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Efficacy of Balance Training in Combination With Physical Therapy in Rehabilitation of Knee Osteoarthritis: A Randomized Clinical Trial

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Abstract

Objectives: The aim of this study was to assess the efficacy of balance training in combination with physical modalities in patients with knee OA.

Materials and Methods: In this single-blinded randomized clinical trial, 60 patients (mean age: 56.5±0.90 years) with primary knee osteoarthritis were recruited. Participants were assigned to two groups. Physiotherapy (PT) group received routine physical therapy (hot pack, ultrasound, transcutaneous electrical nerve stimulation (TENS), and exercise) while balance training group (BT) received conventional physical therapy plus balance training using Biodex balance system (BBS).

Results: The comparison between two groups revealed significant differences with regard to the visual analogue scale (VAS) pain score ($P=0.023$), Western Ontario and McMaster Universities Osteoarthritis (WOMAC) pain score ($P=0.018$), WOMAC total score ($P=0.042$), Lequesne index ($P=0.015$) as well as the score of Timed Up and Go (TUG) test ($P=0.003$). Similar results were observed for the fall risk score ($P<0.001$). The WOMAC stiffness score in the BT group significantly decreased from 2.80±0.34 to 1.70±0.32 ($P<0.0$ 1), but it did not decrease in the PT group ($P=0.096$).

Conclusions: The combination of balance training and physical therapy provided more pain relief and development of functional abilities in patients with knee OA.

Keywords: Knee, Osteoarthritis, Physical therapy modalities, Postural balance, Pain

Introduction

Knee osteoarthritis (OA) is a form of chronic disabling musculoskeletal disease affecting older adults, resulting in pain, reduction in quality of life, and physical disability (1, 2). Moreover, it is the most prevalent type of chronic joint disease and the foremost cause of lower limb disability among the elderly in the whole world (1,3,4). It is well believed that increased age is the most common cause of knee OA (primary OA) (5). The rare cases of knee OA in young people under 30 years old are mostly because of the mutations in matrix genes that cause important structural anomalies and/or joint deformities (6). Other causes include weight, and trauma to joint caused by repetitive movements, particularly, bending and kneeling (7).

These patients usually confront difficulties while doing daily activities such as taking the stair, walking and other actions involving the lower extremities (1,8). American College of Rheumatology has recommended a mixture of non-pharmacological and pharmacologic treatments (9,10). Physical therapy is one of the most widely used non-pharmacological interventions which includes various modes such as manual technique, massage, exercise, ultrasound, thermotherapy and so on (9,10).

Patients with early knee OA demonstrate postural deficits while one-leg standing on both unaffected and affected knee and transformed hip adduction moment (11). OA subjects also have been reported to have reduced balance, a higher number of falls (12), and increased postural instability (13).

People who have knee OA experience reduced proprioception that might affect postural instability and fall risk. Moreover, researchers reported greater postural sway in knee OA patients as compared to their healthy controls. Stability deficits seem to be more marked in moderate knee OA as compared to mild OA (14). Kim et al stated that patients who have moderate to severe OA have more insufficiencies in balance control than patient with mild forms. Consequently, the estimation of balance

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control and rehabilitation aiming at preventing falls can be beneficial to patients who have knee OA (15).

The data obtained from previously conducted researches have implications for planning balance training rehabilitation programs for improving the balance and postural stability of patients who have knee OA.

Recently, some evidence has been found supporting the role of balance and agility techniques (4,5) and muscle strength for dynamic balance in knee OA (16). Strength and postural stability maintains body's balance to keep it upright (17,18). Most of the activities of daily living need good postural stability. Previous researches have shown that knee OA patients have decreased proprioception, worsened postural stability and experience more falls compared to age-matched healthy controls (12,19, 20)

Although empirical evidence proposes that the effect of balance exercises on patients who have knee OA can be promising (21,22), most studies focus on functional and resistance exercises (23,24), and balance exercises are rarely considered in published clinical trials (5, 25).

