Effect of Reverse Treadmill Walking and Low Intensity Cycle Ergometry in Chronic Knee Osteoarthritis Subjects-Comparative Study

Ms. FarhinShamshuddinMulla*, Dr. Amrutkuvar H. Pawar**, Dr.TruptiWarude***

Abstract

Background:*Osteoarthritisis a progressive disorder of the joints caused by gradual loss of cartilage resulting in the development of bony spurs and cysts at the margin of the joints.The present study was conducted to find out effect of reverse treadmill walking and low intensity cycle ergometry in chronic knee osteoarthritis subjects.*

Method:*An Experimental study was conducted at Krishna College of Physiotherapy , Karad. 20 subjects with age group between 40-70 years were taken. A total of 20 subjects were selected and were equally divided in to two groups. Both the Groups received short wave diathermy while Group A received reverse treadmill walking, and Group B received low intensity cycle ergometry.*

Results:*Analysis using pairs't' test and wilcoxon matched pairs test found statistically significant improvement (p=0.0020) in pain and functional disability within the groups. Comparative Analysis using Unpaired 'T' test found no statistically significant difference in improving pain & functional disability in both the techniques. However reverse treadmill walking group found significantly greater improvement in exercise tolerance and endurance compared with low intensity cycle ergometry.*

Conclusion:*Present study concluded that both the techniques shown to have equal effect on improving pain and functional disability. However reverse treadmill walking is effective in improving exercise tolerance and endurance than low intensity cycle ergometry.*

Keywords: *reverse treadmill walking, low intensity cycle ergometry, knee osteoarthritis.*

Introduction

The knee is the largest and complex joint of the body. It is formed by fusion of the lateral femorotibial, medial femorotibial, and femoropatellar joint. It is compound synovial joint, incorporating two condylar joints between the condyles of the femur and tibia. And one saddle joint between the femur and the patella. The movement and damage of knee joint is controlled by the muscles and ligaments.[1]

Osteoarthritis is chronic degenerative disorder of multifactorial etiology characterized by loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis, and range of biomechanical and morphological alterations of the synovial membrane and joint capsules.[2]The prevalence of osteoarthritis in India is 22-39%.[3]Osteoarthritis is more common in women than men, prevalence is increased dramatically with age. Nearly 45% of women over the age of 65 years have symptoms while Radiological evidence found in 70% of those over 65 years.[4,5,6]

*BPT student, , **MPT (Lecturer), ***Lecturer,

Address for correspondence:
Ms. FarhinMulla
BPT student, Krishna Institute of Medical Sciences, Faculty of Physiotherapy, Karad-415110, Satara, Maharashtra.
Email id: Farhin9575@gmail.com

The major symptoms present in osteoarthritis are pain and functional disability. The knee is most common site for osteoarthritis with characteristic sign like pain during weight bearing, limitation of knee range of motion (ROM), crepitus, joint effusion, and local inflammation.[7]

Short wave diathermy (SWD) is a physical therapy modality suggested for the management pain and loss of function due to osteoarthritis.[8]It is being used for its thermal effects to aid in soft tissue healing. Diathermy uses shortwaves of about 1.8 to 30MHz frequency and 3 to 200 meter wavelength to produce deep heat changes within the tissue including vasodilation, elevation of pain threshold, increase tissue extensibility and increase enzymatic activity.[9,10]

Reverse treadmill walking is also called as backward walking. It puts less strain on knees and requires less range of motion from knee joints. Also, reverse treadmill walking eliminates the typical heel strike to the ground.In forward walking knee joint flexes, extends and then flexes in support phase, prior to flexing and extending during swing. However support swing ratio of backward walk is similar to forward walking with 60% support and 40% swing. Reverse treadmill walking increases stride rate, decreases stride length and increases support time. It reduces overall range of motion of knee thereby increase active functional range.[11]

Cycling is an non-weight bearing activity. It is considered as an alternative exercise modality for patients with knee osteoarthritis. Cycling improves the joint mobility, increase muscle strength and flexibility and also improves the posture and co-ordination. The repetitive knee motion is good for arthritic knee because it encourages the production and flushing of fluids through the joint and lubricating it. Low-intensity-cycle ergometry is effective in improving in function and gait, decrease pain.[12]It is common exercise modality that has been shown to produce aerobic training effects in well elders.[13]

Material and Methods

Subjects who were referred to physiotherapy department diagnosed by orthopedician or Physiotherapist, as chronic osteoarthritis of knee were selected. Further they were screened clinically and diagnosis was confirmed. Considering inclusion and exclusion criteria they were requested to participate in the study. The nature of study and intervention were explained to the subjects and those willing to participate were included. Before proceeding to intervention a written consent was taken from subject. A brief demographic data including name, age, gender, side affected as per data collection sheet were recorded. By using random sampling method the participants were divided into two groups by chit method; Group A and group B, both groups received a baseline treatment (short wave diathermy for 10 days).

