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Original Research Article

Effect of Retrowalking on Pain, Functional Disability and Functional Mobility in Patients with Chronic Knee Osteoarthritis

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ABSTRACT

Osteoarthritis is a degenerative joint disease involving the cartilage and surrounding tissues. The aim of this study was to investigate the effectiveness of retro walking in comparison with the Conventional closed chain exercise programme in chronic knee osteoarthritis patients.

Study Design: Forty subjects participated in this study who had chronic Osteoarthritis of knee. Subjects were randomly assigned to two groups: Experimental and Control group. Experimental group followed Retrowalking and the Control group followed Conventional Closed kinematic chain exercises. Two primary outcome measures used were pain with functional disability and functional mobility which were measured using Western Ontario and McMaster Universities Arthritis Index and Timed up and go test respectively. The secondary measures included pain intensity, Strength of hip abductors, extensors, knee extensors muscles and knee flexion range of motion which were measured using Numerical Pain Rating Scale, manual muscle testing and universal goniometer respectively.

Results: After comparing values using independent t-test, functional disability and mobility showed highly significant difference in experimental group than control group. Changes in pain intensity were equal for both the groups. Strength of hip muscles and knee Range of motion improved significantly in the Experimental group than control group.

Conclusion: The study concluded that retrowalking was more effective than conventional closed kinematic chain exercises in reducing symptom, improving functional mobility, overcoming physical dysfunction and increasing strength of hip muscles in osteoarthritis of knee after 4 weeks of rehabilitation.

Key words: Retrowalking, Closed kinematic chain exercises, Knee Osteoarthritis.

INTRODUCTION

Osteoarthritis (OA), a chronic degenerative joint disease, is a progressive disorder of the joints involving the cartilage and the surrounding tissues. [1] OA is a non-inflammatory progressive disorder of movable joints, particularly weight bearing joints. The disease limits everyday activities, such as getting in and out of bed, dressing and climbing stairs. [2] It is a commonest cause of severe pain and functional limitation that affects individuals worldwide. It is the second most common rheumatologic problem with a prevalence of 22% to 39% in India. [3-5] Among all, there is high prevalence of knee OA (osteoarthritis) affecting 15-40% of people aged 40 and 60-70% of the population older than 60 years. [6]

The physical disability arising from knee OA prevents the performance of daily life activities and negatively affects life quality. Several factors play roles in the occurrence of physical disability. These include pain, joint movement restriction, muscle weakness, and coordination impairment. [7] Exact cause of OA is not known. However it is strongly believed that

it Knee has a multifactorial etiology characterized by wear and tear of articular cartilage, hypertrophy of bone at the margins and a host of biochemical and morphological alterations of the synovial membrane and joint capsule. Sub chondral bone in turn can then become sclerotic and stiffer than normal bone. These changes in cartilage result in increased friction, decreased shock absorption and greater impact loading of the joint. [8]

Risk factors for OA knee includes age, gender, obesity, occupation, sports, osteoporosis, previous trauma, irregularity in joint surfaces, internal derangement, heredity, leisure and diseases leaving articular cartilage damage. [9] In patients with knee OA, there is a prominent loss in proprioception compared with control subjects of the same age and gender. [10] It has been demonstrated that impaired proprioception adds to functional insufficiency by generating impairment in walking rhythm, shortening step distance, and a decrease in walking speed and total walking time. [11]

Management of OA Knee necessitates a multidisciplinary approach including both conservative and surgical. Physiotherapy is the main choice of treatment wherein the conservative part is concerned, which includes exercise therapy-supervised strengthening exercise, [3,5,6] manual therapy, [12] taping [13] and electrical modalities with or without thermal modalities as measures for pain reduction. [14] A growing body of evidence suggests the role of exercises in improvement of symptoms and joint function in knee OA.

Recently, closed kinematic chain exercises have drawn much attention in the management of knee OA. Studies suggest that these exercises are more effective and functional than the traditionally employed open kinematic chain exercises. [15] Conventional closed kinematic chain (CKC) exercise programme aims to increase the strength and stability of knee joint. These exercises help to promote muscle strength, improve range of motion, increase mobility and ease pain**.** Closed kinematic chain exercises for knee joint can be incorporated in many ways; Mini-squats, lunges, step ups, press legs, etc. Those are the conventional closed chain exercises used from many years. Retro-walking, also a part of closed chain exercises, has recently gained importance in management of OA knee.