Diracoglu et al used an 8-week, 3 days a week kinesthesia and balance training in combination with strengthening exercises to improve functional outcomes (i.e., WOMAC, quality of life, times for accomplishment of daily living activities, isokinetic exercises to strengthen quadriceps muscle, and proprioceptive sensations) among 66 female patients with knee OA. This research has shown that adding kinesthesia and balance training to standard strengthening exercises, in addition to improving neuromuscular restoration, can also increase the dynamic muscle strength by considerable improvement in the patient's functional status (5).

The authors of a simple 6-week clinical trial concluded that multi-station kinesthesia, balance, and agility (KBA) type exercises had added benefits compared to strength training alone and may improve physical function, decrease knee instability, and increase physical activity levels (26).

Although it has been proven that the Biodex balance system (BBS) is a reliable and objective tool for balance assessment and training (5), few studies have used this system for evaluating the effectiveness of balance training in individuals who have knee OA.

Since most subjects with knee OA require physical therapy and application of physical modalities, we aimed to compare the efficacy of physical therapy and balance training simultaneously with standard physical therapy alone. It was hypothesized that physical therapy combined with balance training is more effective than physical therapy alone in improving physical function and balance among patients who have knee OA.

Materials and Methods

Participants

In this randomized, single-blinded clinical trial, 68 patients aged over 50 years old were recruited from the local community with primary mild or moderate knee OA. All participants who visited Physical Medicine and Rehabilitation Clinic of Imam Reza hospital were included under supervision of a physiatrist.

The inclusion criteria were as follows: having bilateral knee OA according to the American College of Rheumatology criteria, being between 50 and 70 years old, having knee OA grades I, II (mild) and III (moderate) based on Kellgren Lawrence radiological criteria (grade 1: doubtful joint space narrowing (JSN) and possible osteophytic lipping, grade 2: definite osteophytes and possible JSN on the anteroposterior weight-bearing radiograph, and grade 3: multiple osteophytes, definite JSN, sclerosis, possible bony deformity) (27), being able to walk 100 meters on a flat surface and having full or near full passive range of motion in both knees. The exclusion criteria included any deformities of the lower limb (for example, knee joint flexion contracture), hyperextension of the knee joint, severe OA, rheumatologic disease, intra-articular knee joint fractures, any history of knee surgery, intra-articular corticosteroid or hyaluronic acid injection in the past 6 months and deficit in balance control related to neurological problems (ataxia, neuropathy, multiple sclerosis, Parkinson, etc), a history of significant valgus and varus deformity in the knee which is not related to knee OA (based on previous radiologic imaging) and hallux valgus, lower limb joint replacement, any fractures of the lower limb during the previous 6 months, recent fall history (past 1 year), and any treatment such as oral corticosteroid in the last 6 months or nonsteroidal anti-inflammatory drugs in the last 2 weeks, and recent rehabilitation program for knee OA. The flow diagram shows the study protocol and excluded patients (Figure 1).

Sample Size and Assignment

The sample size was calculated based on the sample size formula used in a study by Ozgonenel et al (28). Considering the power of 80% and confidence of 95% and regarding the possibility of 20% loss of samples, the final research sample size was determined to be 30 people per group. The overall mean (SD) scores of visual analogue scale before and after the intervention were 5.1 (2.3) and 4.0 (2.6) for the placebo group and they were 6.7 (1.8) and 3.9 (2.0) for the treatment group, respectively.