Subjects with chronic knee osteoarthritis were assessed by Visual Analogue Scale (VAS), functional disability by WOMAC, and exercise tolerance by six minute walk test. Measurement of VAS, WOMAC and six minute walk test were made on all subjects on the first day before intervention and after 10 days of interventions.

Procedure

1. Both the groups received short wave diathermy with a dosage of 27,12MHz in frequency, for 20 minutes of treatment durationby cross fire method to the knee joint (antero-posteriorly 10 minutes andmedio-laterally 10 minutes.was given in common as a part of the conventional treatment.

GROUP A

In this group subjects received reverse treadmill walking.

As the reverse treadmill walking is not part of our routine lives and subjects were not accustomed to reverse treadmill walking , so they were given training one day before the actual intervention in treadmill. Reverse treadmill walking is unaccustomed activity so it was done with the supervision. And next day onwards treatment was started.

On the day of treatment, the subject was asked to stand facing opposite to the display board of treadmill. Railing was held by both the hands during reverse walking on treadmill.

The therapist was standing facing to the subject, with both the feet's besides the rolling surface of the treadmill and holds the patient firmly for the support.

Each subject was asked to perform the walking at the level of ground for 10 minutes at their comfortable speed

up to Rate of perceived exertion of 11-13 according to borg scale.

Subject was asked to report the therapist immediately if he or she feels any of the complaints like loss of balance, shortness of breath, giddiness, fatigue, etc. To avoid that, rest periods were given in between the treatment.

GROUP B

In this group subjects received low intensity cycle ergometry.

The seat height was adjusted high so that no more than 10 degrees of knee flexion was permitted. If flexion of knee exceeds than 10 degrees it can precipitate the symptoms like pain. The flexion was permitted at the lowest point in the rotation of pedal.

The subjects were allowed to perform cycle ergometry at minimal intensity while maintaining the upright posture of upper body during cycling. Subjects were explained to maintain the intensity of exercise at rate of perceived exertion 11-13 according to borg scale.

Findings:

Statistical analysis was done manually as well as using the statistics software INSTAT so as to verify the result obtained. Various statistical measures such as mean, standard deviation, and paired and unpaired test of significance, Mann whitney test and Wilcoxon matched pairs test were utilized for this purpose. Probability values less than 0.005 were considered statistically significant and probability values less than 0.001 were considered statistically extremely significant.

Result:

Table no.1:Comparison of values of visual analogue scale

Group	Pre- treatment		Post-treatment	
	Mean ± SD	Median	Mean ± SD	Median
A	6.37 ± 1.034	6.500	3.5 ± 0.8819	3.750
B	7.41 ± 0.8595	7.650	4.1 ± 0.4107	4.250
'p'	0.0408		0.1974	

Intra group analysis of VAS score revealed statistically reduction in pain post interventionally for both the groups. This was done using Wilcoxon matched pairs test Group A (p=0.0020), Group B (p=0.0020).

Inter group analysis of VAS score was done by using Mann-Whitney test.Pre interventional analysis showed no significant difference between group A and group B (p=0.0408). Post intervention analysis showed no significant difference between Group A and Group B (p=0.1974).

Table no.2:Comparison of values of WOMAC score.

Group	Pre- treatment		Post-treatment	
	Mean ± SD	Median	Mean ± SD	Median
A	41.5 ± 10.207	37.500	22.1 ± 5.301	21.000
B	53.6 ± 13.327	49.500	24.2 ± 5.731	26.000
'p'	0.0312		0.4266	

Intra group analysis of WOMAC score revealed statistically reduction in pain and functional disability scores post interventionally for both the groups. This was done by using Wilcoxon matched pairs test Group A (p=0.0020), Group B (p=0.0020).

Inter group analysis of WOMAC score was done by using Mann-Whitney test. Post intervention analysis showed significant difference between Group A(p=0.0312) and Group B (p=0.4266).

