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Effectiveness of Retro Walking in Women with Osteoarthritis of Knee

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ABSTRACT

Background: Osteoarthritis (OA) of the knee is a major cause of mobility impairment, particularly among females. The incidence of osteoarthritis (OA) increases after menopause, and may be related to hormonal changes in women. Estrogen deficiency is known to affect the development of OA.
Methodology: Eighteen post-menopausal women with knee Osteoarthritis of age 45-75 were assessed and selected for the study who satisfies the inclusion criteria and were assigned into two groups of 9 subjects each. In Group A the experimental group underwent a protocol with retro-walking along with conventional exercises and Group B conventional group was treated with Static Quadriceps, Terminal Knee Extension, IFT exercises and performed it for 3 months and the study period was 3 weeks. The outcome measures were the Western Ontario and McMaster Universities (WOMAC) scale, Modified Sphygmomanometer Test (MST), Timed Up to Go Test (TUGT). Using these outcome measures pre-test and post-test value were obtained.
Result: The results were analyzed using paired and independent t- test. The significance level was kept as $p < 0.05$. In case of pain, there were significant difference between the pre- test and post-test WOMAC (pain) scores in both experimental and conventional groups, $p< 0.001$, $p < 0.001$ respectively. In the group comparison of WOMAC, the obtained p value was 0.015 ($p < 0.05$), hence there was a significant difference in post-test scores between the two groups. The mean difference 10 shows that the improvement is more significant in Experimental group.
In case of functional mobility, there were significant difference between pre-test and post-test TUG scores in both experimental and conventional groups, $p < 0.001$, $p < 0.01$ respectively. In the group comparison, the obtained p value was 0.04 ($p < 0.05$), hence there was significant difference in post - test scores between the experimental and conventional groups. The mean difference 3.6 portrayed that the, Experimental group showed more significant improvement.
In case of muscle strength, there were significant difference existing between the pre-test and post-test scores in both experimental and conventional groups, $p < 0.001$, $p < 0.05$. When the two groups were compared, the obtained p value was 0.02($p < 0.05$) and hence there was significant difference in post - test scores between both the groups. The mean difference 7.2 shows more significant improvement in the Experimental group. Although both groups showed improvement, the scores in the experimental group are significantly higher than that of the conventional group.
Conclusion: The study concluded that experimental group shows better in pain reduction, quadriceps muscle strength and functional mobility in experimental than control group.

Keywords: Osteoarthritis, Knee joint, Post-menopausal, Retro-walking, Pain, Muscle Strength, functional mobility, Quadriceps muscle.

INTRODUCTION

Osteoarthritis of knee joint is a very common cause of locomotor disability in elderly populations. The incidence of OA increases after menopause may be related to hormonal changes in women. Estrogen deficiency is known to affect the development of OA. Osteoarthritis is ranked as the fifth highest cause of years lost to disability in the whole population in high-income countries, and the ninth highest cause in low- and middle-income countries. It accounts for 50% of the entire musculoskeletal disease burden, and thus it is considered the highest-burden condition within the musculoskeletal group of diseases, which also includes rheumatoid arthritis and osteoporosis. Radiographic evidence of knee osteoarthritis is present in approximately 30% of men and women over the age of 65.2 Worldwide estimates are that 9.6% of men and 18.0% of women over the age of 60 years have symptomatic osteoarthritis. Approximately 80% of those with OA will have limitations in movement, and 25% cannot perform their major activities of daily life[1].

OA is one of the most prevalent conditions resulting in disability particularly in the elderly population[2]. It is a degenerative disorder of synovial joint, characterized by the loss of articular cartilage, with reactive changes in subchondral & marginal bone, resulting in the development of bony spurs and cysts at the margins of the joint[3].

OA may cause joint pain, bony or soft tissue swelling, tenderness, bony crepitus, peri-articular muscle atrophy, bony hypertrophy, deformity and marked loss of joint range of motion. It mainly affects the hands, feet, spine, and large weight-bearing joints, such as the hips and knees. It can present as localized, generalized or as erosive osteoarthritis[4].

Joints on one side of the body are often more affected than those on the other. Usually, the symptoms alter over years. It can affect the work and normal daily activities of individuals[5].

In the primary stage of OA, with advancing age the proteoglycans content of the articular cartilage will decrease thereby reducing the water content of the cartilage and it becomes resilient and cracks occur during the activities of daily living. This is responsible for the onset and progression of the degenerative process. It starts innocuously in the beginning; it progresses slowly over a period of time and then becomes severe. The main causes include previous joint injury, abnormal joint or limb development, and inherited factors. Risk is greater in those who are overweight, have limb length variations, and have jobs that result in high levels of joint stress. Osteoarthritis is believed to be caused by mechanical stress on the joint and low-grade inflammatory processes. It occurs as the cartilage will be lost and the underlying bone becomes affected. As pain may make it difficult to exercise, muscle loss may occur. Diagnosis is typically based on the signs and symptoms, with medical imaging and other tests occasionally used to either support or rule out other problems [6].

Walking is widely used in knee rehabilitation as it allows early weight bearing movement. In this study we are performing Retro-walking in acute OA knee as it is a simple, cost-effective technique and it can be performed as home exercise.

OA strikes women more often than men and it increases in prevalence and incidence after menopause. Females are found to have severe OA, a greater number of joints are involved, they have more symptoms and are increased in hand and knee. Many experimental, clinical and epidemiological studies suggest that loss of estrogen at the time of menopause increases a woman's risk of getting osteoarthritis and use of Hormone Replacement Therapy (HRT) did seem to be associated and will not only relieving of symptoms but also reduce the rate of progression of osteoarthritis[4].

Relation of estrogen / menopause and osteoarthritis

Females are found to have more severe OA, a greater number of joints are involved, and have more symptoms and are increased in hand and knee. After several observations it was evaluated that, there will be painful form of hand osteoarthritis after menopause, and chance of loss of estrogen at that time and these leads woman to the risk of osteoarthritis. Similarly, long term hormone replacement therapy increases bone mineral density in women who have experienced natural menopause and protects against bone loss in surgically postmenopausal women. Combined estrogen and progestin replacement therapy can relieve the knee OA symptoms of postmenopausal women. Significant differences on pain at night and tenderness around the knee were seen in the treatment group compared with the control group after one months of treatment. Otherwise, treatment will include Nonpharmacological measure in the form of education and behavioral intervention, weight loss, exercises, mechanical aids, transcutaneous nerve stimulation, local massage, acupuncture, pain management counselling and support groups. Assistive devices in knee osteoarthritis, physical therapy in form of knee sleeves, cone or walker and occupational therapy are other modalities which can be used [4].