Data Collection and Assessments

All patients were examined by one physician and after the evaluation for inclusion and exclusion criteria were included in the study. The same physician performed tests required to assess interventions in both study groups while he was blinded to the type of treatment that the patients would receive. Demographic data including age, weight, height, BMI (body mass index and) and the grade of knee OA were recorded. Body weight was measured in patients who were dressed in light indoor clothes without wearing shoes. Anteroposterior and lateral knee joint radiographs

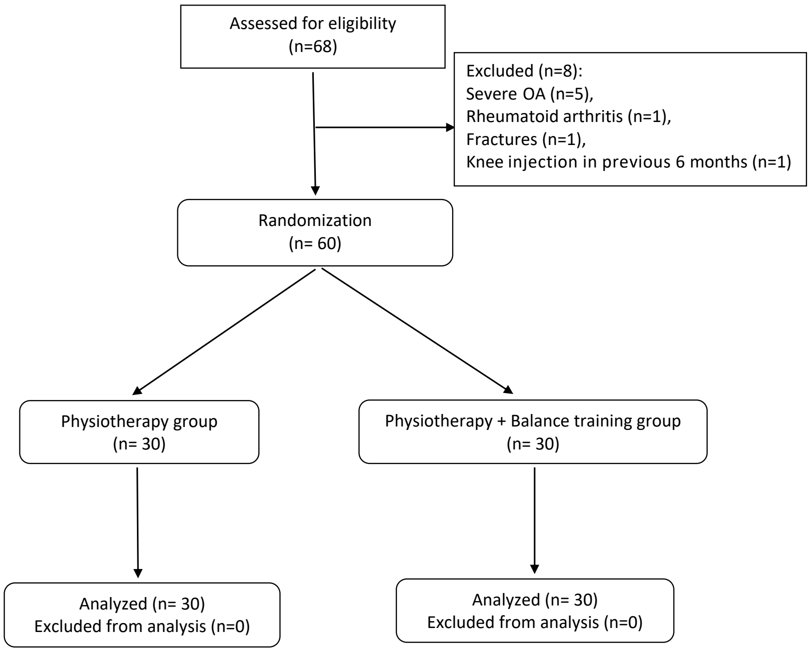

Figure 1. Flow Diagram of the Study Protocol.

were done in weight-bearing position and then were graded by the same physician and the study continued for more than 2 years (May 2010 to March 2013).

Values of baseline Western Ontario and McMaster Universities Osteoarthritis (WOMAC), Lequesne (29, 30), visual analogue scale (VAS) (31) were recorded. The score of Timed Up and Go (TUG) test (32) was also recorded at baseline. Fall risk was calculated using BBS (Biodex Medical Systems, Inc. 20 Ramsey Road, Shirley, New York). The variables were also evaluated immediately after the last treatment session.

The pain measurement was done using a 10-cm VAS. The intensity of pain is rated from 0 to 10, in which 0 = no pain and 10 = the worst pain possible. Then, the subjects were asked to place a mark on the VAS which corresponded to their pain level at rest over the last 2 days.

The 24-item WOMAC questionnaire was used to assess knee pain (5 items), joint stiffness (2 items), and overall functional disability levels (17 items) (33). Each of the 24 questions was answered on a 5-point Likert scale (none=0, mild=1, moderate=2, severe=3, extreme=4), with composite scores ranging between 0 and 96. A higher score represents greater disease severity. The WOMAC yields reliable and valid scores that are sensitive to changes in pain and functional status of patients with OA of the knee (34).

Lequesne questionnaire is another tool for assessing patients' functional status which contains three parts evaluating pain or discomfort, the maximum distance that the patient walks despite having pain and the ability to do daily activities, with total item scores ranging from 0 to 24. A higher score shows greater disability (30).

TUG test was performed pre- and post-training in both groups. TUG is a test that is used to evaluate the patient's mobility. It measures the time taken by a participant to stand up from a comfortable 45-cm high armchair, walk 3 meters at a fast and comfortable speed, cross a line on the floor, turn around, walk towards the chair and sit down. The participant was encouraged to do the test very fast. Physical assistance from another person was not allowed during the test but verbal assistance could be provided. The measurement of patients' walking time started when the instructor said 'go' and ended when the patients sat down with their back against the chair. The TUG test time was measured in seconds, which was done three times with a 120-second interval between each try and the minimum time was considered as the test result.