Table no.3: Comparison of values of six minute walk test score

Group	Pre- treatment		Post-treatment	
	Mean ± SD	Median	Mean ± SD	Median
A	429 ± 65.396	435.00	504.5 ± 73.577	510.00
B	350 ± 50.990	340.00	439.5 ± 84.078	427.50
'p'	0.0075		0.0824	

Intra group statistical analysis revealed statistically extremely significant increase in six minute walk test post interventionally for both the groups. This was done by using paired t test Group A (t_9=16.778, p=<0.0001), Group B (t_{18}=2.878, p=0.0100)

Inter group analysis of knee joint was done by using unpaired t test. Pre interventional analysis showed very significant difference between group A and group B (p=0.0075). Post intervention analysis showed not quite significant difference between Group A and Group B (p=0.0824)

Discussion

Osteoarthritis is a progressive disorder of the joints caused by gradual loss of cartilage resulting in the development of bony spurs and cysts at the margin of the joints. It is an extremely common condition occurring after 40 years of age.[3]

The purpose of this study was to compare the effect of reverse treadmill walking and low intensity cycle ergometry in chronic knee osteoarthritis subjects.

Short wave diatrhermy-

The Short wave diathermy is one of the oldest forms of electrotherapeutic modalities traditionally used by physical therapist to treat knee joint osteoarthritis. SWD typically utilizes electromagnetic radiation at 27.12 MHz. which is applied in either continuous short wave diathermy Or a pulsed short wave diathermy mode, with the latter delivered in the form of pulse trains.[14,15]Continuous short wave diathermy or a pulsed short wave diathermy were specified as treatments for acute knee osteoarthritis by 34.8% and 73.9% of the respondents, respectively, and for chronic OA by 97.8% and 59.4% of the respondents, respectively.[14]Pain reduction, improvement in functional status and exercise tolerance may be due to the major physiological effects of CSWD which are related to an induced increase in tissue temperature, which may induce vasodilatation, elevation of pain threshold, reduction in muscle spasm, acceleration of cellular activity, and increased soft tissue extensibility.[14,16,17]

Reverse treadmill walking-

In Reverse treadmill walking there is 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; of these may have helped in reducing disability thus leading to improved function. Reverse walking 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 and leading to improved function.[18]

According to many studies the backward walking allows increases the hamstring activation which generates reduced patello femoral and lower tibio femoral compression load stress and ACL strain, and therefore backward walking reverses the shear forces in knee joint.[19]

Reverse walking is effective in improving extensor muscle activation, gaining flexibility with reduced reaction and shear force directing on joint. According to Finland etal backward walking increases Vo2max.[11]

Low intensity cycle ergometry-

Low-intensity-cycle ergometry is non weight bearing so it is effective in improving in function and gait, decreasing pain.[12]cycling helps to reduce the pain and improve quality of life.[20] It has been found that low intensity cycle ergometry is as effective as high intensity cycle ergometry, in patients with OA knee, for improving functional status, gait, pain and aerobic capacity.[21]There was reduction in

pain, improvement in functional status as well as improvement in exercise tolerance and endurance with low intensity cycle ergometry. Many studies show that tibiofemoral joint forces may be increased during forward cycling, but the same reduces patellofemoral joint forces.[22]Which also supports for the additional benefit of reduction of painand improvement in functional status.

Comparison of pain and disability between two groups was done using Mann-Whitney test to find effectiveness between two groups.

The statistical analysis revealed that there was no significant difference in reduction of pain and disability in both groups. So, both the groups are equally effective in reduction of pain (p=0.0020).and disability (p=0.0020).

Comparison of the six minute walk test between groups was done using unpaired t test to find the effectiveness between two groups.

The statistical analysis revealed that there was a significant difference in six minute walk test in both the groups. The Group A which received reverse treadmill walking is more effective in improving exercise tolerance and endurance (p=<0.0001) than group B which received low intensity cycle ergometry.

Hence above result showed that subjects treated with reverse treadmill walking and low intensity cycle ergometry along with short wave diathermy showed better pain relief on VAS, improved functional ability on WOMAC. Both the techniques are equally effective in improving knee function, but statistically reverse treadmill walking is more effective than low intensity cycle ergometry in improving the exercise tolerance and endurance, possible mechanism could be 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 heel strike in reverse walking.[23]

The result from the statistical analysis of present study supported alternative hypothesis which stated that there is beneficial effect of reverse treadmill walking and low intensity cycle ergometry as an adjunct to conventional physiotherapy treatment in chronic knee osteoarthritis.

Thus it can be stated from above study that physical therapy interventions like reverse treadmill walking and low intensity cycle ergometry along with reverse treadmill walking and low intensity cycle ergometry are efficacious and cost effective.

