Original Research Article

Effectiveness of balance training to improve function in patients in post-operative phase following total knee arthroplasty

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Abstract

Background: Knee osteoarthritis is the occurrence of osteoarthritis (OA) in the knee joint. Osteoarthritis involves the degradation of joints, including articular cartilage and subchondral bone. Osteoarthritis is the most common disease of joints adults suffer from worldwide. The most common procedures done for the treatment of osteoarthritis of knee is a surgical procedure called Total knee arthroplasty (TKA) or total knee replacement (TKR) which is mostly done in advance cases. It is usually starts from age group of 40 and slowly progresses. The most common age group in which its seen is between 50-60 years. They slowly start losing balance after the TKR. Balance is an important aspect of mobility and physical function. Patients with severe OA who are awaiting total hip arthroplasty (THA) or total knee arthroplasty (TKA) are reported to have a higher incidence of falls compared to the general population. Balance Training Exercises with Conventional Therapy gives much better effect. So, the aim of the study is to check the effectiveness of balance training to improve function in patients in post-operative phase following total knee arthroplasty.

Materials and methods: 60 patients were included in the study which was divided into two groups; Group A and Group B, 30 patients in each group. Subjects were randomly selected and assigned to each group. Pre-test measurements of the patient were done with the help of TUG for each group. The

Subjects in Group-A were given Conventional Therapy. The Subjects in Group-B were given Balance Training Exercises with Conventional Therapy. Then the Result analysis was done.

Results: On comparing Group A and Group B for post-treatment TUG score, results showed a significant difference (p=0.001). The overall study proved that Balance Training Exercises with Conventional Therapy is beneficial in improving functional activities and decreasing the disability level.

Conclusion: The analysis obtained indicated that Group B (Balance Training Exercises with Conventional Therapy) showed more significant improvement when compared to Group A (Conventional therapy).

Key words

Knee Osteoarthritis, TKR, TUG, Balance Training.

Introduction

According to JAMA more than 10 million are affected with knee osteoarthritis [1]. Most commonly affecting a population age 45 and greater this condition occurs as the cartilage in the knee wears away eventually causing bone on bone contact between joint surfaces. Most common complaints include joint swelling, joint stiffness, and pain. Knee osteoarthritis can be diagnosis via radiographs indicating boney cysts, narrowing joint space, and sclerosing of the bone. Knee osteoarthritis is the occurrence of osteoarthritis (OA) in the knee joint. Osteoarthritis has many definitions, but Kuttner, et al. defined it as follows: "Osteoarthritis, also known as degenerative arthritis or degenerative joint disease, is a group of overlapping distinct diseases, which may have different etiologies but with similar biologic, morphologic, and clinical outcomes" [2].

In other words osteoarthritis involves the degradation of joints, including articular cartilage and subchondral bone. But also ligaments, the capsule and the synovial membrane degenerate. This will eventually lead to pain and loss of function [3]. Osteoarthritis is the most common disease of joints adults suffer from worldwide. The name 'osteoarthritis', a Greek word, can be divided in 'osteo', 'arthro' and 'it is'. If we translate the word we become 'of the bone', 'joint' and 'inflammation" [4]. Thus, simply put, we can say that osteoarthritis is an inflammation of the bone and joint. Besides knee osteoarthritis, which is the most common, you also have hand and hip osteoarthritis.

Total knee arthroplasty (TKA) or total knee replacement (TKR) is orthopedic surgical procedure where the articular surfaces of the knee joint (the femoral condyles and tibial plateau) are replaced. There is at least one polyethylene piece, placed between the tibia and the femur, as a shock absorber [1, 11]. In 50% of the cases the patella is also replaced. Reasons for a patella replacement include: osteolysis, maltracking of the patella, failure of the implant. The aim of the patella reconstruction is to restore the extensor mechanism. The level of bone loss will dictate which kind of patella prosthesis is placed. Older patients who have undergone THR or TKR have been found to have some increased risk of falls, but high-quality evidence is sparse and the size and scope of this problem remains uncertain. Older adults who undergo joint replacement surgery may have reduced[5]proprioception, as well as a short-term increase in pain and reduction in muscle strength following surgery. TKR provides pain relief and, on average, improves function at 6 and 12 months post-surgery for patients with advanced knee OA [5, 6].