Fall risk is an index to assess the efficacy of interventions in this study. The index is calculated by BBS. In this test, the patient stands on the BBS platform without shoes. Patients were instructed to put their feet on the marked area of the platform and grab the adjustable support handles and focus on the BBS monitor. The patient opens his/her feet as much as shoulder width while being located on the platform and trying to maintain the marker in the smallest circle shown on the device screen for 20 seconds. This test was done 3 times with a 10-second interval and the instability degree of the platform in level eight for all participants was assessed. In the fall risk test, an unstable surface is used in which the patient's swing is used to specify the falling risk index. The participant tries to keep his/her body balanced on the platform and it is locked when this goal is achieved. The zero point is determined before the test when the surface is stable. The changes around this zero point are recorded as the test results (35).

Interventions

Following recording basic information, patients were assigned to one of the PT or BT groups. All patients received 10 sessions of one-hour treatment with routine modalities of physical therapy including hot pack, ultrasound (US), transcutaneous electrical nerve stimulation (TENS) and exercise. Sessions were held twice a week. Physical therapy and exercises were conducted by a physiotherapist and the outcome measures were evaluated by a physiatrist blinded to the groups. After allocation, the participants were entered one of the intervention groups and physical therapy was conducted separately for each patient.

A TENS MED 911 unit (Enraf-Nonius B Delftech park 39, 2600 AV, Delft, the Netherlands) was used for TENS therapy. Each session lasted 20 minutes. The TENS unit was set at a frequency of 60–100 Hz with 60 milliseconds pulse duration. During the application of US, patients were instructed to lie in a supine position with both knees in the full extension while electrode pads were positioned over the area which was the source of pain. Continuous US therapy (1-MHz, 1.5 W/cm^2, for 10 minutes) was provided using a Sonopuls 590 US system (Enraf-Nonius B Delftechpark 39).

A hot pack was applied for 20 minutes in both groups. In addition, exercises for both groups were the same and focused on quadriceps muscle strengthening. Quad sets were applied to all participants for 10 minutes.

In the study group, following physical therapy and a 30-minute break, the patients underwent 1-hour balance training including postural stability, limits of stability and weight shift using the Biodex Balance System SD (Biodex 945-302, Biodex Medical Systems Inc; Shirley, New York). The BBS software collected the anterior-posterior (AP) and medial-lateral (ML) aberrations at a rate of 20 Hz and through a dedicated task, estimated the AP index (API), ML index (MLI) and OSI. These indices were determined by the degree of oscillation of the surface, in which the low values indicated good stability for the individual. For each mode, the mean of 3 replications was considered as the individual's index.

Postural stability exercises simulate specific movement patterns. The patient stands on the platform of BBS and controls the body movement and balance to keep the curser on the circular grid of the central point of the screen as long as possible. This is done by placing markers on determinate points on the device screen using BBS software. In each session, the patient must tag determinate markers on the screen for 9 times using his/her feet and shifting weight on the platform. Limits of stability exercises are performed while the patient tries to move the platform using his/her feet to maintain the center of gravity on the determinate marker. Displacement is defined as 8 degrees on the right and left sides, 8 degrees anteriorly and 4 degrees posteriorly. The difficulty of the test is assumed 75%. Weight Shift exercises allow the patient to practice daily activities which require weight transfer or weight shift. In these exercises, the patient translocates his/her weight in medial/lateral, anterior/posterior and diagonal planes. Each plane is specified by 2 parallel lines. The static level (degree of platform instability) in all exercises is defined as 6 to 12.

Statistical Analysis

All statistical tests were done by SPSS for Windows version 16.0 (Chicago, IL, USA). Quantitative data were demonstrated as the mean ± standard deviation (SE), and qualitative data were presented as frequency and percentage (%). Independent samples *t* test for quantitative variables and chi-square test for qualitative variables were performed to compare data obtained from the two groups. Reaching of minimal clinical difference with regard to comparable studies was calculated as 33% for VAS score (36).