Conclusion

In conclusion The present study provided evidence to support the use of reverse treadmill walking and low intensity cycle ergometry with conventional treatment in reducing pain, knee functional disability and improving exercise tolerance and endurance in knee joint osteoarthritis subjects.

In addition Results Supported that reverse treadmill walking given with conventional treatment was more effective in improving exercise tolerance and endurance than low intensity cycle ergometry in subjects with chronic knee osteoarthritis.

Acknowledgement :

We acknowledge the guidance and constant support of Dr. G Varadhrajulu, Dean, Faculty of physiotherapy, Karad. Dr. S.V. Kakade for help in statistical analysis.

Source of funding:

The source of funding for study is KIMSDU karad.

Conflict of interest:

There is no conflict of interest.

Ethical clearance:

Ethical clearance was taken from institutional ethical committee of KIMSDU.

References:

1. B D Chaurasia's Human Anatomy, Volume 2, lower limb abdomen and pelvis, joints of lower limb. Page no. 150
2. Silman AJ, Hochberg MC. 2nd ed. Oxford; Oxford University press; 2001; Epidemiology of the Rheumatic diseases.
3. Ries MD, Philibian EF, Groff GP, Relationship between severity of ganarthrosis and cardiovascular fitness in orthop.1995;313;169:76
4. Mahajan A, Verma S, Tandon V. Osteoarthritis J assoc physicians India. 2005;53:634-41
5. Davis MA, Ettinger WH, Neuhaus JM, Hauck WW. Sex differences in OA of the knee. The role of obesity AM J Epidemiol 1988;127:1019-30

6. Solomon L, Beighton P, Lawrence JS. Rheumatic disorders in the south African Negro. Part 2. Osteoarthritis Afr Med J. 1975;49:1737-40
7. MundermannA, Dyrby CO, Andriacchi TP. Secondary gait changes in patients with medial compartment knee OA : Increased load at the ankle, knee and hip during walking ,arthritis Rheum .2005;52:2835-44
8. Dr. FalahSalimManchal, Dr. Abdullah Eiada Mecgeser, Suhad Abdul Hussain. Effectiveness of short wave diathermy and therapeutic ultrasound on the management of knee osteoarthritis.
9. Laurel Charbonneau. The efficacy of short wave diathermy in decreasing knee pain in female with knee osteoarthritis.
10. Y.Lufer, G.Dar :effectiveness of thermal and athermal short wave diathermy for the management of knee osteoarthritis; a systemic review and meta analysis
11. Pradeep Shankar, Renukadevi M. Adithibhandiwad, Harish pai. Effectiveness of retrowalking in chronic osteoarthritis of knee joint.
12. Cycling for knee rehab, exercise bikes, static bikes, stationary cycles, bicycle ergometers- these are all names for the bicycles that you find in virtually every physiotherapy clinic or health club across the world.
13. Kathleen Kline Mangione, Kevin McCully, Alyson Gloviak, Isabella Lefebvre, Mary Hofmann, Rebecca Craik.The effects of high-intensity and low intensity cycle Ergometry in older adults with knee osteoarthritis.
14. Shields N, Gormley J, O'Hare N. Short wave diathermy: current clinical and safety practices. Physiotherapy res Int 2002;7:191-202.
15. Cameron MH, Physical agents in rehabilitation : from research to practice. Philadelphia: W.B. Saunders; 1999.
16. Kitchen S, Partridge C. review of shortwave continuous and pulsed patterns. Physiotherapy 1992;78:243-52.
17. Shields N, Gormley J, O'Hare N. Short wave diathermy: a review of existing clinical trials. Physther rev 2001;6:101-18
18. GouriArunGondhalekar and MedhaVasantDeo :2013
19. Christopher Osmond, march 5th 2005- The use of backward running and cycling as a post operative modality for rehabilitation of various knee disorders.
20. Multani NK, The changing role of physiotherapists in the management of osteoarthritis knee , "Physiotherapy". The Journal Of The Indian Association Physiotherapist2005; 1:15-20
21. Mangione KK, McCully K, Gloviak A, Lefebvre I, Hofmann M, Craik R. The effects of high intensity cycle and low intensity cycle ergometry in older adults with knee osteoarthritis. J Gerontol A Biolsci med sci 1999;54:M184-90.
22. Ericson MO,Nisell R. Tibiofemoral joint forces during ergometer cycling. Am intern med 1986;116:529-34.
23. Retro rehabilitation- An extremely effective form of rehabilitation and training –Gary Gray,PT.