The role of sex hormones in the development of osteoarthritis has been suggested based on the increasing rate of osteoarthritis during or soon after menopause[7]. Estrogen lowers serum calcium & phosphate and inhibits bone resorption[8].

Knee Osteoarthritis (KOA) is associated with advancing age and a most common cause of locomotor disability and is characterized by the degradation and an erosion of articular cartilage, inflammation of the synovial membrane, sclerosis of subchondral bone and formation of osteophytes which causes arthritic symptoms such as joint pain, swelling, stiffness, deformation and loss of function in middle aged and elderly people. Optimal management of patients with KOA requires a combination of non-pharmacological and pharmacological treatments, including surgical interventions when necessary [9].

In non-pharmacological interventions, rehabilitation includes exercise and physical therapies and may be an important alternative for bridging the gap between disease onset and final operative intervention. Effective clinical management of hip and knee OA should therefore address the issue of muscle weakness. Exercise management is an efficacious, safe and low-cost treatment available to all in the community[10].

Biomechanics and patho-mechanisms of osteoarthritis

For weight-bearing joints the altered loading mechanisms, increased mechanical forces, ligament derangements, cartilage degradation, subchondral bone changes and muscular impairments leading to change the biomechanics and are significant contributing factors for initiation and progression of OA. This imbalance is thought to be the driving force in this progressive disease and may produce pain and disability, although many patients with obvious radiographic findings will not report any symptoms related to OA. Thus, OA is a disease of the whole joint, including muscles, tendons, ligaments, synovium and bone. OA is most commonly affecting the weight bearing joints such as the hips, knees and the ankle but it can occur in any synovial joint of the body. Biomechanically the knee joint bears higher shear forces than the hip or ankle joint as it incorporates sliding, rotating and rolling motions during movements [11].

Joints connected serially act as a kinematic chain. This construct allows motion and simultaneously provides stability, congruency and shock absorption. Alignments, adduction moments and muscle balancing are the key determinants for optimal load reduction and distribution as

well as to guarantee painless gliding: hence unphysiological loading patterns on one joint may influence the adjacent levels as well. It leads to social, psychological and economical burdens in patients with substantial financial consequences. A further increase has to be expected due to the increasing prevalence of obesity and ascending life expectancy of the population [11]. Muscle weakness is one of the first and most frequent symptoms in OA and somatosensory deficits that are consistently accompanied by OA. Muscle weakness occurs due to narrowed joint space, increased knee pain and elevated development of OA in elderly women. Patho-biologically, synovitis leads to the secretion of proinflammatory cytokines such as tumor necrosis factor (TNF) –alpha, interleukin (IL)-1 or 6. This impaired cytokine balance in the synovial fluid leads to the induction of proteinases such as metalloproteinases or aggrecans with subsequent cartilage degradation and an inflammatory reaction once the fluid has contact with the subchondral bone, e.g., by subchondral cyst formation [11].

Mechanical axis: The deviation of the mechanical axis does strongly correlate with radiographic joint space narrowing, subchondral cyst formation, bone sclerosis, and functional decline in OA.

Retro walking

Retro walking is defined as walking backwards[12]. In retro walking, initial contact occurs in the forefoot, then the heel strike and propulsion occur relatively passive shortly after heel lift.[13]

Benefits of retro walking

Retro walking provides a number of benefits to your mind and body.

Mental benefits

- Enhance the sense of body awareness.
- Increased body coordination and movement in space.
- Helps to avoid workout boredom.
- Improves overall mood.
- Helps with sleep cycles.
- Motivates to step outside within the comfort zone.
- Keeps the mind guessing.
- Sharpens the thinking skills and enhances the cognitive control.
- Puts senses into overdrive, improving vision [14].

Body benefits

- Increases the strength in lesser-used leg muscles.
- Helps to rehabilitate knee injuries.
- Improves walking technique and form.
- Helps with balance.
- Burn calories.
- Helps to maintain a healthy weight.
- Strengthens bones and muscles.
- Boost energy levels.
- Elevates body's metabolism[14].

Other benefits: While walking normally (forward motion) is something that perform involuntarily, walking backwards helps to improve the leg endurance and aerobic capacity more rapidly and due to the challenge, that placing the body is greater. The body will adapt to new and unfamiliar demands, which promotes the improvements and growth in physical fitness.[14]

Retro walking for osteoarthritis knee

Knee osteoarthritis causes chronic disability in the older population worldwide. Its prevalence increases dramatically with age. Prevalence of radiographic osteoarthritis is estimated at 80% of all adults at or over the age of 65 years. The common impairments such as knee pain, decreased functional mobility, quadriceps strength, and stiffness leading to physical disability have been associated with knee osteoarthritis. The prevalence of osteoarthritis is gradually increasing in both low- and high-income countries. The Global Burden of Disease studies recently indicated that knee osteoarthritis is the fastest increasing major health disorder and the

second global cause of disability. In the lower extremity, the knee is often affected, and knee osteoarthritis results in significant mobility restrictions and a substantial financial burden. The risk of osteoarthritis associated disability is equal to that of cardiac disorders and more common than any other medical problem in older populations. The common clinical manifestations of knee osteoarthritis include pain, stiffness, joint enlargement, crepitus, muscle weakness, deformity, impaired proprioception, reduced joint motion, and disability. Therapeutic exercises are often used to improve physiological impairments such as reduced joint motion, muscle weakness, impaired balance, disability, and proprioception. Hoog Kamer et al. reported that backward walking uses the same rhythm circuitry of forward walking, but additionally requires specialized control circuits. Gait rehabilitation with backward walking puts emphasis on positioning the foot behind the body and, thus, facilitates hip extension while performing a knee flexion that can be useful for patients who have synergistic influences in the lower extremity. A longer period of muscles activity of the legs during backward walking training can result in greater muscle strength gain as compared with forward walking training. Training in backward walking could require higher physiological and perceptual responses than forward walking. Among the current possible gait training methods, backward walking has emerged as an important therapy. Backward walking is regulated by the same central pattern generator as forward walking. Unlike forward walking, backward walking has no heel contact in the early stance phase and thus leads to lower compression force at the patella femoral joint and decreased force absorption at the knee joint. In addition, lower limb muscle activity during backward walking is intensified on account of the higher recruitment of motor units. During the loading response phase of backward walking, the ground reaction force rapidly increases to support the weight of the entire body. The absence of visual cues during backward walking results in increased spatial and smaller temporal gait parameters. Therefore, backward walking can be considered as a treatment strategy to improve gait. Many pharmacological treatment strategies may improve disease-related impairments; however, have limited impact on gait. In recent years, backward walking has become an attractive alternative for training and rehabilitation purposes to improve mobility.[15]

Holistic approach to osteoarthritis management

People with osteoarthritis may experience several challenges like the individual's ability to contribute to society, to enjoy a reasonable quality of life it is because of their symptoms. The holistic approach to care consists of the global needs of an individual, considering their social and psychological factors that influence their quality of life and the ability to carry out activities of daily living, employment related activities, family commitments and hobbies [16].

