meta -analysis (Descriptive study)

Criteria for considering studies for this review: Studies included in this review were selected according to the following set of criteria: a) the design being a RCT; b) all patients involved had a TKA; c) all interventions in which has physiotherapy rehabilitation protocol specifically balance training also studies comparing physiotherapy with non-physiotherapeutic treatment were considered for this study d) the studies were published in peer reviewed journals from year 2010 till 2018

Search strategy for identification of studies: A search was performed using computerized bibliographic databases [Medline, CINAHL, PEDro] in the period from 2001 end 2015 to identify RCTs. This was combined with the medical subject heading TKA and other key words pertaining to TKA and physiotherapy (e.g osteoarthritis, balance, TKA, physiotherapy, randomized controlled trial).

Total 27 articles were found. References of identified articles, relevant conference proceedings and textbooks were checked by the first author (CB). Any additional study that seemed eligible was retrieved and assessed according to title, abstract and keywords. The last search for RCTs was performed on June 2013.

Methodological quality assessment of the studies: Trials included in this review were rated using a checklist called the PEDro scale (Table 1)[15]. The PEDro scale is based on the Delphi list, a validated quality assessment tool. This scale includes the following aspects of trial quality: a) the internal validity of the trial and b) whether or not the trial contains sufficient statistical information to be interpretable.

In total the PEDro scale contains 11 items, of which 10 items assess internal validity. In judging the studies, we omitted criterion one (eligibility criteria) because it refers to the generalization of the results. The maximum score by using the PEDro scale is therefore 10. Two reviewers (CB, IB), independently assessed each of the eligible studies. In case of disagreement a consensus method was used and a third reviewer (RO) was consulted to resolve this disagreement. For each study a total score ranging between 0 and 10 was calculated by

summing the dichotomized scores of 2-11 of the PEDro scale.

Results of the design and the methodological quality of the studies : The overall methodological quality of the study, assessed by using the PEDro scale, is shown in Table 3.

These studies are classified as a randomized controlled trial. The report of Sara R. Piva and Chun-De Liao showed that randomization was computer generated to assign participant in experimental and control group while randomization in study done by Pankaj Jogi is by coin toss method to assign them in typical exercise group and typical exercise plus balance exercise group.

In study A, 5 loosed in FT group while 2 loosed in FT+B group. Statistician, assessor and participants were blinded in randomization. In study B, 7 were drop out in experimental group while 10 were drop out in control group. Assessor and participants were blinded in randomization. In study C, there were 2 dropped out in typical+ balance group while 7 were in typical group. Only participants were blinded to their group allocation. No intention to treat analysis was done for any of included study.

Results of physiotherapy as shown by the outcome measuring pain, stiffness, adherence and attrition are mentioned in study A while study B showed distance of functional forward reach; duration of single leg stance; timed sit-to-stand test; timed up-and-down stair test; timed 10-m walk; timed up-and-go test; and the Western Ontario and McMaster Universities Osteoarthritis Index score. Study C measure WOMAC, Activities-specific Balance Confidence Scale, Berg Balance Scale and timed up-and-go test score. The study reported means and standard deviations, and also the standard error of the results. Besides these measures, outcomes in study B showed in descriptive tables. While in Study A and C it shows re-

sult with both graphs and descriptive tables.

Characteristics of the participants: All patients in the study A had a TKA. Patients included with at least 50 years of age and had a unilateral TKA in the previous 2 to 6 months. A minimum of 2 months after TKA was specified to avoid knee pain, effusion, or limitations in motion restricting the implementation of the exercise programs.

The mean age in FT group was 67±6 year and in FT+B group a range was given from 70±10 years.

While in study B, patients aged 50–85 years who were scheduled to undergo unilateral total knee replacement were potential candidates for this study.

In study C patients who had primary unilateral THA or TKA as a result of hip or knee joint OA and had been advised by their surgeon to weight-bear as tolerated following their surgery were included.

Home Exercise Program: The home exercise program was same as the supervised exercise program, with some modifications for the home exercises such as

For the FT program: Stationary cycling or treadmill walking was replaced by walking outside.