Retro walking is walking backwards. Since there is propulsion in backward direction and reversal of leg movement in Retro walking, different muscle activation patterns from those in forward walking are required. [16] A gait cycle during retrowalking can be defined as toe-on of a limb to the subsequent toe-on of the same limb. [17] Along with a unique muscle activation 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. [18] It has been suggested that retro-walking may provide additional benefits beyond those experienced by forward walking in healthy adult males and females. [19,20] Retro-walking significantly lowers peak patellofemoral joint compressive force and a significantly slower rate of loading has been found during backward walking. Consequently, trauma to the articular cartilage is reduced during retro-walking; therefore it could be used as a mode of training after sustaining injuries to the lower limb. Retro-walking could be an effective tool to increase quadriceps strength after immobilization or surgery since the quadriceps is activated for a longer period. [17]

Though retro walking is a part of CKC, we have very less evidences regarding the functional rehabilitation of patients with degenerative diseases around the knee joint. Considering the advantageous effect of retro-walking with respect to forward walking in decreasing the compressive load on knee and improvising the muscular strength, the current study

aimed at finding out the effectiveness of retro walking in comparison with the Conventional closed chain exercise programme in chronic knee osteoarthritis patients.

MATERIALS AND METHODS

40 subjects, both male and female, in age group of 40-60 (mean age=51, SD=6.05) were recruited fulfilling the inclusion and exclusion criteria. The participants fulfilling three out of the six clinical criteria listed by The American College of Rheumatology were diagnosed as knee OA which was confirmed using radiological investigations. [21] The criteria are (1) Knee pain (2) Morning stiffness lasting <30 min, (3) Crepitus with active motion, (4) Bony tenderness, (5) Bony enlargement, and (6) No warmth to touch. Patients in the age group of 40-60, having knee pain for more than 6 weeks were included. Patients with bilateral involvement, a history of any lower extremity injury or underlying pathology, a history of any inflammatory joint disease and balance problems or using an assistive device for ambulation were excluded. Patients with cardiovascular and neurological problem (Motor and sensory loss) were also excluded.

Two primary outcome measures used in this study were pain with functional disability and functional mobility which were measured using Western Ontario and McMaster Universities Arthritis Index (WOMAC) and Timed up and go test (TUG) respectively. The secondary outcome measures included pain intensity, Strength of hip abductors, extensors, knee extensors muscles and knee flexion range of motion which were measured using Numerical Pain Rating Scale, manual muscle testing (MRC grading) and universal goniometer respectively. Western Ontario and McMaster Universities Arthritis Index (WOMAC) of OA, (CRD, Pune version) a patient reported scale, was used to assess pain, stiffness and physical function levels in the subjects. It measures 5 items for pain, 2 for stiffness, and 17 for functional limitation. Physical functioning questions cover activities of daily living. Its Psychometric properties have been established. It has good test-retest reliability in pain and physical function domain.7Timed up and go test (TUG), was used to assess functional mobility related to balance. [22] A firm chair with arms (seat height of 46 cm) will be placed at one end and an object will be placed at the other end at a distance of 3-m. The participants was instructed as follows: "On the word 'go', stand up, walk comfortably and safely to the object at the end on the floor, walk around the object, come back, and sit all the way back in your chair." Timing was started on the word "go" and ended when the participant returned to the chair, with back resting against the chair. The average of the 2 recorded trials was used for data analysis. A 10 cm Numerical Rating Scale (NRS) for rating the intensity of perceived pain was used. The patient was asked to tell his/her pain on a scale of 0-10 where 0 indicates no pain and 10 indicates maximal pain. [23] Medical Research Council grading (MRC) was used to assess concentric strength of hip abductors, extensors and knee extensors muscles. A Universal Goniometer was used to assess knee flexion ROM in prone position. [24]

