

EFFECT OF RETRO-WALKING VERSUS FORWARD WALKING ON WALKING ABILITY AND STAIRS CLIMBING ON SUBJECTS WITH OSTEOARTHRITIS OF KNEE JOINT: A RANDOMIZED CLINICAL STUDY

¹Heli Dhankecha, ²Bhavana Gadhavi

¹MPT Scholar, ²Professor, Principal.

Abstract

Introduction: Osteoarthritis (OA) is a developing non-inflammatory disease of the movable joints. the knee is most common site for osteoarthritis. Retro walking is one kind of backward walking. The aim of this research was to see how Retro- Walking worked in combination with conventional physiotherapy on walking ability and stairs climbing activity compared to Forward-walking along with conventional physiotherapy on walking ability and stairs climbing on patient with OA knee joint.

Methodology: After assessing inclusion and excluded criteria, total 20 subjects aged between 40-60 were taken for the study. They were randomly divided into two groups. Group A(N=10) received Retro-Walking plus conventional physiotherapy program and Group B(N=10) received Forward-walking along with conventional physiotherapy program only for twice a day 3 days/week for 3 weeks. Walking ability assessed by Six Min. Walk Test and stair climbing activity were assessed by Time Stair Climbing Test. The data was analysed using paired and unpaired t tests.

Result: The result of this present study showed that, MEAN and SD value difference for 6 min. walk test of Group A and Group B was were 5.3 ± 2.1 and 19.9 ± 4.79 respectively while MEAN and SD value difference for Time Stair Climbing Test of Group A and Group B was 5.5 ± 2.27 and 16.9 ± 3.34 respectively. So in Group B there is statistically highly significance founded compare to Group A for both Outcome. Significance was assessed at 5% level that is $p < 0.05$ (2-tailed hypothesis test was considered)

Conclusion: The present study concluded that a Retro-Walking along with conventional physiotherapy program is more effective to improve walking ability and stair climbing over Forward-walking along with convention physiotherapy program.

Key Words: Retro-Walking, Forward-walking, Osteoarthritis, Time Stair Climbing Test, 6 Min. Walk Test

INTRODUCTION

The knee complex is one of the most often injured joints in the human body. This anatomical complexity is necessary to allow for the elaborate interplay between the joints mobility and stability roles. Dynamically, the knee complex is responsible for moving and supporting the body during a variety of both routine and difficult activities^[1]. The knee complex is composed of two distinct articulation located within a single joint capsule; the tibiofemoral joint and the patellofemoral joint. The tibiofemoral joint is the articulation between the distal femur and proximal tibia. The patellofemoral joint is the articulation between the posterior patella and the femur^[1].

Under normal conditions there is a normal distribution of the load forces on these three articular components in both the static load and during ambulation^[4].

The tibio-femoral joint is the largest joint in the body. It is modified hinge joint having 2 degrees of freedom. The synovium around the joint is extensive, it communicate with many of the bursae and pouches around the knee joint. Its distribution within the knee is such that the cruciate ligaments, which run from the middle of the tibial plateau to the intercondylar area of the femur, are extra synovial. The articular surface of the tibia and femur are not congruent, which enables the two bones to move different amounts, guided by the muscle and ligaments. The space between the tibia and femur is partially filled by two menisci that are attached to the tibia to add congruency^[2].

Osteoarthritis (OA) is a non-inflammatory progressive disorder of movable joint, particularly weight bearing joints. Exact cause of OA is not known. However it is strongly believed that it occurs due to aging or wear and tear or degenerative changes in the joints. Risk factors for OA knee includes Age, gender, obesity, occupation, sports, osteoporosis, previous trauma, irregularity in joint surface, internal derangement, heredity, leisure and diseases leaving articular cartilage damage.^[1] Pain and other symptoms of OA may have a profound effect on quality of life affecting both physical function and psychological parameters. OA of the knee impairs quadriceps functions which, in turn, impair the patients balance and gait reduction their mobility and function. Osteoarthritis is one of the most prevalent condition resulting to disability particularly in elderly population. It is painful and disabling disease that affects millions of patients^[3]. OA is classified into two groups according to its etiology: primary (idiopathic or non-traumatic) and secondary (usually due to trauma or mechanical misalignment^[9]).