Balance is an important aspect of mobility and physical function. While the effect of hip

osteoarthritis (OA) on balance is unclear, knee OA has been reported to significantly reduce standing balance in the elderly. Impairment in balance subsequently limits an individual's mobility and physical function, including activities of daily living such as self-care and transfers and is also associated with an increased incidence of falls [4, 6, 7]. Patients with severe hip and knee OA who are awaiting total hip arthroplasty (THA) or total knee arthroplasty (TKA) are reported to have a higher incidence of falls compared to the general population. Also, one in four patients is reported to have a fall within 2 years following THA or TKA surgery [8, 16]. The cost of falling is high, both to the individual (physical and psychological trauma) and the health-care system (financial burden related to surgery and rehabilitation) [18]. At the same time, costs related to the patient's inability to look after them and/ or to be discharged to their home environment present additional burdens for the patient, their family, and the health-care system [9].

Balance while standing requires the integration of different components such as: the sensory systems, the central nervous system and the motor system. The sensory and motor systems provide input through the mechano receptors in joint capsules, ligaments, tendons, muscles and from cutaneous receptors. The integrity of joints, ligaments, tendons and muscles play an important role in providing proprioceptive feedback to maintain balance. Although the effects of hip osteoarthritis (OA) on hip joint proprioception are unclear, knee OA has been reported to result in impairment of proprioception in the knee joint [10].

Materials and methods

A randomized controlled trial design with two groups was used for the study. Potential participants for the study were recruited between June 2015 and June 2017 from a large outpatient home physical therapy provider. At their first post-operative home visit and before any assessments, qualified participants were randomly assigned by their physical therapist to a typical exercise (TE) group or a typical exercise plus balance exercise (TE + B) group using a coin toss method of randomization. Heads was allocated to the TE group, and tails was allocated to the TE + B group to determine the group assignment of each participant. The participants flipped the coin and were assigned to the exercise group based on the outcome. The participants were blinded to their group allocation; however, the physical therapists were not blinded to the group allocation of the participants. Participants in the TE group completed joint ROM and muscle strengthening exercises, and participants in the TE + B group completed joint ROM, muscle strengthening, and additional balance exercises. All participants were assessed before (baseline) and after (follow-up) the intervention period. Assessments of participants at baseline were completed at the participant's home by their attending physical therapist, who was one of the two participating physical therapists, having 3–4 years of experience in working with patients with THA and/or TKA. The physical therapists started administering intervention to the participants on the same day immediately after the baseline assessments were completed. The intervention program was administered for a period of 5 weeks. At the end of 5 weeks, follow-up assessments were completed by the primary investigator (one of the two participating physical therapists) within 3–6 days in a biomechanics laboratory at an academic center. At the beginning of the study, the two physical therapists visited one patient together for the first as well as the follow-up visits to ensure that similar information was conveyed to all participants with respect to instructions during assessment on outcome measures and also during implementation of the intervention.

Participants

Participants in the study were a sample of convenience of consecutive patients that were referred for outpatient home physical therapy following either THA or TKA. Patients' charts were reviewed to determine their eligibility with

respect to the operated joint, any surgery-related complications, any contraindications to exercise, and other health conditions, for participation in the study. The inclusion criteria were 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. Patients with revision THA or TKA, or those who had been advised by their surgeon to remain non weight-bearing or partial weight-bearing on either the operated or non-operated leg, were excluded. Patients with neurological conditions, such as hemiplegia, peripheral neuropathy, Parkinson's disease, multiple sclerosis or spinal cord compression, and vestibular disorders that might affect balance, and those who were considered unable to communicate or follow instructions were also excluded from the study. A total of 60 patients (28 males, 32 females) as advised by the surgeons, all patients were taking blood thinners for prevention of blood clots, and pain medication as needed following surgery. Some patients had other health problems such as high blood pressure and high cholesterol level which did not affect their balance or participation in the study and were taking medication for these health problems as advised by their family physicians.