Table 4b. Study B: In FT group: Participants in the FT+B group carried out all standard home program activities. In addition, they performed all agility training, except for the multiple changes in direction during walking on therapist command activity. They also did not perform tilt board and roller board activities. Foam activity was replaced by single-leg standing balance.

Effects of the interventions: Both the study shows improvement in patient's condition post-operatively

Table 1: The PEDro Scale

Eligibility criteria were specified	no / yes
Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	no / yes*
Allocation was concealed	no / yes
The groups were similar at baseline regarding the most important prognostic indicators	no / yes
There was blinding of all subjects	no / yes
There was blinding of all therapists who administered the therapy	no / yes
There was blinding of all assessors who measured at least one key outcome.	no / yes
Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	no / yes
All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by intention to treat	no / yes
The results of between-group statistical comparisons are reported for at least one key outcome	no / yes
The study provides both point measures and measures of variability for at least one key outcome.	no / yes

Table 2: Characteristics of the included studies.

Study	Method	Participants	Intervention	Outcomes
Sara R. Piva, et al(2010) [16]	RCT, two experimental groups: Functional training (FT) and Functional training + Balance (FT+B), - blinding of both assessor and statistician - loss to follow-up: 5 in FT group while 2 in FT+B group - no intention to treat analysis	N= 130 Inclusion criteria: at least 50 years of age and had a unilateral TKA in the previous 2 to 6 months. A minimum of 2 months after TKA was specified to avoid knee pain, effusion, or limitations in motion restricting the implementation of the exercise programs. Exclusion criteria: 2 or more falls within the previous year, were unable to ambulate a distance of 30.48 m (100 ft) without an assistive device or a rest period, had an acute illness or cardiovascular disease, had high blood pressure not controlled by medication, had severe visual impairment, had a lower extremity amputation, had a progressive neurological disorder, or were pregnant	6 weeks (12 sessions) of a supervised Functional Training (FT) or Functional Training with Balance (FT+B) program, followed by a 4-month home exercise program	Primary outcome measure: battery of physical performance tests: self-selected gait speed, chair rise test, and single-leg stance time. Secondary outcome measures: Western Ontario and McMaster Universities Osteoarthritis Index and the Lower Extremity Functional Scale. Degree of improvement seemed higher for gait speed, single-leg stance time, and stiffness in the FT+B group compared with the FT group.
Chun-De Liao et al (2013) [2]	Prospective intervention study and randomized controlled trial. The control group received conventional function training for eight weeks. The experimental group received conventional training as the control group along with balance exercises in each admission. Blinding of both assessor and investigator. Drop-out in control group 10 while that in experimental group were 7.	N= 65 Inclusion criteria: Patients aged 50–85 years who were scheduled to undergo unilateral total knee replacement. Exclusion criteria: Uncontrolled hypertension, diabetes, body mass index (BMI) > 40 kg/m ² other lower extremity orthopedic problems that limited the patient's function, neurological impairment	It was 8 week protocol for two months. Experimental group with functional training programme and additional balance training. Duration of programme was up to 90 minutes, composed of 30 minutes of routine function training and 60 minutes of additional balance training. control group with functional training only with duration of each session was 60 minutes.	Primary outcomes: distance of functional forward reach; duration of single leg stance; timed sit-to-stand test; timed up-and-down stair test; timed 10-m walk; timed up-and-go test; and the Western Ontario and McMaster Universities Osteoarthritis Index score.
Pankaj Jogi et al (2015) [6]	RCT, randomly assigned into Typical exercise group (n= 33) and Typical exercise + balance group (n=30). Only participants were blinded for treatment.	Inclusion criteria: Who had primary unilateral THA or TKA because of hip or knee joint OA and had been advised by their surgeon to weight-bear as tolerated following their surgery. Exclusion criteria: Patients with revision THA or TKA, or those who had been advised by their surgeon to remain nonweight-bearing or partial weight-bearing on either the operated or nonoperated leg and patients with neurological condition.	In the 5 week protocol participants in the TE group completed joint ROM and muscle strengthening exercises, and those in the TE + B group completed joint ROM, muscle strengthening, and additional balance exercises with 410 repetitions thrice a day.	Outcomes assessed prior to the intervention and after 5 week of exercise training. Outcomes used were the Berg Balance Scale, Timed Up and Go test, the Western Ontario McMaster Universities Osteoarthritis Index, and the Activities-specific Balance Confidence Scale