OA is most common articular disease of the developed world and a leading cause of chronic disability. Knee OA is not a localized disease of cartilage alone but is considered as a chronic disease of the whole joint, including articular cartilage, meniscus, ligament, and peri-articular muscle that may result from multiple pathophysiological mechanisms. Knee OA at high prevalence rate compare to other joint OA. The incidence of OA increased by age and further increase with longer lifetime and higher average weight of the Population^[3].

The proportions of people affected with symptomatic knee OA is likely to increase due to the aging of the population and the rate of obesity or overweight in the general population^[6]. During a one year period, 25% of people over 55 years may demonstrate persistent episode of knee pain . Symptomatic knee OA occurs in 10% men and 13% in women aged 60 years or older^[5]. Prevalence of knee OA in men is lower compared with women^[7]. The prevalence of moderate-to-severe knee osteoarthritis changed from 3.7% at the baseline assessment to 26.7% in the follow-up visit eleven years later. Middle- aged women had a high prevalence of moderate-to-severe knee osteoarthritis^[8].

Retro-walking is referred to as backward walking, has been thought to be used already to get a physical workout, improve sport performance, promote balance and also to stay mentally fit^[11].

Retro-walking has been shown to reduce patellofemoral pain, increases functional capability while strengthening the lower limbs and improving proprioception and balance^[10]. Back ward walking increases stride rate, decreases stride length and increases support time. Muscular structure supporting ankle and knee reversed their role during retro-walking. Backward walking produces significantly lower patellar compressive force than forward walking and helps to reduce maximal vertical force and impulsive force on knee in comparison to forward walking because of Toe heel contact pattern. Retro-walking is associated with increased cadence, decreased stride length and different joint kinematics as compared to forward walking and hence may offer some benefits over forward walking alone^[12].

The primary aim of the present study was the compare the effect of Retro-Walking versus forward walking on walking ability on subjects with OA knee joint. Secondary aim of the present study was the compare the effect of retro walking versus forward walking on time of stair climbing on subjects with OA knee joint. As there is multiple studies already done on comparison of Retro-Walking versus Forward Walking on pain, functional ability, balance etc. but very few studies may be done to know specific effect of walking-ability and Stair Climbing activity.

METHODOLOGY

This is a comparative study, randomized clinical trial to find out the effect of retro-walking compared to forward walking for stair climbing and walking ability in patients diagnosed by orthopaedic doctor in Parul Sevashram Hospital, having Osteoarthritis of knee joint with radiographic grade 1 and 2 on Kellgren-Lawrence Scale¹⁹. This study was conducted in Physiotherapy department of Parul Sevashram Hospital. Ethical approval from the Parul University Institution ethical committee for human research (PU-IECHR) was taken. The study population was composed in aged between 40-60 years. Convenient sample size was taken. The informed and written consent about enrolment in the study were taken and subjects were allowed to refuse anytime while the study period if they wanted to. There were total 20 diagnosed subjects of OA knee which were recruited for present study in two groups which were Group A (control group) and Group B (experimental group) each group was divided by concealed envelope method.

Subjects were included who are clinically diagnosed with OA of knee by Orthopaedic. Male and female between 40-60 years. Participate with unilateral or bilateral involvement of knee taken. Subject who will sign consent form willingly. Patient also has to have a sufficient level of English or Gujarati or Hindi languages to complete the questionnaires. And subjects were excluded who are with history of lower limb or spinal surgeries, neurological disorder (motor or sensory loss). Subject with other musculoskeletal disorders associated with knee joint, IT band, adductor muscle and Sartorius muscle tightness.

Treatment protocol

The subjects were made to walk 4 steps of retro-walk for 10 minutes per session on flat surface & observed for the subjects who felt discomfort or dizziness as they were unable to perform the retro-walk and were excluded (n=5) from the study. The participants included in the study were assigned the supervised 10 mins of the retro-walking and forward walking training with warm up and cool down sessions, where subjects were instructed to perform heel raise exercises, ankle toe movements, and gastrocnemius-soleus and hamstring stretches, for 3 days/week for 3 weeks on flat surface at their comfortable walking speed in form of 4 mins of retro-walking and forward walking and 2 mins rest and again 4 mins walking, along with conventional physiotherapy as indicated below.

GROUP A

Group A received forward-walking along with conventional physiotherapy in form of open and closed kinematic chain exercises, those are isometric hip adduction, terminal knee extension, semi-squat, leg press, straight leg raises, along with forward walking.(17)

GROUP B

Group B received conventional physiotherapy and Retro-walking same as mentioned above in group A along with retro-walking.