Procedure

A total 60 subjects were included in the study the subjects who fulfilled the inclusion and exclusion criteria and were willing to participate in the study were randomly assigned one of two groups (Group – A and Group - B) after obtaining written informed consent. **Group A:** In this group 30 subjects were given only conventional therapy **Group B:** In this group 30 subjects were received conventional therapy with balance training exercises.

Treatment strategy

- Assisted knee flexion with a knee strap in lying.
- Knee extension on a towel roll in lying.
- Knee flexion by sliding foot on bed in lying
- Straight leg raises in lying
- Assisted knee extension with strap around the foot in lying
- Knee extension in sitting
- Knee flexion by sliding foot on the floor in sitting.

Experimental Group – B

- Rotate Trunk Clock Wise And Then Anti-Clock Direction In Standing Without Support
- Lunge in walk standing position without support and repeat with other leg forward: stand with feet shoulder width apart. Step forward on operative leg while slowly bending the knee to a 45 degree bend. May need to hold on to a counter top or chair back for balance. Hold for 5 seconds and then slowly straighten the knee back to a relaxed stance position. Repeat on the non-operative leg. Repeat 10 repetitions each leg.
- Shift weight to once side in a stride position without support and then repeat on the other side: same as above mention shift the weight on the other side in stride position [12].

Statistical analysis

The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, System 12.0 and R environment ver.2.11.1 were used for the analysis of the data. Descriptive and inferential statistical analysis had been carried out in the present study. Significance was assessed at 5% level of significance. The following assumptions on data are made.

Assumptions: Dependent variables should be normally distributed, Samples drawn from the population should be random, and Cases of the samples should be independent [20, 21].

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters. Student t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale within each group.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis.

Significant figures

+Suggestive significance (P value: 0.05 <P <0.10)

*Moderately significant (P value: 0.01 <P <0.05)

**Strongly significant (P value: P0.01)

Results

Chi-Square test/ Fisher Exact test was applied for between group comparison of group A and group B For on comparing group A and group B for post treatment Timed up and go test score results showed a significant difference in improvement in terms of timed up go test [22, 23].

Balance training exercises with conventional therapy

Group B (Experimental Group) received balancing training Exercises along with Conventional Therapy for a period of 5 weeks with 3 day treatment session in a week. The outcome measures were measured with timed up go test (TUG scale), Values were taken before and after completion of treatment. They were then assessed statistically.

The mean score of timed up go test (TUG scale) in group B (Experimental Group) prior to treatment was 26.53 and the post treatment score was 14.83.

There was a significant decrease in TUG SCORE and improvement in functional mobility as the mean difference between the pre and post treatment was 11.70 [24].

Group A- Control group

Conventional therapy

Group A (Control Group) received Conventional Therapy for a period of 5 weeks with 3 day treatment session in a week. The outcome measures are measured with timed up go test, Values were taken before and after completion of treatment. They were then assessed statistically.

The mean score of timed up go test (TUG scale) in group B (Control Group) prior to treatment was 27.43 and the post treatment score was 22.53.

The significant difference between the pre and post score of TUG score was decreasing and improving functional mobility was 5.90.

On comparing group A and group B

Though there was a significant increase in both group A and group B, on comparing the mean scores obtained after treatment, the effectiveness of the treatment was determined.

The difference among the mean scores of TUG in group B was 4.900 and group A was 11.700 which was statistically significant (p<0.001) indicates that the experimental group (Group B) had a much better increase of 7.067 (**Table – 1 to 4**).