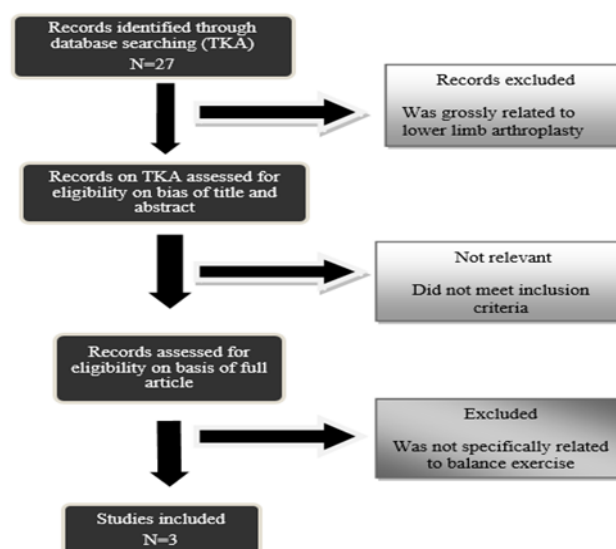


Fig 1: Review progress of included studies

Table 3: The methodological quality of the studies as measured by the PEDro scale

Author	Year	PEDro scale											Sum
		1	2	3	4	5	6	7	8	9	10	11	
Sara R. Piva et al.[16]	2010	Yes	1	1	1	1	0	1	1	0	1	1	8
Chun-De Liao et al [2]	2013	Yes	1	1	1	1	1	1	1	0	1	1	9
Pankaj Jogi et al. [6]	2015	Yes	1	0	1	1	0	0	1	0	1	1	6

with balance training program. In study A, degree of improvement seemed higher for gait speed, single-leg stance time, and stiffness in the FT+B group compared with the FT group. In study B, it demonstrated significant changes in 10-m walk and in timed up-and-go tests along with significant changes of all other measures and WOMAC index. Study C showed significantly greater improvements in balance and functional mobility compared to typical exercises alone in the typical plus balance exercise.

RESULTS

Included studies review progress was summarized as a flow diagram in Figure 1. Twenty seven eligible randomized controlled trials were identified. 24 were excluded. Characteristics of the 3 included studies are presented in Table 1. Studies ranged in size from 43–160 patients (median 94) and included a total of 1,739 patients. Where reported, the main diagnosis was osteoarthritis, and the mean age in studies ranged from 66 to 73.5 years. The duration of follow up ranged from 3 weeks to 24 months, though we describe data in our meta-analysis from 3 months onwards.

One RCT involving patients with TKA and physiotherapy were identified (A. Sara R. Piva, et al. B. Chun-De Liao, et al. C. Pankaj Jogi, Tom J Overend et al.) See Table 2 for characteristics of these studies.

DISCUSSION

Randomized controlled trials of physiotherapy and exercise interventions after TKA provide some evidence for short term effectiveness. Three randomized controlled trials were identified over the time period from 2010 to 2018, these trials (Sara R. Piva, et al. Chun-De Liao, et al and Pankaj Jogi, et al.) showing diversity in many aspects: heterogeneous patient groups, interventions and outcome measures. The quality of the studies was reasonable/good.

While studying exercise therapy approaches, it is important to consider factors that may contribute to functional deficits of patients with TKA. One such important factor may be impaired movement control and balance. Although during TKA surgery several tendons, capsule, and remaining ligaments are retightened to restore the joint spaces deteriorated by the arthritis, to restore the intra-articular geometry, some of the knee ligaments are removed or released. These alterations may affect the function of several mechanoreceptors and impaired movement control and balance. Several studies have identified deficits in components of the balance system, such as decreased ability to detect joint position and motion, delayed muscle latency, altered amplitude of muscle activity, and decreased postural control, in patients after TKA. Therefore, exercises aimed at improving the impaired movement control and balance of patients after TKA should be considered [16].