The participants were instructed by a trained Physiotherapist to perform the prescribed exercises 3 days a week for 3 weeks home program for 2nd & 3rd week: same walking pattern. as previously published (table 1)(18). All participants were requested to avoid any exercise other than the prescribed program during the trial. Frequent reminders and corrections were given by the therapists who involved in the training to avoid incorrect or any other forms of exercise during the trial.

Outcomes

All the outcome were measured by physical therapist and has experience of using the outcomes used in this study.

All the subjects from Group A & Group B was assessed and analysed as per the outcome measure at 1st day of treatment and after 3 weeks of treatment. (pre and post intervention as follow: 1.6 min. Walk test, 2. Time stair climbing test,)

The primary outcome including mean walking ability, measured by 6-min. Walk test, respectively, were analysed at 1st day before treatment and at the end of 3rd weeks after treatment. In this participant were requested to walk for 6 mins. Pre and post analysed was done.

The secondary outcome including mean of stair climbing ability measured by time stair climbing. In these participant requested to ascend and descend 11 stairs. And therapist have to record time. respectively, were analysed at 1st day before treatment and at the end of 3rd weeks after treatment.

RESULT

In the present study, total 20 subjects age between 40-60 years were taken. 6 Min. Walk Test were used for walking ability and Time stair climbing Test were used to measure stair climbing ability at the level of 0.95 significance. Statistical software Microsoft excel was used to analyse the data.

Within the Group analysis of group A

Table no 1 pre-post comparison of 6 min. Walk test value of Group A

	Pre	Post	t value	p value	Result
Mean \pm SD	255.8 \pm 76.07	261.1 \pm 76.65	2.85	0.05	S

*S= Significant

Graph 1 pre-post comparison 6 min. Walk test value of Group A

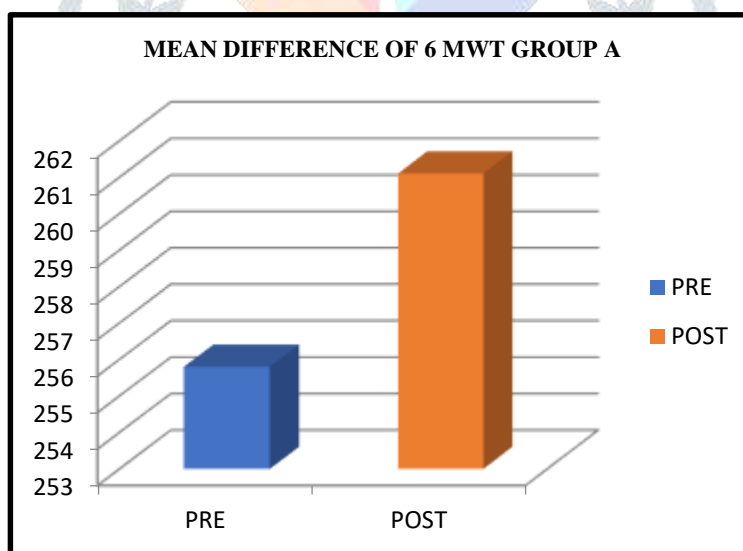


Table no 1 and Graph 1 shows pre and post intervention mean difference of 6 min. walk test of Group A. Paired t-test was used to analysis of data, Pre-test mean \pm SD value was 255.8 \pm 76.07, and Post-test mean \pm SD value was 261.1 \pm 76.65. There is significance difference between Pre and Post intervention value. P value for the test is 0.05.

Table no 2 pre-post comparison of t Stair Climbing Test value of Group A

	Pre	Post	t value	p value	Result
Mean \pm SD	93.9 \pm 18.41	88.4 \pm 18.22	3.15	0.05	S

