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Effectiveness of Retrowalking Versus Retro Treadmill Walking on Pain, Range of Motion and Functional Disability in Female Subjects with Chronic Knee Osteoarthritis

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Abstract: ***Background and objectives: Osteoarthritis is a progressive disorder that affects the weight bearing joints. According to the Global Burden of Disease studies, knee OA is the fastest growing major health disorder and the second leading cause of disability worldwide. A part of closed chain exercises is retro - walking, which uses different muscle patterns compared to forward walking. Reverse treadmill walking increases stride rate and shortens stride length. The purpose of the study is to compare the effect of retro walking versus retro treadmill walking on pain, mobility and function in female subjects with chronic knee osteoarthritis. Methods: Quasi experimental study done on 60 subjects who were randomly assigned into two groups, 30 subjects in group A (retro walking), 30 subjects in group B (retro treadmill walking). Interventions are given in both groups 3 days per week for a period of 6 weeks. Outcome measures are assessed using VAS, Goniometer and WOMAC scores before and after the study duration. Results: Statistically significant difference was found between pre - test and post - test measures of in Pain, ROM and functional disability when compared within group. When compared between groups retro treadmill walking has more significant improvement to retro walking in reducing pain, increasing ROM and decrease in functional disability. Conclusion: The results of this study support retro treadmill walking as an effective intervention in reducing pain, increasing ROM and decreasing functional disability in the management of osteoarthritis of knee.***

Keywords: Osteoarthritis of knee, retro walking, retro treadmill walking, goniometer, western Ontario McMaster Universities Arthritis index

1. Introduction

Osteoarthritis is a progresses degenerative condition caused due to the gradual deterioration of cartilage, ultimately leading to the formation of bony growths and cysts at the joint margins. It is one of the main medical conditions that lowers quality of life and reduces functionality. [1, 2]

Physiotherapy is the main choice of treatment where in the conservative part is concerned, which includes exercise therapy - supervised strengthening exercise, manual therapy, taping and electrical modalities with or without thermal modalities as measures for pain reduction. Recently closed kinematic chain exercises have drawn much attention in the management of OA knee OA. The closed kinetic chain exercises bear a strong resemblance to the everyday activities we engage in and have a more functional character. Knee rehabilitation can begin with weight - bearing and early mobilization through a closed kinetic chain exercise program that involves walking. [4, 6, 20]

Furthermore, closed kinetic chain exercises may also enhance joint proprioception, muscle strength, and balance. Retro walking is regarded as a highly effective form of closed kinetic chain exercise for improving muscle strength and the equilibrium of the human body. Retracing steps leads to a substantially lower peak joint compressive force and a notably slower rate of force application, thereby reducing trauma to the articular cartilage. Engaging in reverse treadmill walking results in an elevated stride rate, a decrease in stride length, and an increase in support time. This form of walking also leads to a reduction in the overall range of motion of the knee, thereby increasing the active functional range. Retro - walking and retro treadmill walking have been separately recommended for their impact on osteoarthritic knee joints, yet few studies have compared these methods directly. [20, 23]

The primary objective of my investigation is to examine the impact of retro walking compared to retro treadmill walking on pain levels, range of motion, and functional impairment in females suffering from chronic knee osteoarthritis. Future studies can build upon this research to gain a more comprehensive insight into optimal treatment methods for patients with osteoarthritis of the knee. [9]

2. Materials and Methods

This study is approved by institutional Ethical committee of KIMS college of physiotherapy, Amalapuarm. All the subjects are Screened to ensure they met the following inclusion:

Inclusion Criteria:
1] Female Subjects with the age 40 - 60 Years.2] Subjects with chronic OA knee with bilateral involvement.3] Subjects who are willing to participate.4]Grade 3 osteoarthritis changes on radiological evaluation using Kellgren and Lawrence system. [21, 23, 24]

Exclusion Criteria:
1] Patients with lower extremity injury or any underlying pathology.2] history of any inflammatory joint disease.3] balance problems.4] patients with cardiovascular and neurological problems.5] history of any lower limb or spinal surgeries. [21, 23, 24]
Subjects are recruited from Outpatient department of orthopaedics, KIMS Hospital, Amalapuram. Total of 60 subjects were taken by convenient sampling. All the subjects were explained about the treatment procedure and mode of assessment and written informed consent were obtained. The subjects are randomly assigned into 2 groups, group A (retro walking) and group B (retro treadmill walking). Subjects were scheduled to attend exercise session 3 days a week for 6 weeks.

3. Design and Interventions

The study was an observer - blinded pilot randomized controlled study.