A holistic assessment of the individual's medical, social and psychological needs can enable a tailored approach to the treatment options, encouraging positive health seeking behaviors that are relevant to the individual's goals. A therapeutic relationship based on the shared decision making endorse the individual ability to self-manage their conditions and reduce the reliance on pharmacological therapies providing a greater sense of empowerment for the individual [16].

- Through effective communication skills the practitioner fully understands the context of osteoarthritis in the patient's life and assess the patients experience and perceptions with an accurate assessment, explanation and prognosis.
- Body function and structure (Symptoms)- Studies found that pain, function and negative feelings are the important factors affecting the patients

with OA. Patients found their pain was distressing and OA becomes a limitation and had a major impact on their daily living. The areas that caused major problems for patients were pain, stiffness, fatigue, disability, depression, anxiety and sleep disturbance.

- Activities and participation- Studies found that poor performance of tasks was associated with female gender, BMI, pain and pessimism. Patients often felt embarrassed at not being able to do things that their peers could do and one of the things they felt most distressing was not being able to do activities that they used to do. The common activities affected by osteoarthritis were leisure activities, social activities, close relationships, community mobility, employment and heavy housework.
- Psychosocial and personal factors of feeling old, depression, anxiety and life satisfaction - People felt that there were negative stereotypes of older age and that they were a burden on society and wanted to distance themselves from such stereotypes. Patients often minimized or normalized their condition (which was more commonly done among older patients who attributed it to age) and disability should be expected and accepted in old age. Many ignored their disease and tried to carry on as normal despite experiencing exacerbated symptoms and worsening the condition.
- Knowledge of arthritis and its management- Studies found that most patients expected to have OA permanently and they assume that there will be no cure for OA or there are no effective methods for treating OA and they were reluctant to seek treatment for their OA. Beliefs about the cause and control of OA and the helpfulness of treatment showed no relationship to general health perceptions. Most of the patients assume that OA was a 'normal' and 'integral' part of their life history, was an inevitable result of hardship or hard work (common view amongst women and across different occupational groups).
- Expectations desired from treatment- Studies found that most patients felt it was 'very' or 'extremely' important to try to prevent their OA from getting worse. Areas where patients mostly wanted improvements in pain management, mobility/functional ability and maintaining an independent life in the community. Pain was a major concern for most patients; however, their main goals were to maximize and increase their daily activity as a strategy to manage their pain, rather than identifying 'pain control' itself as a major or single issue.
- Use of self-management methods- Observational and qualitative studies found that patients with more education were more likely to use active pain coping methods. The more serious and symptomatic the participants perceived their condition to be, the less positive they felt about the management methods they used to control it. Use of self-management methods was associated with symptoms and seriousness but not with age or gender. Several patients felt embarrassed about their disabilities and felt stigma in using walking aids or wheelchairs – some disguised their needs for using walking aids. Patients wanted more information about the condition, self-help and available treatment options.[16]

Need of the study

This study is going to be conducted in post-menopausal women who are more prone to OA knee, as performing exercises in acute stage thus aiming to prevent the futuristic chances of getting into chronic stage of OA knee.

In Retro-walking there is less range of hip motion, shorter step length, slower speeds, higher energy requirements and less fluid motions.[17] There is a scarcity of literature concerning retro-walking on

improving pain, quadriceps strength, functional mobility.

According to a study Neptune and Kautz (2000), backward walking allows increased hamstrings activation which generates reduced patellofemoral and lower tibiofemoral compression load stress and ACL strain, therefore backward walking reverse the shear forces in the knee joint.[1]

METHODOLOGY

Study design

- Pre-test and post-test Experimental study.

Sampling technique

Convenient Sampling.

Sample size

- 18 subjects.
- 9 in each group (Group A and Group B).

Study duration

- Total study duration - 6 months.
- Interventional period - 3 weeks.

Study settings

- Tabitha Old Age Home, Irumpanam.
- Retreat Community center, Thiruvamkulam.

Inclusion criteria

- Postmenopausal females with age between 45-75years.
- Clinical diagnosis of acute OA by a medical practitioner.
- Complaint of pain in step down activities.
- Subjects who can walk 10 steps backwards without any discomfort.

Exclusion criteria

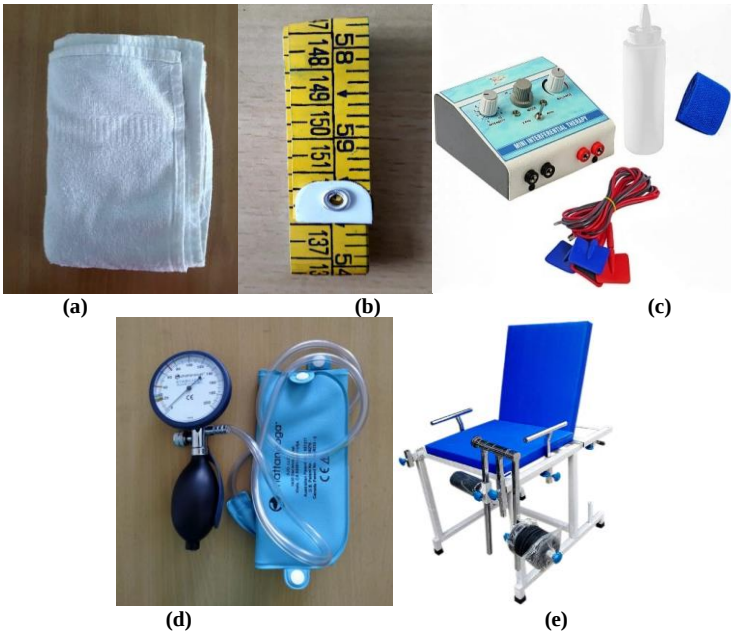
- Recent surgeries of knee joint (3months).
- Elderly subjects with balance deficits.
- Soft tissue injuries around the knee.
- Subjects with cardiac and sensory problems.
- Non-cooperative patients.