*S= Significant

Graph 2 pre-post comparison of Stair Climbing Test value of Group A

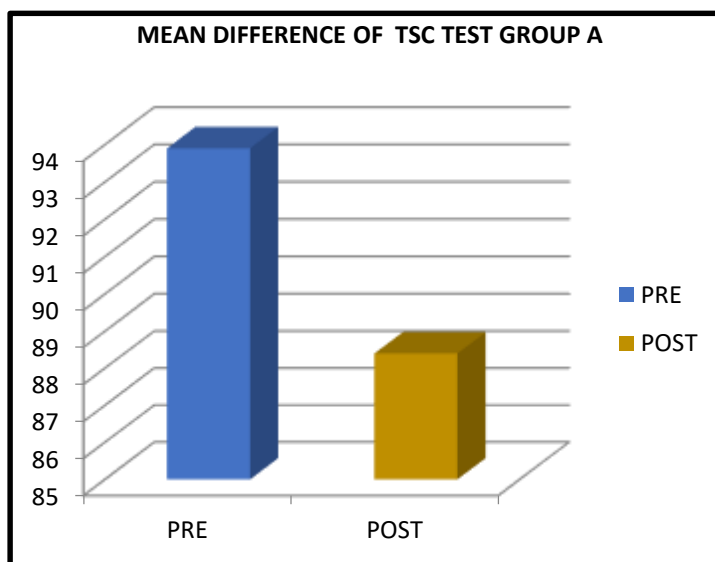


Table no 2 and Graph 2 shows pre and post intervention mean difference of Time Stair Climbing Test of Group A. Paired t-test was used to analysis of data, Pre-test mean \pm SD value was 93.9 ± 18.41 , and Post-test mean \pm SD value was 88.4 ± 18.22 . There is significance difference between Pre and Post intervention value. P value for the test is 0.05.

Within the group analysis of Group B

Table no 3 pre-post comparison of 6 min. Walk test value of Group B

	Pre	Post	t value	p value	Result
Mean \pm SD	236.4 \pm 64.52	256.3 \pm 61.65	3.57	0.05	S

*HS= High Significant

Graph 3 pre-post comparison 6 min. Walk test value of Group B

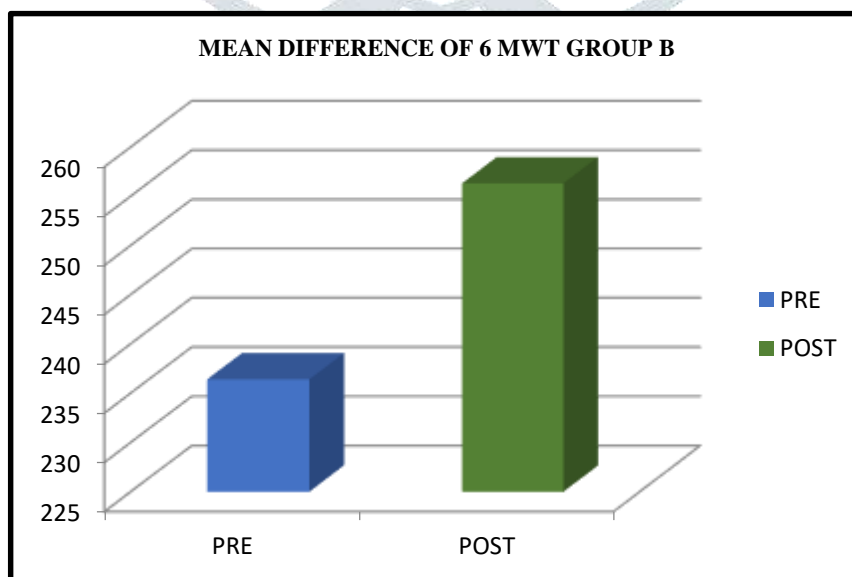


Table no 3 and Graph 3 shows pre and post intervention mean difference of 6 min. walk test of Group B. Paired t-test was used to analysis of data, Pre-test mean \pm SD value was 236.4 ± 64.52 , and Post-test mean \pm SD value was 256.3 ± 61.65 . There is High significance difference between Pre and Post intervention value. P value for the test is 0.05.

Table no 4 pre-post comparison of t Stair Climbing Test value of Group B

	Pre	Post	t value	p value	Result
Mean \pm SD	94.4 \pm 23.38	77.5 \pm 21.29	6.57	0.05	S