The general linear model was used to evaluate the changes in the mean score of dependent variables (VAS, WOMAC Subscales, Lequesne, TUG, and Fall Risk) at two time points (pre- and post-intervention) and between two groups (physiotherapy vs balance training). Before analyzing, we checked if the data can be analyzed using the general linear model. Shapiro-Wilk test revealed that dependent variables follow a normal distribution. To assess variance homogeneity, Levene test was used, which was not significant. The type one error in pairwise comparisons was adjusted using Bonferroni correction. The GraphPad Prism software version 6.0 was used for drawing the graphs. A P value of <0.05 was considered statistically significant.

Results

In the present study, which was conducted during a 34-month period, a total of 68 participants were included and assessed for eligibility criteria and 8 were excluded before randomization. In the end, 60 patients who were diagnosed with mild or moderate OA and met the inclusion criteria were included and divided into two equal groups (PT and BT groups). All randomized patients completed a five-week trial (100% of the patients attended 100% of their sessions).

The participants of the study were predominantly females (47 subjects, 78.33%). The mean age of patients was 56.55 ± 0.90 years. More than three-fourths of patients (58 patients, 96.67%) were diagnosed with unilateral knee OA (right knee in 24 patients and left knee in 34 patients) and 2 (3.33%) with bilateral knee OA. In patients whose both knees were painful, the most severe and painful knee was chosen for the investigation in the present study. The majority of participants (37 patients, 61.67%) had mild (grade I) OA.

Before treatment, the mean of pain intensity based on visual analogue scale and WOMAC pain subscale was not

Table 1. Demographic Characteristics of Participants and the Study Parameters at Baseline

Variable	Total (n=60)	PT Group (n=30)	BT Group (n=30)	*P* Value
Age (y)	56.55 ± 0.90	55.57 ± 1.6	57.53 ± 0.8	0.208
Female (n, %)	47 (78.3%)	25 (83.3%)	22 (73.3%)	0.347
BMI (kg/m^2)	29.91 ± 0.62	30.66 ± 0.92	29.16 ± 0.82	0.230
Right knee involved	24 (40.0%)	11 (36.7%)	13 (43.3%)	0.432
OA severity, moderate (grade II-III) (n, %)	23 (38.3 %)	14 (46.7%)	9 (30.0%)	0.198
VAS	7.03 ± 0.73	6.77 ± 0.24	7.30 ± 0.20	0.124
WOMAC pain	11.52 ± 0.32	10.93 ± 0.44	12.10 ± 0.49	0.065
WOMAC stiffness	2.35 ± 0.25	1.90 ± 0.35	2.80 ± 0.34	0.073
WOMAC function	30.25 ± 0.92	29.10 ± 1.23	31.40 ± 1.30	0.215
WOMAC total	44.12 ± 0.21	41.93 ± 1.68	46.30 ± 1.68	0.072
Lequesne	11.80 ± 0.31	11.45 ± 0.43	12.15 ± 0.41	0.257
TUG (s)	10.48 ± 0.23	10.92 ± 0.32	10.05 ± 0.31	0.058
Fall risk	4.01 ± 0.20	4.20 ± 0.34	3.83 ± 0.28	0.358

PT: Physiotherapy; BT: Physiotherapy + balance training; BMI: Body Mass Index; OA: Osteoarthritis; VAS: Visual Analogue Scale; WOMAC: Western Ontario and McMaster Universities Arthritis Index; TUG: Timed Up and Go test.
Note: Data are presented as mean ± SE or frequency (percentage).