Outcomes Measures

- Western Ontario and McMaster Universities Arthritis Index (WOMAC)
- Modified sphygmomanometer
- Timed up and go test

Materials required

- Modified Sphygmomanometer (Chattanooga Stabilizer Pressure Biofeedback device)
- Chair (Back supported chair with hand rest)
- Stopwatch
- Measuring tape
- IFT Machine
- Towels
- Inch tape
- Quadriceps Table



(a) (b) (c) (d) (e)

Materials required (a) Towel (b) Inch tape (c) IFT machine (d) MST (e) Quadriceps table

Procedure

The total study duration was 6 months and the study period was 3 weeks.

18 Postmenopausal females with acute OA (diagnosed by a medical practitioner) between 45-75 years of age were taken from Tabitha Old Age Home and Retreat community center, they are selected through convenient sampling method according to the inclusion and exclusion criteria.

The subjects were divided into two group:

Pre-test will be done before the treatment

- **Group A: Experimental group**

Retro walking: The participants initially were made to walk 5 steps forward and 4 steps retro walk and were observed for any discomfort. If no discomfort then, participant was made to retro walk for 10 minutes per session. The participants will be first familiarized with the retro walking on flat surface such that during retro walking, the toes strike the ground first instead of the heel. Practice session was made for retro walking with support of wall. The participants received retro walking on flat surface at their maximum pace with support of the wall for 10 minutes per session. The session included 4 minutes of retro walking following 2 minutes of rest time and then again 4 minutes of retro walking. The therapist was walking besides the participant. The protocol followed was retro walking for 10 minutes, 3 days/ week for duration of 3 weeks. The conventional treatment consists of IFT, Static quads, Terminal knee extension as given in group B (conventional group).

- **Group B: Conventional group**

Warm up of 5 minutes (walking) and then followed by these exercises on both legs:

1. STATIC QUADRICEPS- 10 sets each and 3-6seconds hold

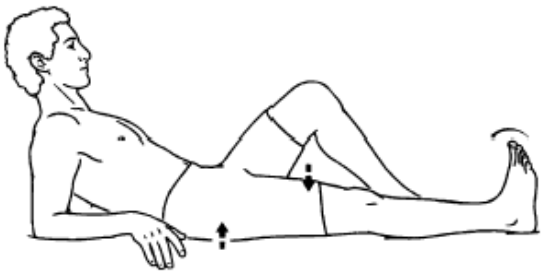


Fig. 1: Static Quadriceps.

In lying position with the opposite leg bend, tighten the muscle at the front of the thigh (quadriceps) by pushing the knee down on the bed.[6,10,25]

2. TERMINAL KNEE EXTENSION- 10 sets each and 3-6seconds hold

Fig. 2: Terminal Knee Extension

On lying on the back with a rolled towel or foam roll under the knee and the knee relaxed. Slowly straighten the knee as far as possible tightening the front of the thigh (quadriceps).[6,10,25]

Cool down for 5 minutes are given.

3. INTERFERENTIAL THERAPY (IFT)

- Before starting the treatment therapist explain the subjects about the modality. The area to be examined and was exposed, cleaned.
- Position- supine/sitting position.
- Electrodes Placement- Four interferential pad electrodes will be placed around the affected knee joint, 3 days for 3 weeks. The patient was explained that, she will feel a tingling sensation which could not be unpleasant.
- Parameters: Frequency 100 Hz, Time 10 min.

IFT output intensity was increased until the "normal" tingling was encountered by the patient.

- Post-test will be done after the treatment.

Post- interventional procedure

The outcomes were measured again. WOMAC for measuring pain, stiffness, physical function in 24 item condition - specific questionnaire, MST measuring muscle strength of Quadriceps and TUGT measuring functional mobility. These measures were noted as post-test values after the intervention is given.

WOMAC

The Western Ontario and McMaster Universities Arthritis Index (WOMAC) is widely used in the evaluation of Hip and Knee Osteoarthritis. It is a self-administered questionnaire consisting of 24 items divided into 3 sub scales:

- Pain (5 items): during walking, using stairs, in bed, sitting or lying, and standing upright.
- Stiffness (2 items): after first waking and later in the day.
- Physical Function (17 items): using stairs, rising from sitting, standing, bending, walking, getting in / out of a car, shopping, putting on / taking off socks, rising from bed, lying in bed, getting in / out of bath, sitting, getting on / off toilet, heavy domestic duties, light domestic duties.

WOMAC Index was developed in 1982 at Western Ontario and McMaster Universities. WOMAC is available in over 65 languages and has been linguistically validated.[26]

- **Modified sphygmomanometer**

To assess the muscular strength.

Modified Sphygmomanometer – The device (Chattanooga Stabilizer Pressure Biofeedback Product) Dimensions 7.75 x 4 x 4.25, Inches 1.15 Pounds, Item model number CH153PA01. The Chattanooga Stabilizer Pressure Biofeedback device used to assess muscle strength. The inflatable bag was folded in three equal parts and fixed inside an inelastic bag. The MST for the knee extensor muscle strength is evaluated with the application of the Make Test for angles of 90 degrees. Make Test is a mechanical test where the MS is placed between the test leg and a stationary device with appraised performing maximal isometric strength. Quads table is used as a stationary device and it is stabilized with a support of the wall.[27,28]

(A) **(B)**

Fig. 3: The Modified Sphygmomanometer Test for Knee Extensors (Quadriceps) in 90 0 knee position.

- **Timed up and go test**

To assess a person's mobility that requires both static and dynamic balance.

Instructions

- Equipment: armchair, tape measure, tape, stopwatch.

- Begin the test with the subject sitting correctly (hips out of the way to the back of the seat) in a chair with arm rests. The chair should be stable and positioned such that it will not move when the subject moves from sit to stand. The subject can use the arm rests during the sit – stand and stand – sit movements.
- Place a piece of tape or other marker on the floor 3 meters away from the chair so that it is easily seen by the subject.
- Instructions: On the word "GO" you will stand up, walk to the line on the floor, turn around and walk back to the chair and sit down. Walk at your regular pace.
- Start timing on the word "GO" and stop timing when the subject is seated again correctly in the chair with their back resting on the back of the chair.
- The subject wears their regular footwear, may use any gait aid that they normally use during ambulation, but may not be assisted by another person. There is no time limit. They may stop and rest (but not sit down) if they need to.
- The subject should be given a practice trial that is not timed before testing.
- Results correlate with gait speed, balance, functional level, the ability to go out, and can follow change over time.[29,30]