Table 4: Physiotherapeutic interventions in the identified studies are as follow (4a. Study A: In FT group)

Exercise	Description	Dose/Progression
Ankle ROM	Patient in long-sitting position performs ankle dorsiflexion and plantar flexion.	Progress from 10 to 20 repetitions.
Knee ROM	Patient in long-sitting position. Knee and hip of exercise leg flex as far as possible by sliding the foot toward the pelvis. Extension is done by sliding the foot back	
Posterior thigh and leg stretch	Patient in supine position. With help of a belt, patient flexes exercise hip as far as possible while keeping the knee in full extension and the ankle in dorsiflexion.	Stretching is held for 30 seconds, 5 repetitions.
Knee extension strengthening in sitting position	Patient is seated on a chair with the knee flexed. Elastic band is wrapped around patient's ankle and leg of the chair. Patient pushes against elastic band as vigorously as possible. Exercise is performed from 90 degrees to 60 degrees or from 30 degrees to 0 degrees, depending on pain tolerance	Each contraction is held for 3 seconds. Progress from 10 to 20 repetitions
Knee extension strengthening in standing position	Patient is standing facing away from a door and resting the hands on the back of a chair for support. The hip and knee of exercise limb are slightly flexed, with one end of an elastic band secured to the ankle and the other end secured in a door jam. Patient fully extends the knee against the resistance of the elastic band as vigorously as possible without pain.	
Knee flexion strengthening in standing position	Patient is standing facing a door, with one end of an elastic band secured to the ankle and the other end secured in a doorjamb. Patient flexes knee against the resistance of the elastic band as vigorously as possible without pain (up to 60° of flexion).	
Hip abduction strengthening	Patient is in side-lying position with the back against a wall and the exercise hip up. Patient abducts the exercise hip 30 degrees (2 seconds to lift and 3 seconds to come down). The heel of the exercise limb touches the wall throughout the exercise. Ankle cuff weights are used for resistance.	Progress from 10 to 20 repetitions. Progress cuff weights as tolerated.
Get up from a chair and sit back down	Patient is sitting in a chair with both feet flat on the floor and the hips flexed to 90 degrees. Patient stands up and then sits back in the chair (2 seconds to stand and 3 seconds to sit down). Patient initially uses chair armrests for assistance	Progress from 10 to 20 repetitions. Progress by not using armrest.
Bilateral knee flexion/extension in standing position	Patient is standing with feet together and hands holding on to a handrail. Patient slowly squats down until the knees bend 90 degrees and then slowly returns to a standing position. Patient starts exercise while bearing moderate body weight on handrail.	Progress from 10 to 20 repetitions. Progress by only touching handrail for balance.
Unilateral knee flexion/extension in standing position	Patient is standing over one foot and hands holding on to a handrail. Patient will slowly squat down until the knee bends 90 degrees and then slowly return to a standing position. Patient starts exercise while bearing moderate body weight on handrail.	
Ascend and descend stairs	Patient climbs up and down a flight of stairs.	Progress from 10 to 30 steps. Speed as tolerated.
Stationary cycling or treadmill walking	Patient selects stationary bicycle or treadmill walking. Activity is performed from 50% to 75% of the patient's predicted heart rate. If patient has no preference, treadmill walking is the exercise of choice. For stationary bicycle, the seat height is adjusted so that the knee can fully extend on the down stroke of cycling.	Progress from 5 to 20 minutes. Speed as tolerated.