Table 2. Intragroup Comparison of the Study Parameters in Physiotherapy and Balance Training Groups

Variable		PT Group (n=30)	*P*-value	BT Group (n=30)	*P*-value
VAS					
Pre-treatment		6.77 ± 0.24	<0.001	7.30 ± 0.20	<0.001
Post-treatment		3.83 ± 0.21		3.43 ± 0.23	
WOMAC Subscales	**Pain**				
	Pre-treatment	10.93 ± 0.44	<0.001	12.10 ± 0.49	<0.001
	Post-treatment	5.70 ± 0.41		5.30 ± 0.42	
	Stiffness				
	Pre-treatment	1.90 ± 0.35	0.096	2.80 ± 0.34	<0.001
	Post-treatment	1.40 ± 0.31		1.70 ± 0.32	
	Physicalfunction				
	Pre-treatment	29.10 ± 1.23	<0.001	31.40 ± 1.30	<0.001
	Post-treatment	21.17 ± 1.24		22.07 ± 1.29	
	Total				
	Pre-treatment	41.93 ± 1.68	<0.001	46.30 ± 1.68	<0.001
	Post-treatment	28.27 ± 1.52		29.07 ± 1.52	
Lequesne					
Pre-treatment		11.45 ± 0.43	<0.001	12.15 ± 0.43	<0.001
Post-treatment		8.07 ± 0.38		7.73 ± 0.38	
TUG (s)					
Pre-treatment		10.92 ± 0.32	<0.001	10.05 ± 0.32	<0.001
Post-treatment		9.54 ± 0.30		7.61 ± 0.30	
Fall risk					
Pre-treatment		4.20 ± 0.34	0.017	3.83 ± 0.28	<0.001
Post-treatment		3.79 ± 0.25		1.90 ± 0.27	

Note: Data are presented as mean ± SE.
PT: Physiotherapy; BT: Physiotherapy + balance training; VAS: Visual Analogue Scale; WOMAC: Western Ontario and McMaster Universities Arthritis Index; TUG: Timed Up and Go test.

significantly different between the study groups ($P = 0.124$ and $P = 0.065$, respectively).

Patients' baseline information is demonstrated in Table 1, where the study groups were found to be similar with regard to all baseline findings (Table 1).

The intragroup comparison revealed a clear trend toward improvement in all assessed parameters in both study groups except for WOMAC stiffness in physiotherapy group (Table 2). More than two-thirds of the participants achieved MCID in VAS score in both groups (24 (80 %) patients in PT group and 29 (96%) patients in BT group).

As shown in Table 3, the intergroup comparisons demonstrated that the reduction in the pain intensity was higher in BT group compared to PT group based on visual analogue scale and WOMAC pain subscale ($P=0.023$, $P=0.018$, respectively). The reduction in the WOMAC total scores was also higher in BT group compared to PT group ($P=0.042$).

Compared to the 29.36% reduction in Lequesne index seen in physiotherapy group, balance training group showed significantly greater reductions (36.22 %; $P=0.015$).

Although TUG mean score improved after intervention in both study groups ($P<0.001$ in each group), the significantly greater improvement was observed in balance training group (2.44 ± 0.22 vs. 1.38 ± 0.26; $P=0.003$, Figure 2). Additionally, the comparison of the changes between groups indicated that the combination of balance training and routine physiotherapy results in a significantly higher reduction in patients' fall risk (1.93±0.16 vs. 0.41±0.17; $P<0.001$, Figure 3).

Discussion

In this randomized clinical trial, we evaluated the effect of adding balance training to routine physical therapy on the treatment of mild or moderate knee OA. At the end of the study, all assessed parameters were improved in both study groups except for WOMAC stiffness subscale. With respect to VAS and WOMAC pain subscale, pain intensity was controlled more effectively in the BT group. We also observed greater improvement in WOMAC total score in BT group which is mainly due to the changes in pain subscale. Adding balance training to routine physical therapy in BT group resulted in significantly lower TUG and fall risk mean scores.

Presently, there is no definite treatment for knee OA and therapeutic efforts are based on improving pain and discomfort, changing the disease progression and promoting exercise for specific muscles (37). The initial goals of OA therapy are reducing pain intensity, maintaining functional status, and minimizing deformity and instability of the knee. Nevertheless, conservative non-pharmacological modalities have a significant role in maintaining patients' status and managing their symptoms and disability (38).