*S= Significant

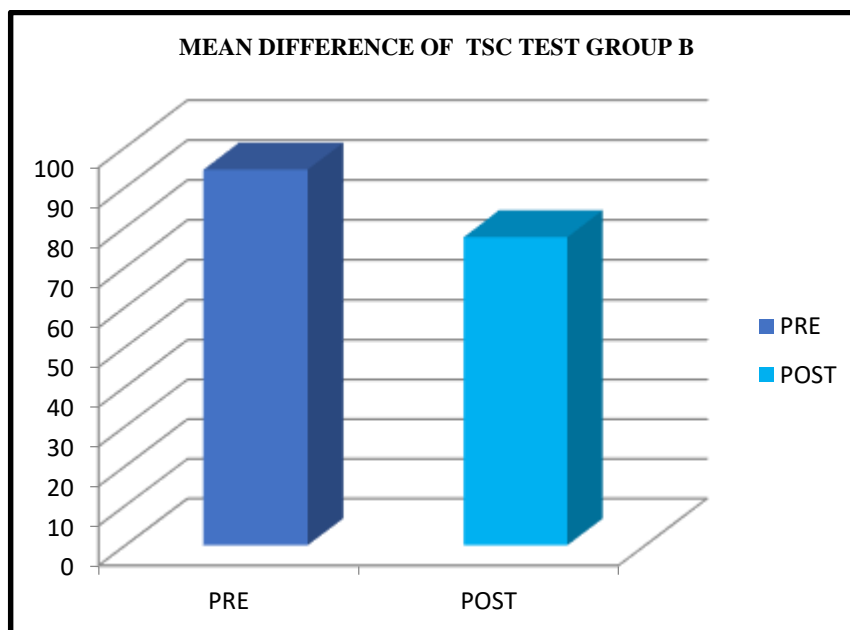
Graph 4 pre-post comparison of t Stair Climbing Test value of Group B

Table no 4 and Graph 4 shows pre and post intervention mean difference of Time Stair Climbing Test of Group B. Paired t-test was used to analysis of data, Pre-test mean \pm SD value was 94.4 \pm 23.38, and Post-test mean \pm SD value was 77.5 \pm 21.29 . There is significance difference between Pre and Post intervention value. P value for the test is 0.05.

Between Group analysis of Group A and Group B for 6 min. Walk test**Table no 5 inter-Group comparison of 6 min. Walk test value of Group A and B**

	Group A	Group B	t value	p value	Result
Mean \pm SD	5.3 \pm 2.1	19.9 \pm 4.79	6.38	0.05	HS

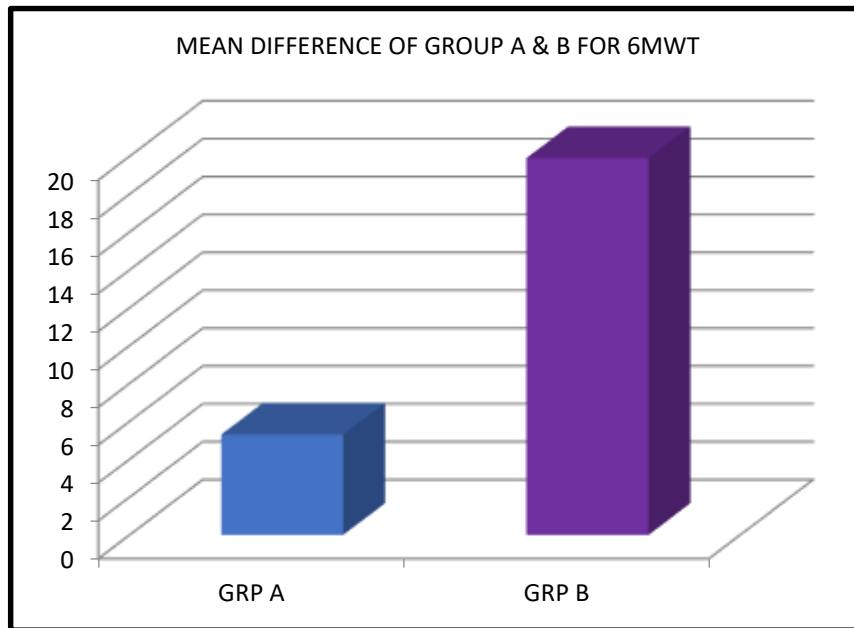
Graph 5 inter Group comparison of 6 min. Walk Test value Group A and B

Table no 5 and Graph 5 shows inter-group comparison of Group A and Group B for 6 min. Walk test value. Unpaired t-test was used to analysis of data The mean \pm SD value of both the Group A and group B were 5.3 ± 2.1 and 19.9 ± 4.79 respectively. On analysing mean values, there was statistically highly significance difference between groups, t-value for the test was 6.38 and p-value was 0.05. Thus, taking the mean into consideration, it can be concluded that Group A and Group B both shows significant improvement, but Group B shows statistically more significant improvement compare to Group A.