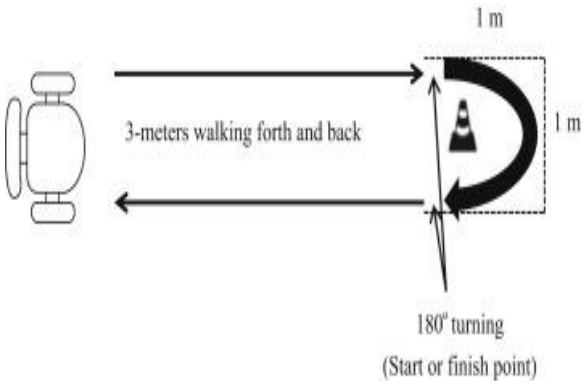


Fig. 4: Demonstration of Timed Up to Go Test

(A) **(B)**

Fig. 5: Timed Up to Go Test

Statistical analysis and interpretation

The statistical analysis of the results was performed by using the SPSS software (SPSS.20). Students t-test was used for the calculation of the results. Paired t-test was used for the intra group comparison of pre and post test results. Independent t-test was used for the inter group comparison. Significance level kept p <0.05. Equations were used in:

Samples – $n \geq \frac{2\sigma^2(z_\beta + z_{\alpha/2})^2}{difference^2}$

- n- Sample size in each group (assumes equal sized groups)
- σ- Standard deviation of the outcome variable

- Zα- Represents the desired level of statistical significance (typically 1.96)
- Zβ-Represents the desired power (typically 0.84 for 80% power)
- differences- Effect size (the difference in mean)

Independent variables: Retro-walking, Conventional exercises.
Dependent variables: Pain, Strength and functional mobility.

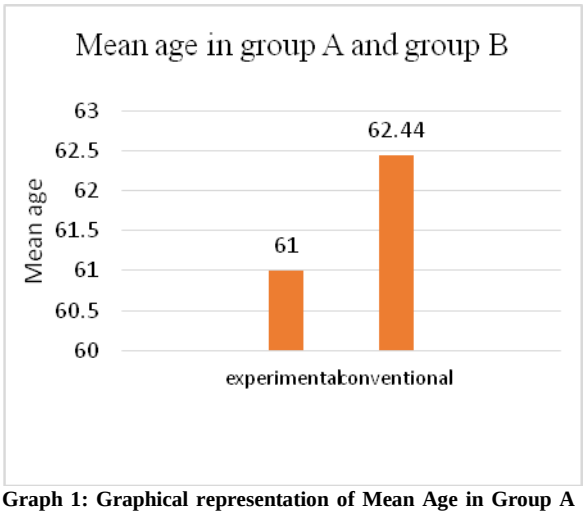
DEMOGRAPHIC INFORMATION

AGE

Table:1 Mean Age in Group A and Group B

	Mean Age	Standard Deviation	Minimum	Maximum
Experimental group	61	6.42	53	69
Conventional group	62.44	7.89	52	70

The age group taken for the study was between 45-75 years and the mean age for the Experimental group was 61 with a standard deviation of 6.42 and the mean age for the Conventional group was 62.44 with a standard deviation of 7.89.



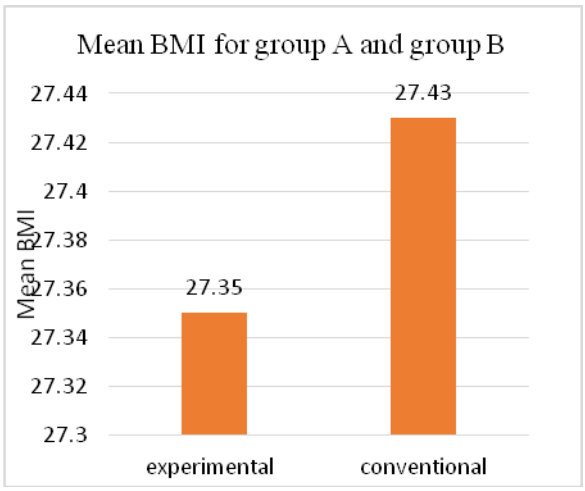
Graph 1: Graphical representation of Mean Age in Group A and B

BODY MASS INDEX

Table 2: Mean BMI in Group A and Group B

	Mean BMI	Standard Deviation	Minimum	Maximum
Experimental group	27.35	1.63	25.03	29.53
Conventional group	25.31	1.54	25.31	29.47

The BMI taken for the study was between 23 to 29.9 and the mean BMI for the Experimental group was 27.35 with a standard deviation of 1.63 and the mean BMI for the Conventional group was 25.31 with a standard deviation of 1.54.



Graph 2: Graphical representation of Mean BMI for Group A and B

Homogeneity: There is no significant differences between Experimental group and Conventional Groups for Demographic Information's, indicating the groups were well matched.

COMPARISON WITHIN GROUP (paired test)

COMPARISON OF PRE-TEST AND POST TEST VALUES OF WOMAC IN GROUP A (EXPIREMENTAL GROUP)

Table 3: Shows paired t test for WOMAC in Group A

Test	Mean	SD	Mean Improvement	n	T	df	p-value
Pre test	57.66	9.88					
Post test	40.88	7.04	16.77	9	7.44	8	<0.001

The mean column displays the mean pre-test and post-test WOMAC scores among women in the Experimental group. SD is the standard deviations of the WOMAC scores in pre & post respectively. Mean change 16.77 is the difference between pre-test and post-test mean WOMAC scores (57.66 and 4.88). Since the t-value 7.44 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test WOMAC score among women in the experimental group. This proves that there is a significant reduction of pain in Experimental Group in post-menopausal women with OA Knee.

COMPARISON OF PRE-TEST AND POST TEST VALUES OF WOMAC IN GROUP B (CONVENTIONAL GROUP)

Table 4: Shows paired t test for WOMAC in Group B

Test	Mean	SD	Mean Improvement	n	t	df	p-value
Pre test	57.88	7.45					
Post test	50.88	8.57	7	9	7.79	8	<0.001

The mean column displays the mean pre-test and post-test WOMAC scores among women in the conventional group. SD is the standard deviations of the WOMAC scores in pre & post respectively. Mean change 7 is the difference between pre-test and post-test mean WOMAC scores (57.88 and 50.88). Since the t-value, 7.79 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test WOMAC score among women in the conventional group.

There is significant change in pain among the women in experimental group as well as in the conventional group.

Now we have to find whether there is homogeneity among pain in the pre-test between experimental and conventional groups and hence compare the post-test pain scores.

COMPARISON OF PRE-TEST AND POST TEST VALUES OF TUG IN GROUP A (EXPIREMENTAL GROUP)

Table 5: Shows paired t test for TUG in Group A

Test	Mean	SD	Mean Improvement	n	t	df	p-value
Pre test	19.55	3.28					
Post test	16.11	2.14	3.44	9	6.84	8	<0.001

The mean column displays the mean pre-test and post-test TUG score among women in the Experimental group. SD is the standard deviations of the TUG scores in pre & post respectively. Mean change 3.44 is the difference between pre-test and post-test mean TUG scores (19.55 and 16.11). Since the t-value 6.84 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test TUG score among women in the experimental group. This proves that there is a significant improvement in functional mobility of Experimental Group in post-menopausal women with OA Knee.

