IOSR Journal of Sports and Physical Education (IOSR-JSPE)
e-ISSN: 2347-6737, p-ISSN: 2347-6745, Volume 3, Issue 2 (Mar. – Apr. 2016), PP 37-43
www.iosrjournals.org

Effects of Retrowalking on Osteoarthritis of Knee in Geriatric Population

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Abstract:
Background: *In rural population, cross sitting positions in farming activities are very common which leads to wear and tear of knee joint. Biomechanical studies indicated individual with OA knee walk with increased adduction moment that alters the joint biomechanics; which causes symptoms in chronic knee osteoarthritis patients. Retrowalking has recently emerged as a new concept in physiotherapy and rehabilitation.*
Subjects and Methods: *The Comparative Prospective study consists of 40 subjects with the age more than 60 years were randomly selected as per inclusion and exclusion criteria. In group A retrowalking and conventional physiotherapy treatment was given. In group B only conventional physiotherapy treatment in the form of pulsed SWD, strengthening exercise such as static and dynamic quadriceps exercise, straight leg raise, prone knee bending, side lying hip abduction, prone hip extension exercise was given. Participants received 9 sessions, 3 days/week for a period of 3 weeks. Outcome measure was NRS, WOMAC and TUG measured before and after intervention.*
Results: *The participants in group A showed highly significant improvement in NRS, WOMAC and TUG. This was associated in group B showed significant improvement in NRS, WOMAC, TUG.*
Conclusion: *Retrowalking is an effective adjunct to conventional treatment in decreasing pain and disability in patients with knee osteoarthritis.*
Keywords: *knee osteoarthritis, patho mechanics, retrowalking*.

I. Introduction

Everyone talks of arthritis but considering its implications; no one wants to suffer from it! Arthritis may lead to reduced mobility, loss of employment, breakdown of social and marital relationships, chronic pain, fatigue and depression. Arthritis foundation of India has cited an interesting Chalo Chalein (come we will move) test that most of us can understand. Four simple questions are asked to the individual and if answer to any one is yes then there is possibility individual suffering from arthritis. These questions are: Is getting up from a seated position or standing for long period of time while cooking; a painful experience?, Are climbing stairs and attending prayer meetings being avoided? And is going for family outings becoming more and more difficult? [1]
Osteoarthritis (OA) is a degenerative disease of synovial joints characterized by chondropathy (cartilage loss) and simultaneously proliferation of new bone with remodeling of joint contour. [2] The word 'osteoarthritis' originated from the Greek word "osteo" meaning "of the bone", "arthro" meaning "joint", and "itis" meaning inflammation, although the "itis" of osteoarthritis is somewhat of a misnomer – inflammation is inconspicuous feature ,it is present in rheumatoid or autoimmune types of arthritis.[3] OA is a non-inflammatory progressive disorder of movable joints, particularly weight bearing joints. American College of Rheumatology Diagnostic and Therapeutic Committee defined OA as ' A heterogeneous group of conditions that lead to joint symptoms and signs which are associated with defective integrity of articular cartilage, in addition to relative changes in the underlying bone at the joint margins'. The disease limits everyday activities, such as getting in and out of bed, dressing and climbing stairs.[4] 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 surfaces, internal derangement, heredity, leisure and diseases leaving articular cartilage damage.[1, 5]

Pathology of OA includes progressive changes in articular cartilage include softening, flattening, splitting, fibrillation, fragmentation and breaking of flake of cartilage; bony changes include eburnation, cystic cavities, micro fractures and accumulation of osteophytes at the margin of articular surfaces, synovial membrane is hypertrophy, edema, and fibrous degeneration resulting in reduction of synovial fluid secretions that reduces lubrication of articular cartilage, capsule undergoes fibrous degeneration and there is a low grade inflammatory change, ligaments may become contracted or elongated, muscles may undergo atrophy.[1, 6] Clinical features of OA are pain, stiffness, tenderness, swelling, crepitus, and loss of movement, valgus or varus deformity, locking of the knee, on auscultation of joint- scratching, crepitus and later on loud crackling sound.[1, 5, 6]