Forty subjects were taken having knee osteoarthritis. All the subjects went through a physical screening performed by a physical therapist to confirm with inclusion and exclusion criteria. Written informed consent was obtained from each participant. The study was approved by institutional ethical committee. The assessments of each group were performed before and after the intervention. The interventions were based on outpatient rehabilitation programs in both groups. An experimental type of study was conducted and subjects were divided randomly in 2 groups having 20 subjects each: Experimental and Control Group. Both the groups received regular physiotherapy treatment followed by retrowalking for the experimental group and

conventional closed chain exercises for the control group. Regular Physiotherapy Treatment included: (1) Deep heating modality (Short wave diathermy) for 10 minutes for pain relief. (2) Free exercises for hip and knee (Static and dynamic quadriceps, knee bending exercises in prone lying, hip flexion exercises in supine, hip abduction in side lying and hip extension in prone lying position); 3 sets of 10 repetitions. Experimental group received retro walking along with the regular physiotherapy treatment as mentioned above; 3 sessions of walking per day (10 mins per session). Walking backward on a flat surface at their maximum pace [1 session was supervised and rest was given as home programme]. [25] Control group received conventional closed chain exercises along with regular physiotherapy treatment which included mini squats, Lunges (Forward & Lateral), Step ups (Forward& Lateral); 3 sets of 10 repetitions per day.[1 set was supervised and rest was given as home programme]**.** The above Outcome measures were assessed pre and post intervention which was for a period of 4 weeks.

Statistical Analysis: The obtained data was calculated using SPSS. The relative values for each individual subject before and after the experimental protocol was compared using paired-t test. After that, the independent t-test was used to compare the relative changes between the two treatment groups. Statistical significance was accepted for values of $p < 0.05$.

RESULTS

The data derived from both the groups at the end of 4 weeks were compared statistically using paired-t test and independent-t test. The change between the pre-and post readings of every individual for WOMAC score, TUG score, NPRS, hip abductors strength, hip extensors strength, knee extensor strength and knee flexion ROM was done using paired-t test. The comparison between the Experimental group and Control group was performed using independent-t test

Table 1: Comparison of Study Parameters Pre and Post Intervention for Experimental and Control group.

1.1 Primary outcome measures

	EXPERIMENTAL GROUP			CONTROL GROUP		
	PRE	POST	p-VALUE	PRE	POST	p-VALUE
WOMAC Score	52.22±10.15	37.10±10.15	<0.001	50.35±7.22	41.40 ±7.61	<0.001
TUG Score	19.70±4.35	12.10± 2.67	<0.001	18.50±4.71	14.95 ±4.46	<0.001

Inference: There is a statistical difference in WOMAC score and TUG score in both experimental and control group.

1.2 Secondary outcome measures

	EXPERIMENTAL GROUP			CONTROL GROUP		
	PRE	POST	p-VALUE	PRE	POST	p-VALUE
NPRS	6.35± 1.03	4.50± 0.82	<0.001	6.75 ± 1.06	4.70 ± 0.92	<0.001
Hip Abductors strength	3 ± 0.4	3.72± 0.6	<0.001	3 ± 0.2	3.17± 0.5	<0.001
Hip Extensors Strength	3.53± 0.7	4 ± 0.8	<0.001	3.07± 0.2	3.25± 0.5	<0.001
Knee Extensors Strength	3.45± 0.7	4± 0.3	<0.001	3.25± 0.5	3.50± 0.8	<0.001
Knee Flexion ROM	114.4±6.32	122.2 ±5.355	<0.001	117.4 ± 6	120.5 ±6.84	<0.001

Inference: There is a statistical difference in NPRS, hip abductors strength, hip extensors strength, knee extensor strength and knee flexion ROM in both experimental and control group.

Table 2: Comparison of Mean Improvement in Parameters between Experimental and Control group

	EXPERIMENTAL GROUP	CONTROL GROUP	P VALUE
WOMAC score	15.450 ± 5.104	8.950 ±4.817	< 0.001
TUG score	7.600 ± 3.817	3.550 ± 1.395	< 0.001
NPRS	1.850± 1.182	2.050 ± 0.999	0.567
Hip Abductors strength	0.7250± 0.571	0.1750± 0.2447	< 0.001
Hip Extensors Strength	0.4750± 0.5730	0.0750 ± 0.1832	< 0.001
Knee Extensors Strength	0.5500± 0.3591	0.2500 ± 0.3804	< 0.05
Knee Flexion ROM	7.800± 3.238	3.150 ± 4.234	< 0.001

Inference: There is a statistical significant difference in all the parameters between experimental & control group except for NPRS.