Between Group analysis of Group A and Group B for time Stair Climbing Test for Group A and B**Table no 6 inter-Group comparison of time Stairs Climbing Test value**

	Group A	Group B	t value	p value	Result
Mean \pm SD	5.5 ± 2.27	16.9 ± 3.34	5.13	0.05	HS

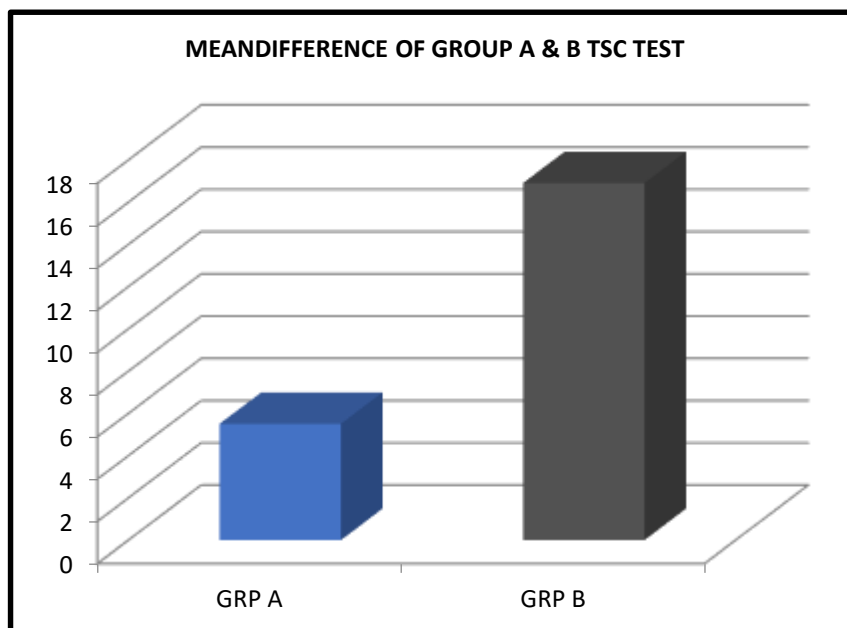
Graph 6 inter Group comparison of Time Stair Climbing Test value

Table no 6 and Graph 6 shows inter-group comparison of Group A and Group B for time stair climbing test value. Unpaired t-test was used to analysis of data The mean \pm SD value of both the Group A and group B were 5.5 ± 2.27 and 16.9 ± 3.34 respectively. On analysing mean values, there was high significance difference between groups, t-value for the test was 5.13 and p-value was 0.05. Thus, taking the mean into consideration, it can be concluded that Group A and Group B both shows significant improvement, but Group B shows more significant improvement compare to Group A.

DISCUSSION

The present randomized controlled trial aimed to see the effect of Retro-walking program along with conventional physiotherapy and forward-walking program along with conventional physiotherapy on walking ability and stairs climbing activity in patient with OA knee. The result of the present study showing that, Retro-walking program along with conventional physiotherapy and forward-walking program along with conventional physiotherapy these both are effective on walking ability and stairs climbing activity but Retro-walking along with conventional physiotherapy is more effective to improving walking ability and stair climbing after 3 weeks of intervention in patient with OA knee. In Group A there were high significant improvement in post intervention score for 6 Min. Walk Test and Time Stair Climbing Test in Group A. However, In Group B there were significant improvement in post intervention score for 6 min. Walk test, but there were high significant improvement in post intervention score for time stair climbing in Group B. i.e. Retro-walking along with conventional therapy Group, as compared to Group B i.e. forward-walking program along with Conventional therapy Group.

Walking is a closed-kinetic-chain exercise that provides for early weight-bearing and mobilization during knee rehabilitation. Walking exercises are helpful and are prescribed by people with knee OA to relieve discomfort and weakness. In a previous systematic study and meta-analysis, walking was found to have a mild impact on knee pain and function as compared to home-based quadriceps strengthening exercises Kovar et al. [20] When opposed to a medical education program, the guided exercise walking program resulted in better function and no deterioration of OA-related symptoms. Closed kinetic chain tasks are more practical in nature and are closely related to things we do in our everyday lives. In addition, closed kinetic chain exercise could also improve joint proprioception, muscle strength, and balance [20]. In contrast to current study, a 3-month RCT evaluating the efficacy of a walking program (forward walking) and home activity in people with knee OA found major changes of 51–55 percent on the WOMAC pain subscale and 57 percent on the WOMAC physical function subscale [21].