Investigations for diagnosing OA knee include knee radiographs, CT scan, MRI, arthroscopy, synovial fluid analysis.[1, 7] The Kellgren–Lawrence grade (or K-L system) is used to assess the severity of knee osteoarthritis on a plain radiograph. The grades are grade 0- No radiographic features of OA, grade 1-Possible joint space narrowing and osteophytes formation, grade 2- Definite osteophytes formation with possible joint space narrowing, grade 3- Multiple osteophytes definite joint space narrowing, sclerosis and possible bony deformity, grade 4- Large osteophytes, marked joint space narrowing, severe sclerosis and definite bony deformity.[8,9, 10] Classification criteria listed by the American College of Rheumatology (ACR) are Age >50 years, morning stiffness lasting <30 minutes, crepitus with active motion, crepitus with active motion, bony tenderness, bony enlargement, no warmth on touch.[11,12,13]

The old slogan, "Move it or lose it," goes double or perhaps triple, for people with osteoarthritis. OA knee can be treated with pharmacologic, non-pharmacologic therapies and surgical management. [14] According to American College of Rheumatology 2012 the recommendations are; pharmacologic therapy: Oral-acetaminophen, cyclooxygenase (COX-2)- specific inhibitor, Nonselective Nonsteroidal Anti-Inflammatory Drugs (NSAIDS) plus a proton pump inhibitor, nutritional supplements and other analgesics- tramadol or other Opioids; Intraarticular: glucocorticoids; Topical: capsaicin, trolamine salicylate, NSAIDS. Non pharmacologic therapy: patient education, self psychosocial interventions, weight loss, aerobic exercise or resistance land based exercise program, aquatic exercise, thermal agents, manual therapy in combination with supervised exercise, walking aids, patellar tapping, tai chi, lateral/ medial wedged insoles, rest, occupational therapy, acupuncture, assistive devices for activities of daily living. Surgical management for OA knee includes arthrodesis, arthroplasty, high tibial osteotomy, unicompartmental knee replacement, patella femoral replacement and total knee arthroplasty.[15,16,17]

Retrowalking is sometimes referred to as backward walking, has been thought to be used already for several decades in China, Japan and Europe to get a physical workout, improve sport performance, promote balance and also to stay mentally fit.[18] In fact in Europe, they have races which vary from sprints to the 26.2 miles marathon. Barry Bates and Janet Dufek at the University of Oregon started to investigate backward walking in mid 1980 s. They suggested that retrowalking provided unique training and rehabilitative benefits. Recently, closed kinematic chain exercises have drawn much attention in the management of knee OA. Closed kinematic chain exercises for knee joint can be incorporated in many ways, one of them is retrowalking.[19] A gait cycle during retrowalking can be defined as toe-on of a limb to the subsequent toe-on of the same limb. Retrowalking 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 retrowalking; therefore it could be used as a mode of training after sustaining injuries to the lower limb. Retrowalking could be an effective tool to increase quadriceps strength after immobilization or surgery since the quadriceps is activated for a longer period. Retrowalking could be utilized as a mode of training during knee rehabilitation since excessive loading of the joint and overstretching of the ligaments are prevented whilst quadriceps strength.[20]

II. Materials And Methods

The research design used for the study was Comparative Prospective study. Participants received 9 sessions, 3 days per week for a period of 3 weeks. Each treatment session lasted for 45-60 minutes. Both male and female participants with a clinical diagnosis of unilateral or bilateral Osteoarthritis of Knee referred to Community Physiotherapy Department, from the Department of Orthopaedics of Pravara Rural Hospital. The sample size was 40. Sample design was Simple Random Sampling. Selection Criteria used for this study was as follows;[21-25] The inclusion criteria for the study: Male and female geriatric participants clinically diagnosed with osteoarthritis of knee by Orthopaedician; Age more than 60 years; Participants having grade 2 and grade 3 as per Kellgren and Lawrence scale; The participants fulfilling clinical criteria listed by the American College of Rheumatology: knee pain and any three out of six: age > 50 years, morning stiffness lasting < 30 minutes, crepitus on active motion, bony tenderness, bony enlargement, no warmth on touch; Participants having knee pain for more than 6 weeks; Participants with unilateral or bilateral involvement of knee; Willingness to participate in the study. The exclusion criteria for the study were: Participants with inflammatory joint disease of lower extremity, neurological disorder (motor and sensory loss), cardiac or metabolic condition; Participants involved in any form of physical exercise for lower extremity for at least 3 months; Participants taking pharmacological interventions; Participants taking an intra- articular injection for knee since last 6 months; Participants with history of recent surgery to hip, knee, ankle joint involving ligament, meniscus; Participants with balance problem.