COMPARISON OF PRE-TEST AND POST TEST VALUES OF TUG IN GROUP B (CONVENTIONAL GROUP)

Table 6: Shows paired t test for TUG in Group B

Test	Mean	SD	Mean Improvement	n	t	df	p-value
Pre test	20.88	4.13					
Post test	19.77	4.52	1.11	9	5.54	8	<0.01

The mean column displays the mean pre-test and post-test TUG scores among women in the conventional group. SD is the standard deviations of the TUG scores in pre & post respectively. Mean change 1.11 is the difference between pre-test and post-test mean TUG scores (20.88 and 19.77). Since the t-value, 5.54 shows $p < 0.01$, there is a significant difference existing between the pre-test and post-test TUG scores among women in the control group. So, we have seen that there is significant change in functional mobility among the women in experimental group as well as in the conventional group.

Now we have to find whether there is homogeneity among TUG score in the pre-test between experimental and conventional groups and hence compare the post-test TUG scores.

COMPARISON OF PRE-TEST AND POST TEST VALUES OF MODIFIED SPHYGMOMANOMETER IN GROUP A (EXPIREMENTAL GROUP)

Table 7: Shows paired t test for Modified sphygmomanometer in Group A

Test	Mean	SD	Mean Improvement	n	t	df	p-value
Pre test	73.77	5.51					
Post test	81.88	5.73	8.11	9	7.95	8	<0.001

The mean column displays the mean pre-test and post-test Modified sphygmomanometer score among women in the Experimental group. SD is the standard deviations of the scores in pre & post respectively. Mean change 8.11 is the difference between pre-test and post-test mean Modified sphygmomanometer scores (73.77 and 81.88). Since the t-value 7.95 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test Modified sphygmomanometer among women in the experimental group. This proves that there is a significant improvement in muscle strength of Experimental Group in post-menopausal women with OA Knee.

COMPARISON OF PRE-TEST AND POST TEST VALUES OF MODIFIED SPHYGMOMANOMETER IN GROUP B (CONVENTIONAL GROUP)

Table 8: Shows paired t test for Modified sphygmomanometer in Group B

Test	Mean	SD	Mean Improvement	n	t	df	p-value
Pre test	71.33	6.5					
Post test	74.66	6.46	3.33	9	3.16	8	<0.05

The mean column displays the mean pre-test and post-test Modified sphygmomanometer scores among women in the conventional group. SD is the standard deviations of the Modified sphygmomanometer scores in pre & post respectively. Mean change 3.33 is the difference between pre-test and post-test mean Modified sphygmomanometer scores (71.33 and 74.66). Since the t-value, 3.16 shows $p < 0.05$, there is a significant difference existing between the pre-test and post-test Modified sphygmomanometer score among women in the conventional group.

There is significant change in muscle strength among the women in experimental group as well as in the conventional group. There is homogeneity among muscle strength in the pre-test between experimental and conventional groups and hence compare the post-test muscle strength scores.

Comparison between groups (independent t test)

Comparison of pre-test WOMAC scores between group A and group B (experimental and conventional group)

The Mean column in the t test table displays the mean pre-test WOMAC scores in experimental and conventional group respectively. The standard deviation column displays the standard deviation of the scores

in two groups. The difference (0.22) shows the difference between mean in two groups (57.66 and 57.88). Since the t-value 0.05, shows p-value 0.95, there is no significant difference in pre-test WOMAC scores between the experimental and the conventional groups. The groups as homogenous in the baseline level.

Table 9: Shows independent t test for pre-test WOMAC score between Group A and Group B

Group	Pre-test Mean	SD	Difference in mean	n	t	df	p-value
Experimental	57.66	9.88					
Conventional	57.88	7.45	0.22	18	0.05	16	0.95

COMPARISON OF POST-TEST WOMAC SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONVENTIONAL GROUP)

Table 10: Shows independent t test for post-test WOMAC score between Group A and Group B

Group	Post test Mean	SD	Difference in mean	n	t	df	p-value
Experimental	40.88	7.04					
Conventional	50.88	8.57	10	18	2.7	16	<0.05

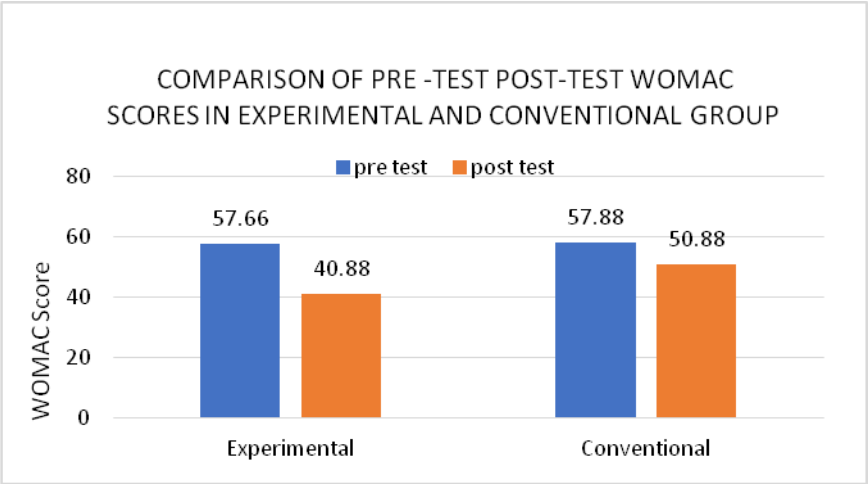
The Mean column in the t test table displays the mean post-test WOMAC scores in experimental and conventional group respectively. The SD column displays the standard deviation of the scores in two groups. The difference (10) shows the difference between mean in two groups (40.88 and 50.88). Since the t-value, 2.7 shows p-value < 0.05, there is a significant difference in post-test WOMAC scores between the experimental and the conventional groups. The scores in the experimental group are significantly higher than that in the conventional group.

Hence retro-walking is effective in reducing pain in post-menopausal women with OA knee.