Retro Walking [Group – A]: Participants were initially instructed to take 4 steps while walking backward, and their comfort levels were monitored for any signs of discomfort. If they experienced no issues, they proceeded to walk backward for 10 minutes during each session. The participants first practiced backward walking on a flat surface for a distance of 20 meters, ensuring that their toes made contact with the ground before their heels. Practice sessions involved retro walking with the support of a wall. Each participant engaged in backward walking on a flat 20 - meter surface at their maximum speed, utilizing the wall for support for 10 minutes per session. This session consisted of 4 minutes of backward walking followed by 2 minutes of rest, then another 4 minutes of backward walking. The therapist accompanied the participant during this exercise (12). DOSAGE: 3 days/ week for a duration of 6 weeks. [24]

Retro Treadmill Walking [Group - B]: A practice session consisting of 2 - 3 rounds on solid ground was conducted, followed by having participants stand on a treadmill facing the opposite direction of the moving belt to facilitate retro - walking. Cardiovascular parameters including heart rate, pulse rate, respiratory rate, and blood pressure were recorded prior to treatment to ensure stability in these measures. Symptoms of fatigue, such as tiredness, discomfort, dizziness, and difficulty concentrating, were discussed with participants, who were instructed to report any discomfort experienced. Initial practice sessions for retro - treadmill walking were conducted with the aid of hand rails, transitioning later to walking without support. They were asked to rest for 5 - 10 minutes, and then continue with their backward walking treatment protocol with an inclination on a treadmill at 0% for 4 days, 5% for next 5days and 10% for another 5 days. Speed for back walking was of 2 km/hr for 15 minutes during first 3 weeks and then progressed to 2.5km/hr for another 3 weeks. DOSAGE: 3 days/ week for a duration of 6 weeks. ([13, 21, 23])

Conventional Physiotherapy: - Conventional physiotherapy was given for all the participants in group A and B, treatment was static quadriceps exercise, dynamic quadriceps exercise, straight leg raises, prone knee bending, and simple hamstring stretches, for10 repetitions with 5 seconds hold followed by 2 seconds rest for each exercise. [26]

Outcome Measures:
Subjects are assessed pre - test on day one and post - test after 6 weeks to measure pain and functional disability using WOMAC and ROM using Goniometer.

1) WOMAC: The WOMAC (Western Ontario and McMaster Universities Arthritis Index) is a widely used self - administered questionnaire designed to evaluate the condition of hip and knee osteoarthritis. It consists of 24 items divided into three subscales: 1] Pain (5 items): Assesses pain during walking, using stairs, in bed, sitting or lying, and standing.2] Stiffness (2 items): Assesses stiffness after first waking and later in the day.3] Physical Function (17 items): Assesses daily activities such as using stairs, rising from sitting, standing, bending, walking, and more. Each item is scored on a scale from 0 (None) to 4 (Extreme), with higher scores indicating worse pain, stiffness, and functional limitations. The scores for each subscale are summed up, with a possible score range of 0 - 20 for Pain, 0 - 8 for Stiffness, and 0 - 68 for Physical Function. The WOMAC scale is considered a reliable and valid tool for assessing the severity of osteoarthritis in the hip and knee. [25]
2) UNIVERSAL GONIOMETER: - Goniometric measurement was used to measure the knee range of motion of flexion and extension. goniometry is a valid and reliable method for measuring joint ROM. [31]

Statistical Analysis
Statistical analysis was performed by using SPSS software version 21.0 and the level of significance for all analyses was set at $p < .05$. Descriptive statistical data were presented in the form of mean +/ - standard deviation and mean difference percentages were calculated and presented. All 60 subjects completed the entire study program as defined by 6 weeks in the outpatient basis.

4. Results

The results of the study were analysed using Paired t - test to measure the outcomes within the group. Independent student t - test was performed to assess the statistically significant difference in mean values between the groups. The p - value for the ROM within group comparison was <0.05. Similarly, the p - value for the WOMAC within group comparison was also <0.05, which was a statistically significant ($p < 0.05$). Analysis of between group comparisons for ROM revealed a p - value of < 0.05, which is less than 0.05, whereas for WOMAC, the p - value was <0.05, greater than 0.05. Both group A and group B demonstrated a significant improvement in range of motion, decrease in pain and reduced functional disability, however, an inter - group comparison revealed a significant difference in range of motion and a clinically meaningful difference in WOMAC scores. Both groups

showed improvements in ROM and disability when compared within groups. when compared between groups Group B showed a statistically significant improvement then Group A.

Table 1: Analysis of pre and post mean value of ROM & WOMAC in Group A

Group A	Tests	Mean	S. D	T - Value	P - Value
WOMAC	Pre	68.5	3.7	31.4	0.05
	Post	46.4	3.5		
ROM	Pre - F	80.1	5.6	22.7	0.05
	Post - F	93.6	5.9		
	Pre – E	36.8	5.3	21.7	0.05
	Post - E	11.8	5.2		

This above table inference is that was a significant difference between pre - test and post - test that is p <0.05.