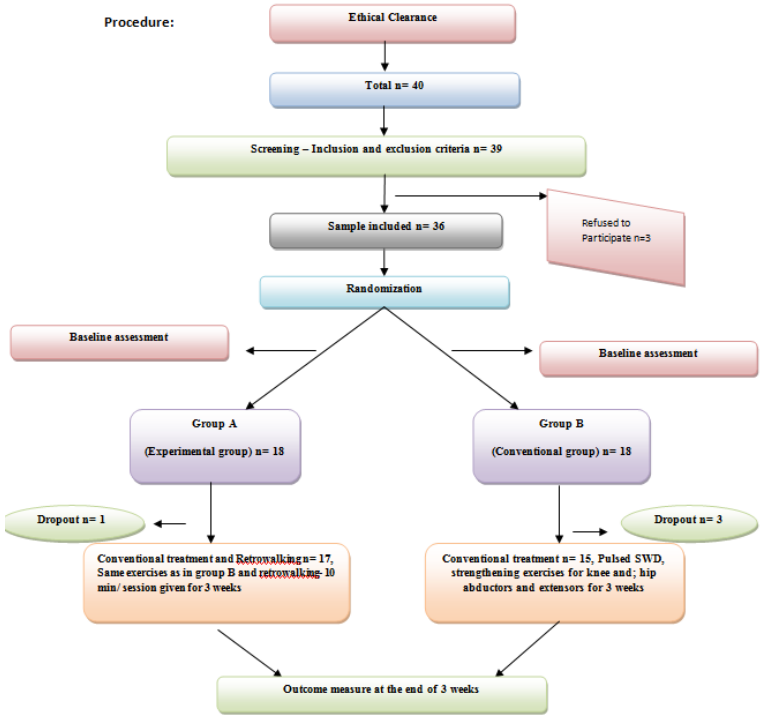


Fig 2.1 Flow chart representing the procedure of selection of participants

The study received ethical approval from the Institutional Ethical Committee (Ref. no. COPT/2015/1561/9).The participants were screened from Out Patient Department of Community Physiotherapy Department, College of Physiotherapy and after finding their suitability according to the inclusion and exclusion criteria, they were requested to participate in the study. The participants were briefed about the nature of study, the duration of intervention and the intervention being used in the language best understood by the participants. They were encouraged to clarify queries regarding the study, if any. An informed written consent form, previously approved by the Institutional Ethical Committee was then obtained from the participants. (figure 2.1) The demographic data was obtained and a detailed assessment of 32 participants was done on the basis of name, age, gender, height, height, BMI, present chief complaints, past history, pain history, medical history, criteria of ACR, K –L grades. Participants were subsequently allocated in a group according to the selection criteria.
The outcome measures NRS, WOMAC and TUG were assessed before the intervention as given below;

- Pain was assessed with the help of Numerical Rating Scale, an 11-point numeric scale with 0 representing one pain extreme (e.g. "no pain") and 10 representing the other pain extreme (e.g. "pain as bad as you can imagine" and "worst pain imaginable"). [26]
- Physical function was assessed with the help of Western Ontario and McMaster Universities Osteoarthritis Index, is a widely used, proprietary set of standardized questionnaire used by health professionals to evaluate the condition of patients with osteoarthritis of the knee and hip, including pain, stiffness, and physical functioning of the joints..[27]
- Physical mobility was assessed with the help of Timed Up and Go test, 3 meters distance and scoring was taken in seconds.[28]