Comparison Of Pre -Test Post-Test WOMAC Scores In Experimental And Conventional Group

Table 11: Shows comparison of WOMAC in Group A and Group B

Group	Pre-test Mean	SD	Post-test Mean	SD
Experimental	57.66	9.88	40.88	7.04
Conventional	57.88	7.45	50.88	8.57



Graph 3: Graphical representation of comparison of WOMAC in Group A and Group B

Comparison Of Pre-Test Tug Scores Between Group A And Group B (Experimental And Conventional Group)

The Mean column in the t test table displays the mean pre-test TUG scores in experimental and conventional group respectively. The SD column displays the standard deviation of the scores in two groups. The difference (1.33) shows the difference between mean in two groups (19.55 and 20.88). Since the t-value, 0.75 shows p-value 0.45, there is no significant

difference in post-test WOMAC scores between the experimental and the conventional groups.

Table 12 : Shows independent t test for pre-test TUG score between Group A and Group B

Group	Pre-test Mean	SD	Difference in mean	n	t	df	p-value
Experimental	19.55	3.28					
Control	20.88	4.13	1.33	18	0.75	16	0.45

COMPARISON OF POST-TEST TUG SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONVENTIONAL GROUP)

Table 13: Shows independent t test for post-test TUG score between Group A and Group B

Group	Post-test Mean	SD	Difference in mean	n	t	df	p-value
Experimental	16.11	2.14					
Conventional	19.77	4.52	3.66	18	2.19	16	<0.05

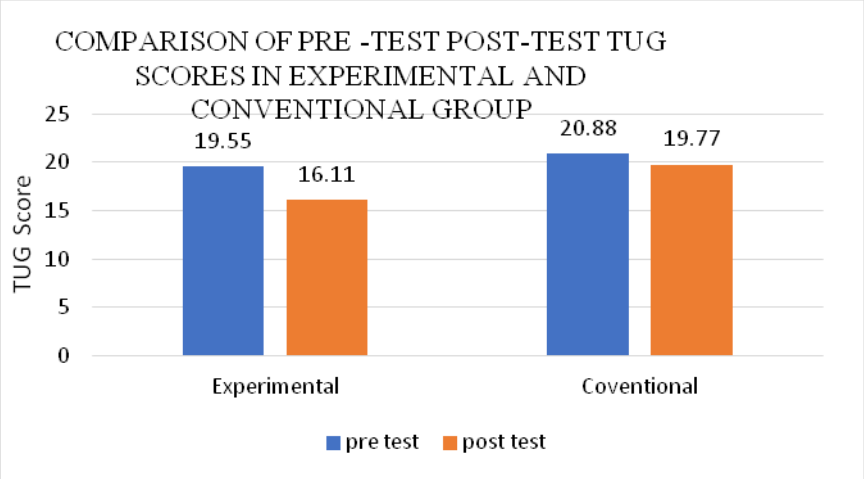
The Mean column in the t test table displays the mean post-test TUG scores in experimental and conventional group respectively. The SD column displays the standard deviation of the scores in two groups. The difference (3.66) shows the difference between mean in two groups (16.11 and 19.77). Since the t-value, 2.19 shows p-value < 0.05, there is a significant difference in post-test WOMAC scores between the experimental and the conventional groups. The scores in the experimental group were significantly higher than that in the conventional group.

Hence retro-walking is effective in improving functional mobility in post-menopausal women with OA knee.

Comparison Of Pre -Test Post-Test TUG Scores In Experimental And Conventional Group

Table 14: Shows comparison of TUG in Group A and Group B

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	19.55	3.28	16.11	2.14
Conventional	20.88	4.13	19.77	4.52



Graph 4: Graphical representation of comparison of TUG in Group A and Group B

COMPARISON OF PRE-TEST MODIFIED SPHYGMOMANOMETER SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONVENTIONAL GROUP)

Table 15: Shows independent t test for pre-test Modified sphygmomanometer score between Group A and Group B

Group	Pre-test Mean	SD	Difference in mean	n	t	df	p-value
Experimental	73.77	5.51					
Conventional	71.33	6.5	2.44	18	0.86	16	0.40

The Mean column in the t test table displays the mean pre-test modified sphygmomanometer scores in experimental and conventional group respectively. The SD column displays the standard deviation of the scores in two groups. The difference

(2.44) shows the difference between mean in two groups (73.77 and 71.33). Since the t-value, 0.86 shows p-value 0.40, there is no significant difference in modified sphygmomanometer scores between the experimental and the conventional groups. This shows both groups are homogenous in the baseline level.

COMPARISON OF POST-TEST MODIFIED SPHYGMOMANOMETER SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONVENTIONAL GROUP)

Table 16: Shows independent t test for post-test Modified sphygmomanometer score between Group A and Group B

Group	Post test Mean	SD	Difference in mean	n	t	df	p-value
Experimental	81.88	5.73					
Conventional	74.66	6.46	7.22	18	2.50	16	<0.05

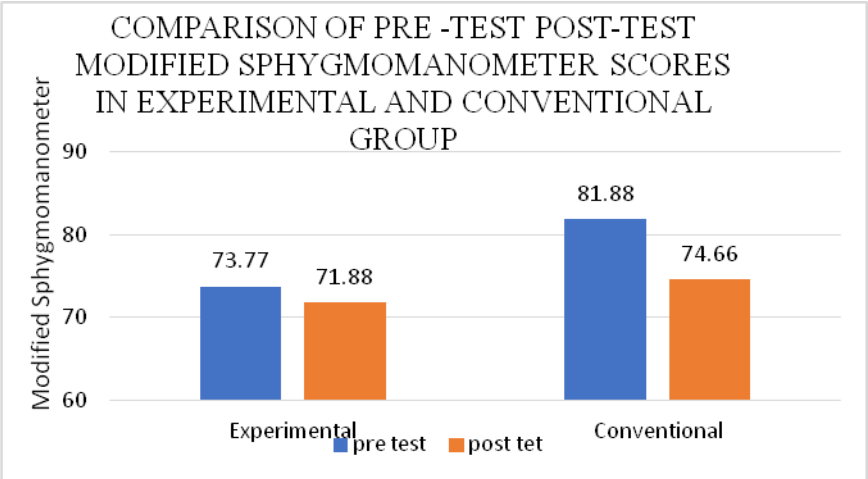
The Mean column in the t test table displays the mean post-test modified sphygmomanometer scores in experimental and conventional group respectively. The SD column displays the standard deviation of the scores in two groups. The difference (7.22) shows the difference between mean in two groups (81.88 and 74.66). Since the t-value, 2.50 shows p-value < 0.05, there is a significant difference in post-test WOMAC scores between the experimental and the conventional groups. The scores in the experimental group were significantly higher than that in the conventional group.

Hence is retro-walking is effective in improving muscle strength in post-menopausal women with OA knee.