Table 2: Analysis of pre and post mean value of WOMAC, ROM in Group B

Group B	Tests	Mean	S. D	T - Value	P - Value
WOMAC	PRE	68.7	3.9	43.5	0.05
	POST	35.9	2.8		
ROM	PRE - F	80.5	6.1	19.3	0.05
	POST - F	100.1	7.2		
	PRE - E	38.8	5.7	28.7	0.05
	POST - E	9.3	2.4		

This above table inference is that was a significant difference between pre - test and post - test that is p<0.05.

Table 3: Analysis of pre mean value of WOMAC and ROM between Group A & Group B

WOMAC	Tests	Mean	S. D	T - Value	P - Value
Group A	Post A	68.5	3.72	0.1	0.05
Group B	Post B	68.7	3.95		
ROM	Tests	Mean	S. D		
Group A	Post - F	80.1	5.6	0.21	0.05
Group B	Post - F	80.5	6.1		

This above table inference is that was a significant difference between pre - test values of group A and B p<0.05.

Table 4: Analysis of post mean value of WOMAC AND ROM between Group **A** & Group **B**

WOMAC	Tests	Mean	S. D	T - Value	P - Value
Group A	Post A	46.4	3.5	12.4	0.05
Group B	Post B	35.9	2.8		
ROM	Tests	Mean	S. D		
Group A	Post - F	93.6	5.9	3.7	0.05
Group B	Post - F	100.1	7.2		

This above table inference is that was a significant difference between post - test of group A and B that is p<0.05.

5. Discussion

The purpose of this study was to compare the efficacy of retro walking versus retro treadmill training in addition to standard workouts for patients with osteoarthritis in their knees. By the end of the sixth week, the mean goniometer and WOMAC scores in both the groups have improved.

The improvement in function in retro walking (Group A) may be attributed because of reduction in pain and improved joint kinetics and kinematics during functional movements and improved muscle activation patterns. Retro - walking provides several benefits, such as enhanced muscular activation pattern, decreased in adductor moment at knee during stance phase of gait, and increased hamstring muscle group stretch during stride. These benefits may have contributed to a decrease in impairment and improvement in function. Proprioceptive and balance training might have taken place during retro - walking, which would have increased its advantages. According to a study by Gouri Arun Gondhalekar and colleagues, people with osteoarthritis in their knees benefit more with retro - walking when combined with conventional therapy. Another study conducted by Marlene and Mary, which shown that retro - walking decreased pain and impairment levels. [31]

By the end of the sixth week, retro treadmill training (Group B) - mean goniometer readings had increased, indicating an increase in knee range of motion. In addition, notable declines in the average WOMAC scores were observed. Walking in reverse on a treadmill improves muscular activation patterns, decreases the adductor moment at the knee during the walking stance phase, and increases hamstring muscle group stretch throughout the stride, according to research conducted in 2015 by Farhin Mulla et al. [29] These improvements might contribute to a reduction in impairment and an increase in general functional ability. Reverse walking on a treadmill has a beneficial effect on hip extensor strengthening, which reduces the hip flexion moment during the stance phase. By reducing excessive strain on the knee joint, this reduction in hip flexion moment helps to prevent impairment and eventually improve joint function. [28, 30]

Retro walking on treadmill serves as an effective strategy for enhancing the activation of extensor muscles, improving flexibility, and mitigating the impact of reaction and shear forces on the joints. Research conducted in Finland and other nations has demonstrated that backward treadmill walking significantly elevates V02 max. In a study by Pankaj Kumar et al. in 2020, a statistically significant enhancement in outcomes was observed for group B. This improvement is linked to a reduced rate of compressive force loading on the patellofemoral joint during the later stages of the stance phase when participants engaged in backward walking on the treadmill. The diminished loading rate facilitates better accommodation and protects the articular cartilage, which is particularly vulnerable to injury due to its viscoelastic characteristics. Furthermore, the biomechanics of retro - walking indicate a reversal in the action of the muscles surrounding the ankle and knee. In this mode of walking, the knee emerges as the primary source of power, characterized by the co - contraction of the quadriceps and hamstring muscles, while the ankle plantar flexors act as shock absorbers. Notably, in retro - walking, the shear force at the knee joint is directed anteriorly, in contrast to the posterior direction observed during forward walking. [22]

6. Limitations of the study

This study was limited to the female gender only. Study was done using small sample size and observations are done on short term period.

7. Conclusion

The results of this study support retro treadmill walking is effective in reducing pain, increasing ROM and decreasing functional disability then retro walking in the management of osteoarthritis of knee.

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