The two groups were as follows: Group A (Experimental Group) and Group B (Conventional Group).
In group A retrowalking, pulsed SWD, strengthening exercise such as static quadriceps exercise, dynamic quadriceps exercise, straight leg raise, prone knee bending, side lying hip abduction, prone hip extension with 5 seconds hold and a rest interval of 2 seconds for 10 repetitions for each exercise for a period of 3 weeks, 3 days per week was given. In group B pulsed SWD, strengthening exercise such as static quadriceps exercise, dynamic quadriceps exercise, straight leg raise, prone knee bending, side lying hip abduction, prone hip extension with a rest interval of 2 seconds for 10 repetitions for each exercise for a period of 3 weeks, 3 days per week was given was given.

In Group A:
Procedure for Retrowalking:[18,21,22-25] The participants initially were made to walk 5 steps forward and 4 steps retrowalk and were observed for any discomfort. If no discomfort then, participant was made to retrowalk for 10 minutes per session. The participants will be first familiarized with the retrowalking on flat surface (distance 20

meters) such that during retrowalking, the toes strike the ground first instead of the heel. Practice session was made for retrowalking with support of wall. The participants received retrowalking on flat surface (distance 20 meters) at their maximum pace with support of the wall for 10 minutes per session. The session included 4 minutes of retrowalking following 2 minutes of rest time and then again 4 minutes of retrowalking. The therapist was walking besides the participant. The protocol followed was retrowalking for 10 minutes, 3 days/ week for duration of 3 weeks.

The conventional treatment consists of Pulsed SWD and Exercises as given in group B.

Procedure for Pulsed Short Wave Diathermy: [21,23,25,29] Patient is in supine lying, contra planer (transverse) method was used. The electrodes were placed over opposite aspects of the part i.e. knee. Timing: was applied for 20 minutes, 3 days/ week for duration of 3 weeks. After pulsed SWD, this group was given static quadriceps exercise, dynamic quadriceps exercise, straight leg raise, prone knee bending, side lying hip abduction, prone hip extension for 10 repetitions with 5 seconds hold followed by 2 seconds rest for each exercise for a period of 3 days per week for duration of 3 weeks.

In Group B: Conventional Physiotherapy treatment was same as given in group A.

III. Results

Assessment of the results: Study variables were done before starting physiotherapy sessions on both groups and at the end of the study, study variables include NRS, WOMAC and TUG.

Data analysis: Statistical analysis was performed on the data obtained from 32 patients. Data was analyzed using Graph Pad Instat Trial Version 13.3. Descriptive statistics for all outcome measures were expressed as mean, standard deviations and test of significance such as paired‘t’ test used for comparing data within each group and unpaired ‘t’ test for comparing between the groups. Data was considered statistically significant with $p<0.05$ and highly significant with $p<0.01$.

Group A composed of 17 participants with a mean age of 65.65 ± 4.26 years (7 males and 10 females). The group B composed of 15 participants with mean age of 67.59 ± 4.78 years (6 males and 9 females), there is no significant difference between the groups regarding to age with (P value; 0.1578).

The mean baseline value for pain in group A was 6.71 ± 1.61 and in group B was 7.20 ± 1.57. After intervention the mean value of pain among participants in both group A and B were 3.88 ± 2.00 and 6.00 ± 1.41 respectively. On comparing within groups, the difference in perception of pain in participants of both group A ($p= 0.0004$, $t = 4.4712$) and group B ($p = 0.0012$, $t = 4.0540$) was highly statistically significant and very statistically significant respectively. (Figure3.1)