Table 3. Intergroup Comparison of Study Parameters in Physiotherapy and Balance Training Groups

Variables	PT Group (n=30)	BT Group (n=30)	*P* Value
VAS			
Point changes	2.93 ± 0.28	3.87 ± 0.29	0.023
Percentage changes	42.37 ± 3.21	51.75 ± 2.53	
WOMAC Subscales			
Pain			
Point changes	5.23 ± 0.42	6.80 ± 0.48	0.018
Percentage changes	47.71 ± 3.24	55.30 ± 3.54	
Stiffness			
Point changes	0.50 ± 0.34	1.10 ± 0.24	0.157
Percentage changes	31.59 ± 16.46	35.91 ± 7.12	
Function			
Point changes	7.93 ± 1.24	9.33 ± 0.77	0.341
Percentage changes	26.69 ± 3.46	29.13 ± 2.28	
Total			
Point changes	13.67 ± 1.28	17.23 ± 1.14	0.042
Percentage changes	33.09 ± 2.65	36.76 ± 1.97	
Lequesne			
Point changes	3.38 ± 0.28	4.42 ± 0.31	0.015
Percentage changes	29.36 ± 2.14	36.22 ± 2.23	
TUG (s)			
Point changes	1.38 ± 0.26	2.44 ± 0.22	0.003
Percentage changes	12.09 ± 2.06	23.75 ± 1.88	
Fall risk			
Point changes	0.41 ± 0.17	1.93 ± 0.16	<0.001
Percentage changes	9.19 ± 4.83	49.81 ± 3.58	

Note: Data are presented as mean ± SE.
PT: Physiotherapy; BT: Physiotherapy + balance training; VAS: Visual Analogue Scale; WOMAC: Western Ontario and McMaster Universities Arthritis Index; TUG: Timed Up and Go test.