Table Continued.,

Side stepping	Patient steps sideways, moving right to left and then left to right. Repeat 2 times in each direction. Progress by stepping over low obstacles.	Course length progressed from 10 to 20 ft width and speed of steps progressed as tolerated.
Braiding activities	Patient alternates front and back crossover steps while moving laterally (walking carioca). Repeat 2 times in each direction.	
Tandem walk	Patient tandem walks while alternating legs with each step. Repeat 2 times during forward ambulation and 2 times during backward ambulation. Progress by stepping over low obstacles.	
Cross-over steps	Patient crosses one leg in front of the other leg, alternating legs with each step to a maximum of 1-ft width. Repeat 2 times during forward ambulation and 2 times during backward ambulation	
Shuttle walking	Plastic pylon markers are placed at distances of 5, 10, and 15 ft. Patient walks forward to first marker, then returns to start by walking backward. Patient then walks forward to 10-ft marker, then returns to 5-ft marker walking backward. Patient then walks to 15-ft marker, returns to 10-ft marker walking backward, and then finishes by walking to 15-ft marker. Repeat 2 times.	Speed progressed as tolerated.
Multiple changes in direction	Therapist directs the patient to either walk forward, backward, sideways, or on diagonal by cueing patient with hand signals. Changes in direction are cued randomly by the therapist. One bout of 30 seconds	
Foam activity	Patient stands on a soft foam surface with both feet on the ground. Therapist attempts to perturb patient's balance in random fashion. One bout of 30 seconds	Progress to single-leg support or ball catching while standing on foam or tilt board.
Tilt board activity	Patient stands on a tilt board with both feet on the board. The therapist perturbs the tilt board in forward and backward and side-to-side directions for approximately 30 seconds each.	
Roller board and platform perturbations	Patient stands with one limb on a stationary platform and the other leg on a roller board. Therapist perturbs roller board in multiple directions, at random, and the patient attempts to resist the perturbations. One bout of 30 seconds. May begin with patient in a semi-seated position, with hips resting on plinth.	Activity progresses to full standing position.

Improvements in balance as observed in this study are supported by previous studies following balance intervention in patients with other health conditions. Diracoglu et al. in an 8-week study showed improvement in balance from kinesthesia and balance exercises added to strengthening exercises as compared to strengthening exercises alone in female patients with knee OA [17]. Williams et al. also reported improvement in balance following a home-based balance exercise program in women with lower limb OA or rheumatoid arthritis on balance measures such as functional reach test, but no increase in the WOMAC function scores was observed [18]. Hiroyuki reported significant improvement in balance measures such as one leg stand test, functional reach test, and the TUG following balance and gait exercise in the frail elderly population [19].

Assessment of proprioception is important for identifying proprioceptive deficits so as to avoid falls. There is a substantial amount of evidence that shows the importance of proprioception for production of smooth, controlled and coordinated movements, maintenance of

posture and motor learning and relearning. Joint motion and position sense also have an equally important role in the maintenance of balance. Diminished joint sensations is observed as a factor contributing to balance deficits in the elderly and patients with osteoarthritis of the knee present with worse balance than that demonstrated by age-matched controls [8].

Despite the fact that many patients with TKA are referred for physiotherapy, little is known about the evidence of the balance exercise program of physiotherapy. Reasons for the small number of RCTs could be that the percentage of physiotherapists treating patients with TKA is small, or that specialists are not well informed about the treatment possibilities of physiotherapy. Another reason could be that it is difficult to generate groups with enough numbers of homogenous patients which matches at their baseline characteristics. The high requirements of RCT guidelines such as described in the CONSORT statement (Consolidated Standards of Reporting Trials) finds difficult to physiotherapists in performing a RCT.