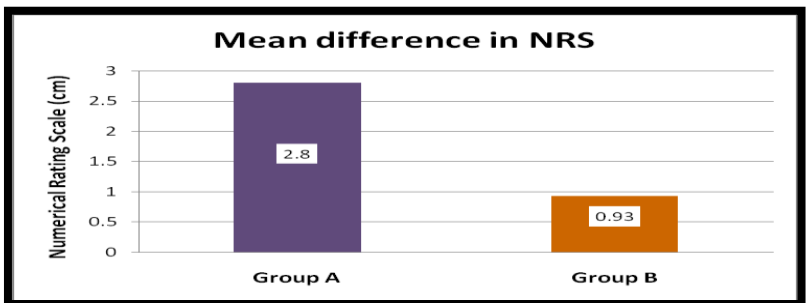


Figure 3.1: Mean difference in NRS between participants in group A and group B

The mean baseline value on WOMAC in group A was 59.24 ± 7.74% and in group B was 58.47 ± 8.41%. After intervention the mean value of WOMAC in participants both in group A and B were 40.47 ± 11.48 % and 49.00 ± 11.64 % respectively. On comparing within groups, the difference in WOMAC in participants of both group A ($p= 0.0001$, $t = 6.2844$ with $df = 16$) and group B ($p= 0.0011$, $t = 4.0815$ with $df = 14$) was highly statistically significant and very statistically significant respectively. (Figure 3.2)

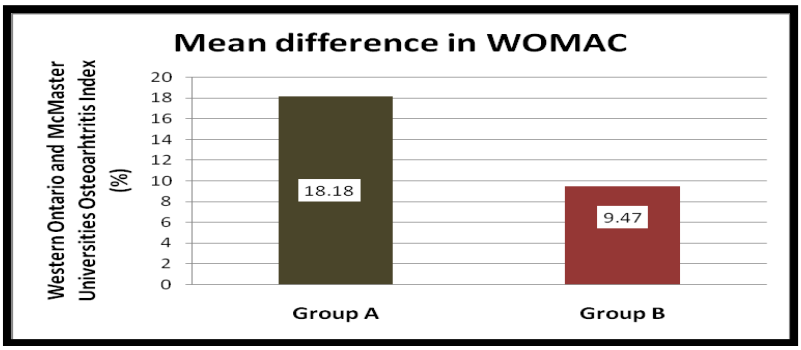


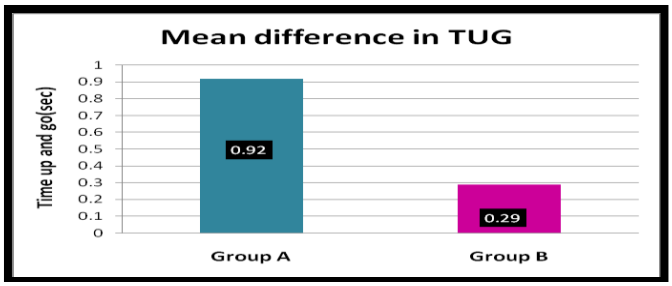
Figure 3.2: Mean difference in WOMAC between participants in group A and group B

The difference between WOMAC domains in group A and group B is given below (Table 3.1)

Table 3.1: Difference in WOMAC domains between participants in group A and B

	Group A		**Group B**	
	Pre	**Post**	**Pre**	**Post**
Pain	13.21	6.71	14.06	10.13
Stiffness	2.79	1.35	0.93	0.86
Physical	43.30	32.47	43.46	37.80

The mean baseline value for TUG in group A was 15.60 ± 2.69 sec and in group B was 16.12 ± 2.38 seconds. After intervention the mean value of physical mobility among participants in both group A and B were 14.68 ± 2.77 seconds and 15.82 ± 2.44 seconds respectively. On comparing within groups, the difference in physical mobility in participants of both group A ($p= 0.0008$, $t = 4.1459$ with $df = 16$) and group B ($p= 0.0641$, $t = 2.0102$ with $df = 14$) was highly statistically significant and not quite statistically significant respectively. (Graph 3.3)



Graph 3.3: Mean difference in TUG between participants in group A and group B

IV. Discussion

The purpose of the study was to determine the effects of retrowalking and conventional physiotherapy treatment over conventional physiotherapy treatment in osteoarthritis of knee in geriatric population. Results of the present study showed that retrowalking is more effective in reducing pain and disabilities as compared to conventional physiotherapy treatment.