Threkeld AJ et al (2014) in their study they said that In subjects with OA knee, Quadriceps muscle activity is compromised, resulting in a reduction in the subject's posture and gait, as well as their mobility. Traditional physiotherapy helps to relieve pain, increase joint agility, coordination, knee muscle control, and knee range of motion. So because of these improvements subject's walking ability also improve^[20]. Patchava Apparao et al (2017) in their study of The study, titled 'Effectiveness of stabilization exercises and traditional physiotherapy in subjects with knee osteoarthritis,' showed that increasing quadriceps muscle strength and extending hamstring muscle strength, breaking the pain loop by minimizing muscle spasm, increasing muscle strength and improving circulation, and decreasing metabolite concentrations were all successful in breaking down the pain loop. The quadricep muscles' increased strength improved both ROM and physical performance. An increase in knee extension The increase in ROM may be due to the impact of stretching exercise, which increases muscle stability and leads to muscle shortening and pain relief. This will lead to increased practice of everyday life tasks and, thus, better physical efficiency if sustained by reinforcing exercise^[24].

Retro-walking is considered a safe closed kinetic chain exercise since the compressive forces at the patella-femoral joint are reduced^[19]. Retro-walking reduces quadriceps eccentric function, while the isometric and concentric quadriceps strength are preserved^[20-22]. Retro-walking training programs have been found to increase quadriceps strength^[22]. In addition, the cardiopulmonary demand is higher during retro-walking as compared to forward-walking^[23, 24]. Therefore, these advantages make retro-walking a safe and effective component of rehabilitation programs^[21]. Priya sungh rangey et al (2016) in their study they proved that that Retro-walking is associated with less biomechanical strain^[22]. Also, Van der Esch M et al (2014) in their study said that during retro-walking, ankle and knee reversed their role by support of their muscular structure. In retro-walking, primary power produced with help of co-contraction of hamstring and quadriceps in knee joint and shock absorbed with help of plantar flexor in ankle joint. Forward walking produce significantly higher patellar compressive force than retro walking. Due to toe-heel contact pattern retro-walking helps in reduce maximal vertical force and impulsive force on knee joint^[23]

In Group A, subject were covered more distance in 6 min. Walk test at the end of 3rd week compared to Group B, so the mean value for 6 min. Walk test was improved at the end of 3rd week, this improvement in mean value its showing a significant improvement in walking ability. In Group A, Subject were took less time to completing time stair climbing test at the end of 3rd week compare to Group B, so the mean value of time stair climbing test was improved at the end of 3rd week, so improvement in mean value in stair climbing test, it showing a significant improvement in stair ascending and descending ability. Hence, result of my study also supported by this study' Ahmad H. Alghadir¹, Dr. Sneha Sameer ganu et al they proved in their study that one of the best advantage of retro-walking is it reduce eccentric activity of quadriceps and at that time maintain isometric and concentric contraction of quadriceps also. Decrease compressive force at knee joint with help of reduced eccentric activity of quadriceps that will lead to reduced pain intensity at the knee joint so that previous studies also indicate that necessary to improve quadriceps strength after retro-walking and that will help in to improve more walking ability and stair climbing activity^[20,25].

CONCLUSION

The present study indicated that a 3 week combined Retro-walking program in combination with conventional physiotherapy program and forward-walking program in combination with conventional physiotherapy program these both are effective to improve walking ability and stair climbing but Retro-walking program in combination with conventional physiotherapy program is more effective over the and forward-walking program in combination with convention physiotherapy program to improve walking ability and stair climbing in OA knee patient.

LIMITATIONS OF THE STUDY

- The study was performed in a small location.
- A small sample size analysis has been carried out.
- Further follow-up was not carried out to see the long-term effects.
- The gender of the participants is not defined in the results.
- Non-gender equity.

FURTHER RECOMMENDATION

- Further experiments of a large sample size may be performed.
- For better effect, the period of the studies should be elongated.
- Further research should be conducted to assess the fairness of gender for different age classes.

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