DISCUSSION

Present study examined the efficacy of Retro walking and Conventional closed chain exercises (CKC) as an adjunct to conventional treatment in reducing pain and disability in patients with chronic knee OA. Study revealed that there was significant improvement in function and pain in both the CKC and Retro walking group. Also showed that, Retro- walking is more effective in reducing disabilities as compared to conventional CKC treatment.

Individual with OA knee walked more slowly, with less knee excursion, increased adduction moment and with more joint stiffness. These secondary compensatory gait adaptations in OA knee patients helps in reducing pain by decreasing ground reaction loading on knee. This prolonged usage of secondary gait compensation creates greater imbalance of muscle, progressively reduces muscle strength, endurance, flexibility and later ending to deformity. [26] During forward walking knee joint flexes, extends and then flexes in support phase, whereas in backward walking knee initially extends, flexes and extends in support phase, prior to flexing and extending during swing. However support swing ratio of retro-walking is similar to forward walking with 60% support and 40% swing.

Muscular structure supporting ankle and knee reversed their role during retro-walking (In, retro-walking knee provides the primary power producer {co-contraction of hamstring and quadriceps} and ankle plantar flexors as shock absorber). Direction of knee joint shear force directed forward initially during retro-walking whereas backward in forward walking. Retro-walking produce significantly lower patellar compressive force than forward walking. Retrowalking helps to reduce maximal vertical force and impulsive force on knee compare to forward walking because of toe-heel contact pattern. Numerous studies revealed pain in OA knee is due to increased abnormal ground reaction force loading on joint and decreased extensor moment. [27]

However, the improvement in Experimental is greater than that of 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. Firstly, there is a toe heel contact pattern, unlike normal, which reduces the direct vertical forces and impulsive forces on knee joint [Flynn et al (1993]. There is dissipation of vertical forces throughout dorsi flexion of ankle controlled by eccentric contraction of the posterior compartment musculature (calf muscle), just prior to the heel strike in retro walking. [28] Studies have shown that compared to forward walking; backward walking creates more muscle activity in proportion to efforts. According to a study by Neptune and Kautz (2000), backward walking allows increased hamstrings activation which generates reduced patello-femoral and lower tibiofemoral compression load stress and ACL strain, and therefore BW reverses the shear forces in the knee joint. Also, a study done by Balraj AM, Kamraj B and Saji VT (2018), concluded that retrowalking is helpful in reducing disability parameters in patients with chronic Osteoarthritis of knee. [29]

As advantages of Retro walking include 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. [30] 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.

Also from the study, both group showed equal effectiveness in relieving pain. Pain relief could be attributed to the thermal effects associated with deep heating modality, strengthening exercises for hip and knee helping 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

An improvement seen in Control group is attributed to the multi-joint movement which mimics the activities of daily living. Also helps in facilitating various muscles at a time and stimulates proprioceptors of knee joint. These Co-contraction and Proprioception enhances the joint stabilization and increases the compressive forces on knee joint, helping in improving balance while weight bearing activities. [15] Also strengthens the muscles around the joint unlike open chain exercises causing shear forces leading to more and more injuries. Thus, the combination of Retrowalking and closed kinematic chain exercises can help in reducing pain and symptoms in patients with chronic Osteoarthritis of knee.

CONCLUSION

The study concludes that retrowalking is more effective than conventional closed kinematic chain exercises in reducing symptom, improving functional mobility, overcoming physical dysfunction and increasing strength of hip muscles in osteoarthritis of knee after 4 weeks of rehabilitation. Thus, our findings may broaden the options for rehabilitation program planning and can be used as a new approach for treatment. Future studies are needed to be done with more precise instruments for strength measurements rather than manual measurement and with a large sample size.

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