The reduction of pain in experimental group can be because of the kinematics of backward walking is unique**.** Knee flexion during the swing phase of backward walking tends to be less than during forward walking. During stance, more flexion occurs in backward walking than forward walking. The range of knee motion is less during backward walking and could be as a result of the limited knee flexion that occurs during the swing phase. So the compressive forces are reduced on the knee. Pain relief after conventional treatment could be attributed to the non 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. . Isometric exercise are appropriate and easy to understand by the patients and can be easily and safely performed at home because it requires no or minimal apparatus. Anwer et al, concluded that isometric exercises has beneficial effects on quadriceps muscle strength.[30] Khyatee et al examined the effects of backward treadmill walking on pain and quadriceps muscle strength in subject with knee pain and quadriceps insufficiency. Backward treadmill walking was effective in decreasing pain and increasing quadriceps muscle strength in knee pain and quadriceps insufficiency. Retrowalking benefits are an increase in knee extensor activity which appears to help reduce patellofemoral pain (Lay, Hass, & Gregor, 2007). [31] Somashekhar et al compared the combination of retrowalking with transcutaneous electrical nerve stimulation and ultrasound therapy in patients with grade 2

chronic knee osteoarthritis. A combination of retrowalking with ultrasound therapy to knee produced better results in terms of reduced pain, improved functional outcomes and increased knee range.[23]

Retrowalking showed significant improvement in function is seen in both the groups and between the groups. As advantages of retrowalking 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. A study conducted by G Gondhalker et al, shown improvement in function because there may be possibility that proprioceptive and balance training may have occurred during retrowalking adding to its benefits.[21] P Shankar et al, studied on the effectiveness of retro walking in chronic osteoarthritis of knee joint. He found that retrowalking showed improvement in WOMAC index, extension lag and dynamic balance which occurred due to its greater impact in increasing extension moment improvising strength in functional range with decline compression force which assist in improving physical function.[22] The findings of present study correlate with the study of M Rathi et al, In their study, the pain and physical function reduced. In this study, pulsed SWD was used for 20 minutes.[18] A study conducted by D Kulchu et al, concluded that pulsed electromagnetic field can be applied as an effective approach in osteoarthritis of knee.[32]

The TUG score in group A was significantly increased than group B. The improvement in the physical mobility can be attributed to retrowalking as well as conventional physiotherapy treatment. Anadkat et al did a study on effectiveness of retrowalking treadmill on osteoarthritis of knee and found significant improvement in the mobility after 3 weeks of intervention.[33] In group B, the scores of timed up and go, a physical mobility measure was not statistically significant. This may be because only conventional physiotherapy treatment was given. A randomized controlled trial carried out by Chang TF et al reported the scores of timed up and go test in control group were not significant better than those in the experimental group.[34] R Hasegawa et al conducted a study on effects of combined balance and resistance exercises on knee pain in community older adults. The results showed no significant improvement in control group for scores of timed up and go test as compared to exercise group when performed combined resistance and balance exercises.[35]

V. Conclusion

On the basis of present study, it can be concluded that retrowalking is a suitable adjunct to conventional physiotherapy treatment which is more effective than conventional physiotherapy treatment in reducing pain and improving the disability of participants with osteoarthritis of knee.

Implication to practice: Patients in rural areas perform their farming activities in crossed leg sitting position, which may lead to wear and tear of the knee. To overcome this problem they can be treated with retrowalking which is a new concept in physiotherapy and rehabilitation has driven its attention in management of osteoarthritis of knee by decreasing the pain and decreasing the disability.

Limitations: In the present study, the duration of the intervention was short. Activities of daily living and recreational activities of patients were not taken into account. Home exercise program was not given. There was no follow up.

VI. Recommendations

As this study was done only for a 3 weeks, a short term study could be conducted with long term follow up sessions to know the effectiveness of the treatment. Study should be conducted with a larger sample size. There were few dropouts that can be strategically improved in future.

Acknowledgement

The author wants to thank all the patients for their participation in the study, Dr S M Khatri for being a great source of inspiration, Dr D N Hande for her valuable contribution and encouraging me and Dr S S Sant for constant support.

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