Table - 1: Gender distribution of patients studied.

Gender	Group A	Group B	Total
Female	15(50%)	17(56.7%)	32(53.3%)
Male	15(50%)	13(43.3%)	28(46.7%)
Total	30(100%)	30(100%)	60(100%)

Samples were gender matched with P=0.605.

Table - 2: Age distribution of patients studied.

Age in years	Group A	Group B	Total
50-54	11(36.7%)	9(30%)	20(33.3%)
55-60	19(63.3%)	21(70%)	40(66.7%)
Total	30(100%)	30(100%)	60(100%)
Mean ± SD	55.33±2.76	55.53±2.40	55.43±2.57

Samples were age matched with P=0.766.

Table - 3: TUG: A Comparative assessment pre and post.

TUG	Pre	Post	% change
Group A (n=30)			
• 1-10	0(0%)	0(0%)	0.0%
• 11-20	0(0%)	4(13.3%)	13.3%
• 21-30	30(100%)	26(86.7%)	-13.3%
Group B (n=30)			
• 1-10	0(0%)	2(6.7%)	6.7%
• 11-20	0(0%)	28(93.3%)	93.3%
• 21-30	30(100%)	0(0%)	-100.0%
P value	1.000	<0.001**	-

Table - 4: TUG: Comparison of TUG in two groups at pre and post therapy.

TUG	Pre	Post	difference	t value	P value
Group A	27.43±1.41	22.53±2.01	4.900	17.697	<0.001**
Group B	26.53±1.78	14.83±2.77	11.700	25.559	<0.001**
P value	0.034*	<0.001**	-	-	-

Discussion

In this study objective was to improve functional mobility by applying a balance exercise program along with typical exercise in patients with TKA. The result of this study showed that the experimental group which received typical exercises and additional 3 balance training within 5 weeks had improvement in a physical performance and mobility including TUG, ROM and strengthening. Similar improvement in balance has been reported by Pankaj Jogi, et al. [13, 14] in patients with knee replacement after administering a balance exercise program .this study balance was assessed on a force plate using 95% ellipse area of the center of pressure amplitude resulted in significantly greater improvements in balance for participants with total hip arthroplasty or total knee arthroplasty In this study ,the patients were recruited 2-6 months after the TKA surgery at completion of studies TUG scores were comparatively higher at baseline assessment. At the completion of this study, the patients 'TUG scores had significantly reduced. This study was completed before the end of 6 months' duration following TKA surgery. Improvements in balance as observed in this study have also been reported in previous studies following balance intervention in patients with other health conditions [13, 17]. Chun-De Liao, et al. [15] functional training for eight weeks study reported improvement in balance on mobility and function outcome in patients with knee osteoarthritis after total knee replacement. After eight-week intervention with additional balance exercises, the experimental group demonstrated significant changes in 10-m walk [15]. ($P < 0.001$, 95% confidence interval (CI): 3.6 to 4.4 seconds) and in timed up-and-go ($P < 0.001$, 95% confidence interval: 2.6 to 3.4 seconds) [14]. Michael J. Bade, et al. [16] showed to measure changes in muscle strength, range of motion, and function from 2 weeks before to 6 months after total knee arthroplasty (TKA). Range of motion was measured actively and passively. Functional performance was assessed using the stair-climbing test, timed up-and-go test, 6-minute walk test, and single-limb stance time [15, 19].

Conclusion

From the above study results it is concluded that there is a difference among the Group A and Group B when the values obtained were analyzed. There were significant changes in TUG scores between the groups. It indicated that Group B (Balance Training Exercises with Conventional Therapy) had a significant improvement in functional ability in all aspects. Their scores in TUG have reduced which indicates decreased level of disability and better functional ability. So, it indicates that Balancing Training Exercises with Conventional Therapy is

more significant and give better results when compared to Conventional Therapy alone.

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