Table 4b: Study B: Functional training programme

A. Warm-up and stretching exercise
Global flexion–extension of the lower limb- 3 minutes Warm-up and stretching exercise- 3 minutes Stretching of the quadriceps and hamstrings- 10 repetitions each side 5 minutes Mobility exercise of the neck, upper limbs, and back- 5 repetitions 5 minutes
B. Muscle strengthening exercise
Isometric knee extensors: flex 0°- 10 repetitions 5 minutes Isometric knee extensors: flex 60°- 10 repetitions 5 minutes Isometric hamstrings: flex 60°- 10 repetitions each side 5 minutes Concentric–eccentric hip abductors- 10 repetitions each side 5 minutes
C. Functional task-oriented exercise
Get up and sit down- 15 repetitions Knee extensor strengthening in sitting with theraband- 60 repetitions 5 minutes Controlled bilateral knee flexion extension in standing- 10 repetitions 5 minutes Unilateral knee flexion to 90° in standing- 15 repetitions Climbing on a platform or a flight of stairs- 30 repetitions Walking backward, on a slope and/or laterally while crossing lower limbs- 10 repetitions each side 5 minutes Stationary bicycle cycling or ergometry- 10 minutes Treadmill Walking- 10 minutes
Additional balance training programme
Side stepping- 5 minutes Braiding activities- 5 minutes Tandem walk- 5 minutes Cross-over steps- 5 minutes Shuttle walking- 5 minutes Multiple changes in direction- 5 minutes Foam activity- 10 minutes BAPS board or Tilt board activity- 10 minutes Balance beam forward and backward walk- 10 minutes

Table 4C: Study C

Typical exercises for THA	Typical exercises for TKA	Balance exercises for THA and TKA
Assisted knee flexion with a strap in lying	Assisted knee flexion with a strap in lying	Rotate trunk clockwise and then in anti-clockwise direction in standing without support
Knee extension on a towel roll in lying	Knee extension on a towel roll in lying	Lunge in walk standing position without support and then repeat with the other leg for war
Isometric quadriceps in lying	Knee flexion by sliding foot on bed in lying	Shift weight to one side in a stride standing position without support and then repeat on the other side
Hip abduction in standing with holding a stable support	Straight leg raises in lying	
Hip extension in standing with holding a stable support	Assisted knee extension with strap around the foot in lying	
Hip flexion in standing with holding a stable support	Knee extension in sitting	
Knee flexion in standing with holding a stable support	Knee flexion by sliding foot on the floor in sitting	

With three RCT we were unable to perform a meta-analysis. Applying the PEDro scale also gave considerations/objections, a disadvantage of the scale being the extended blinding. In physiotherapeutic research it is often not possible to blind both patients and therapists for a specific intervention, giving a substantially lower score on the PEDro scale.

A further disadvantage is that the number of patients is not categorized in the PEDro scale. The number of participants ranged from 40 to 50; without using a power calculation to detect the number of patients needed in the trial. An incorrect number of patients can give false results.

There are insufficient studies with adequate patient numbers to provide conclusive evidence on different methods of provision.

There is increased number of TKA observed in the age group between 50 to 70 years. To regain balance in patients with TKA take a long duration. The outcome used in this study is balance specific along with functional specific. For the future it is important that well-designed randomized controlled trials are conducted in order to validate physiotherapy protocol for patients with TKA.

CONCLUSION

After total knee replacement, physiotherapy interventions including balance specific exercises show improvements in pain, stiffness and functional performance in mobility after surgery. Further randomized controlled studies are required to determine the effectiveness of balance exercises in patients with TKA.

Limitations: There are limited RCT's available for functional improvement after TKA. Full text paid articles were not assessed due to lack of free accessibility.