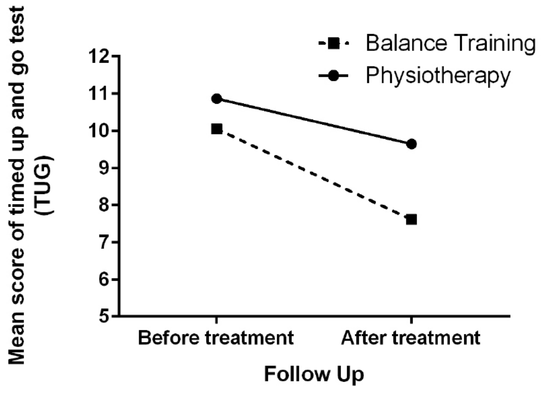

Figure 2. Changes in the TUG at 2 Time Points in Each Group

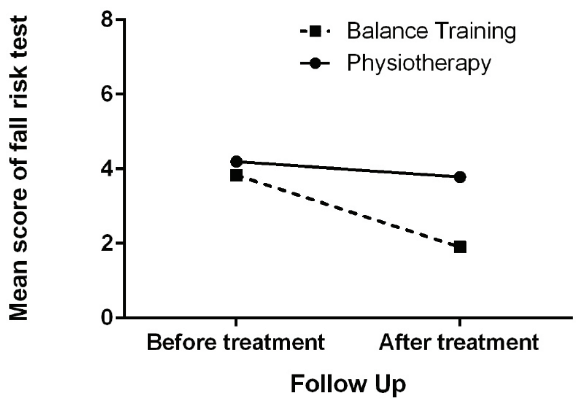

Figure 3. Changes in the Fall Risk at 2 Time Points in Each Group

Some of these methods include TENS, US, thermal modalities, and exercise therapy. There are different reports about the efficacy of the physical modalities used either as a single therapeutic approach or in combination with other modalities. There is also little information about the preference of one method over the others (27,39). What we know is that physical modalities, whether combined with training programs or not, improve patients' condition compared to placebo, although there are some exceptions (34). Bennell et al (40) used a multimodal physical therapy program to manage patients' hip OA and compared it with regular contact with a therapist as placebo. They used VAS and WOMAC scores as primary outcomes. Although there were significant changes pre- and post-treatment similar to our findings, they concluded that physical therapy was no more effective than placebo. Moreover, no result section was shown in this study. However, their protocol included a limited physical therapy study design that should have been more accurately followed to avoid misinterpretation. Cetin et al (34) compared hot pack, short-wave diathermy, US and TENS in the treatment of OA. They concluded that physical therapy can reduce pain and improve the patients' functional status and adding exercise therapy to multimodal physical therapy increases the efficacy of the therapy.

Studies on the effectiveness of adding balance training to other treatment strategies are rare and the results are blurring. The results of a recent trial showed that knee OA sufferers have lower overall postural stability in standing than healthy controls and stability score was associated with pain, fatigue and reduced motivation (41). Simao et al (42) reported that some exercises, particularly squat training and whole-body vibration training, significantly improve balance. As compared to the control group, the walking group had better performance in terms of TUG in this study. Fitzgerald et al (22) in 2011 assessed the effectiveness of standardized exercise therapy combined with agility and perturbation as compared to the standard exercise alone for knee OA. They revealed that both groups showed improvement in function and the global rating of change. However, the additive effect of agility and perturbation training with standard exercise therapy on knee OA was not confirmed.

In our study, we did not find the additive functional improvement, however, we had better improvement in pain using balance training plus physical therapy. Diracoglu et al (5) in 2005 evaluated the short-term effects of kinesthesia and balance training in combination with strengthening exercises in patients with knee OA. They found positive additive effects of kinesthesia and balance training to increase the functional capacities of patients which is in contrast to our findings; we only found additive pain reduction using balance training. Differences between our study and this research could be explained by the use of different additive program (kinesthesia and balance exercises vs balance training with Biodex) and also different primary protocol (strengthening exercises vs physical therapy).

This significant pain reduction in PT plus balance training group could be due to neuromuscular adaptations. In knee OA, the quadriceps muscle strength and accuracy is reduced. It has also been reported that patients who have knee OA have reduced balance, higher fall incidence, increased postural sway and altered muscle activation patterns (11).

All these factors could impair neuromuscular function and increase pain impulses from pain receptors.

The ability of an individual to control over the joint could be increased in repetitive movements. Dynamic stability may help the control of abnormal joint translation during daily movements and can provide better motor control through a reflex route (5) and this could be another explanation for pain reduction. Theoretically, the balance training and kinesthesia affect knee proprioception more than the exercises that are based on standard strengthening. The knee as a weight-bearing joint is vulnerable to micro-traumas during activities of daily living. To protect the knee from these effects, keeping the joint fully stable is fundamentally needed. Proprioceptive information is a critical mediator of appropriate and timely voluntary and involuntary movements (5). There is a relationship between knee OA and proprioceptive loss, and the improvement in proprioception could be another reason for pain reduction in this group.

In newly published articles, authors either discussed balance training for a different group of participants (after knee replacement) or had different interventions such as sensory-motor training, water exercise or Otago exercise (43-46).

The main limitation of this study was the absence of long-term follow up. The groups were only evaluated for 5 weeks. Additionally, the use of medications other than those in exclusion criteria and the lack of a control group with no treatment are other limitations of the study. The exposure time was different between groups and we did not define sham control balance training and this could be a confounding variable. The authors suggest further studies with larger sample size, longer follow-ups and definition of sham balance training protocol without including any kind of balance inputs.

Conclusions

In conclusion, almost all indexes measured in both case and control groups improved following 10 successive sessions. However, the combination of balance training and physical therapy provided more pain relief and functional abilities improvement in patients with knee OA.

Conflict of Interests

Authors have no conflict of interests.

Ethical Issues

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1390.9025). This study was also registered in Iranian Registry of Clinical Trials (identifier: IRCT201008274641N1). The informed consent was received from all participants of the study.

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