Comparison Of Pre-Test Post-Test Modified Sphygmomanometer Scores In Experimental And Control Group

Table 17: Shows comparison of modified sphygmomanometer in Group A and Group B

Group	Pre-test Mean	SD	Post-test Mean	SD
Experimental	73.77	5.51	81.88	5.73
Control	71.33	6.5	74.66	6.46



Graph 5: Graphical representation of comparison of Modified sphygmomanometer in Group A and Group B

DISCUSSION

Osteoarthritis (OA) is the result of mechanical and biological events that destabilize the normal process of degradation and synthesis of articular cartilage chondrocytes, extracellular matrix, and subchondral bone. It involves the entire joint, including the articular cartilage, subchondral bone, pericapsular muscles, capsule, and synovium. The condition leads to loss of cartilage, sclerosis and eburnation of the subchondral bone, osteophytes, and subchondral cysts. It is clinically characterized by joint pain, stiffness, and functional limitation. Risk factors include genetics, female sex hormones, past trauma, advancing age, and obesity. The diagnosis is based on a history of joint pain worsened by

movement, which can lead to disability in activities of daily living.1

18 subjects were selected based on the inclusion and exclusion criteria. They were equally divided into two groups, Group A and Group B. Group A received retro walking and strengthening exercises along with IFT. Group B received only strengthening exercises and IFT. Pre and post-test measurements were done before and after the interventions. The outcome measures used are WOMAC, TUG, modified sphygmomanometer. The results were analyzed using t-test. Paired t-test was used to compare the results within the group and independent t-test to compare results between the groups. Significance level kept as p value < 0.05.

In the case of WOMAC, it was found that in paired t test, since the t-value, 7.44 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test WOMAC scores in the experimental group. The t-value, 7.79 shows $p < 0.01$, there is a significant difference existing between the pre-test and post-test WOMAC scores in the control group also. The results showed improvement in both groups. In the independent t test, since the t-value 2.7, shows p-value < 0.05, there is a significant difference in post-test WOMAC scores between the experimental and the control groups. The mean difference, 10 shows the difference between mean in two groups 40.88 & 50.88 respectively. The scores in the experimental group were significantly higher than that of the control group.

Pain relief after conventional treatment could be attributed to the thermal effects associated with deep heating modality, strengthening exercises for knee helps to steady the knee and give additional joint protection from shock and stress. In addition to this, Retro-walking may have effect on pain relief by reducing excess adductor moment at knee joint decreasing the compressive forces on medial compartment of knee joint.[23]

In the case of TUG, it was found that in paired t test, since the t-value, 6.84 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test TUG scores in the experimental group. The t-value, 5.54 shows $p < 0.01$, there is a significant difference existing between the pre-test and post-test TUG scores in the control group also. The results showed improvement in both groups. In the independent t test, since the t-value 2.19, shows p-value < 0.05, there is a significant difference in post-test TUG scores between the experimental and the control groups. The mean difference, 3.66 shows the difference between mean in two groups 16.55 & 19.77 respectively. The scores in the experimental group were significantly higher than that of the control group.

Improvement in function may be attributed to the reduction of pain, reduction in abnormal joint kinetics and kinematics during functional movements and improved muscle activation pattern. Individual studies have reported knee extensor muscle weakness to be a risk factor for knee osteoarthritis, particularly in women. In a recent review of the literature investigating quadriceps muscle weakness and the risk of developing knee osteoarthritis, it was concluded that greater quadriceps muscle strength seemed to be related to lower risk of incident symptomatic, but not radiographic knee osteoarthritis.[7]

The knee extensors work as shock absorbers and stabilizers, and hence protect the joint surfaces during loading and movement. Excessive mechanical stress on articular cartilage due to muscle weakness has been suggested to induce a degenerative process. Such muscle weakness, characterized by a reduction in muscle force or motor unit activation, could lead to changes in gait and decreased performance in everyday functional activities.[9]

Muscle weakness is associated with changes in gait and decreased performance in everyday functional activities.[2] The presence of Knee pain and quadriceps muscle weakness is associated with Knee

OA, which could explain the lower TUGT score in subjects with knee OA as compared to healthy older adults.[25]

Retro-walking includes the improvement in muscle activation pattern, reduction in adductor moment at knee during stance phase of gait and augmented stretch of hamstring muscle groups during the stride; all of these may have helped in reducing disability thus leading to improved function. There is a possibility that proprioceptive and balance training may have occurred during Retro-walking adding to its benefits. [25]

In case of the modified sphygmomanometer, it was found that in paired t test, since the t-value, 7.95 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test modified sphygmomanometer scores in the experimental group. The t-value, 3.16 shows $p < 0.05$, there is a significant difference existing between the pre-test and post-test modified sphygmomanometer scores in the control group also. The results showed improvement in both groups. In the independent t test, since the t-value 2.50, shows p-value < 0.05, there is a significant difference in post-test scores between the experimental and the control groups. The mean difference,7.22 shows the difference between mean in two groups 81.88 & 74.66 respectively. The scores in the experimental group were significantly higher than that of the control group.

Retro-walking also has effect on improving strength of hip extensors leading to reduced hip flexion moment during stance phase and thus preventing abnormal loading at knee joint and, in turn, the disability. As a result of exercises and Retro-walking there was improvement in the strength of muscles at knee and hip which may have reduced functional disability.[25]

Retro-walking allows increased hamstrings activation which generates reduced patellofemoral and lower tibiofemoral compression load stress and ACL strain, therefore backward walking reverse the shear forces in the knee joint.[18]

STRENGTH OF THE STUDY

- Number of participants were equal in both groups.
- Participants independently committed to the exercise sessions and were regularly present.
- The intervention was a cost-effective programme.

LIMITATIONS OF THE STUDY

- As the measurements were taken manually, this may introduce human error, which could threat the reliability of the study.
- Only short- term effects being evaluated.

FUTURE RESEARCH

- The sample size of the study can be increased and hence it may lead to better results.
- Future investigations can be conducted in different population and age group.
- Another outcome measuring tools can be used.
- The treatment duration of the study can be increased.
- Modified with more subjects, using BMI as a parameter.
- Retro-walking as an adjuvant in OA knee conditions.
- A follow-up study could ensure the long-term effect of the treatment programme.

CONCLUSION

This study results shows that retro-walking is effective in pain reduction, improving quadriceps muscle strength and functional mobility when compared to the conventional group. There was a significant reduction in pain and improvement in quadriceps strength and functional mobility in three-week training. Therefore, I concluded that retro-walking is effective in post-menopausal women with OA knee and I suggest retro-walking could be added

along with conventional therapy to prevent further damages.

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Ethical Clearance: Approved by the institutional Ethics committee of Medical Trust Hospital, Cochin held on 22.07.2020 with Ref No: MTH/MPT/EC/23/20.

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Conflict of Interest: None

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