REFERENCES

- [1] Razieh Yousefian Molla, Heydar Sadeghi, Aamir Hossein Kahlaee. The Effect of Early Progressive Resistive Exercise Therapy on Balance Control of Patients with Total Knee Arthroplasty. *Topics in Geriatric Rehabilitation*. 2017;33(4):286-94
- [2] Chun-De Liao, Tsan-Hon Liou, Yu-Yun Huang, Yi-Ching Huang. Effects of balance training on functional outcome after total knee replacement in patients with knee osteoarthritis: a randomized controlled trial. *Clinical Rehabilitation*. 2013;27(8): 697–709
- [3] Jawahir A Pachore, shrinanand V Vaidya. ISHKS joint registry: A preliminary report. *Indian J Orthop*. 2013;47(5):505-9
- [4] Moutzouri MN, Gleeson EB, Tsepis EI, Panoutsopoulou JG. The effect of total knee arthroplasty on patients' balance and incidence of falls: a systematic review. *Knee Surg Sports Traumatol Arthrosc*. 2017;25:3439–51
- [5] Keith D. Hill, Elin Wee, Soula Margelis, John Bartlett, Stephen McMahon, Pazit Levinger. Falls in people prior to undergoing total hip or total knee replacement surgery: Frequency and associated factors. *Journal of Clinical Gerontology & Geriatrics*. 2016:1-7
- [6] Pankaj Jogi, Tom J Overend, Sandi J Spaulding, Aleksandra Zecevic and John F Kramer. Effectiveness of balance exercises in the acute post-operative phase following total hip and knee arthroplasty: A randomized clinical trial. *SAGE Open Medicine*. 2015:1-9.
- [7] Andy CM, Chan, Marco YC, Pang. Assessing Balance Function in Patients with Total Knee Arthroplasty. *Physical Therapy*. 2015;95(10):1397-1407.
- [8] Cherith Reddy Chillakuru, Jambu N, Akshay Deepak. A comparison of the proprioception of osteoarthritic knees and post total knee arthroplasty: *International Journal of Research in Orthopaedics*. 2017;3(4):781-6
- [9] Neil Artz, Karen T Elvers, Catherine Minns Lowe, Cath Sackley, Paul Jepson, Andrew D Beswick. Effectiveness of physiotherapy exercise following total knee replacement: systematic review and meta-analysis. *BMC Musculoskeletal Disorders*. 2015;16(15):1-21
- [10] John F. Kramer, Mark Speechley, Robert Bourne, Cecil Rorabeck, MD and Margaret. Comparison of Clinic- and Home-Based Rehabilitation Programs After Total Knee Arthroplasty. *Clinical Orthopaedics and Related Research*. May 2003;410:225-24
- [11] Helene Moffet, Jean-Paul Collet, Stanley H. Shapiro, Gaston Paradis, Franc Ois Marquis. Effectiveness of Intensive Rehabilitation on Functional Ability and Quality of Life After First Total Knee Arthroplasty: A Single-Blind Randomized Controlled Trial. *Arch Phys Med Rehabil*. April 2004;85:546-56.
- [12] Gstoettner M, Raschner C, Dirnberger E, Leimser H, Krismer M. Preoperative proprioceptive training in patients with total knee arthroplasty. *The knee*. August 2011;18(4):265-70.
- [13] Huber EO, Roos EM, Meichtry A, de Bie RA, Bischoff-Ferrari HA. Effect of preoperative neuromuscular training (NEMEX-TJR) on functional outcome after total knee replacement: an assessor-blinded randomized controlled trial. *BMC Musculoskelet Disord*. 2015;16(1):101
- [14] Villadsen A, Overgaard S, Holsgaard-Larsen A, Christensen R, Roos EM. Postoperative effects of neuromuscular exercise prior to hip or knee arthroplasty: a randomised controlled trial. *Ann Rheum Dis*. 2014;73(6):1130–7
- [15] PEDro scale (English) [Internet]. [cited 2019 Apr 24]. Available from: <https://www.pedro.org.au/english/downloads/pedro-scale/>
- [16] Sara R. Piva, Alexandra BG, Gustavo JM. Almeida, Anthony M. DiGioia III, Timothy J. Levison, G. Kelley Fitzgerald. A Balance Exercise Program Appears to Improve Function for Patients with Total Knee Arthroplasty: A Randomized Clinical Trial. *Physical Therapy*. 2010;90(6):880-94

- [17] Diracoglu D, Aydin R, Baskent A. Effects of kinesthesia and balance exercises in knee osteoarthritis. *J Clin Rheumatol* 2005; 11: 303–10
- [18] Williams SB, Brand CA, Hill KD. Feasibility and outcomes of a home-based exercise program on improving balance and gait stability in women with lower-limb osteoarthritis or rheumatoid arthritis: a pilot study. *Arch Phys Med Rehabil* 2010;91:106–14.
- [19] Hiroyuki S, Uchiyama Y and Kakurai S. Specific effects of balance and gait exercises on physical function among the frail elderly. *Clin Rehabil* 2003; 17: 472–9.