RETROTREADMILL WALKING AS A REHABILIATIVE TOOL IN KNEE PAIN AND QUADRICEPS INSUFFICIENCY

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ABSTRACT

The Knee extensor strength deficit is a common finding in patients suffering from knee pain[1,2], this deficit is reduced through well accepted methods of knee rehabilitation exercises leading to Quadriceps strengthening and Closed Kinetic Chain (CKC) exercises. The closed chain concept of quadriceps exercise is incorporated by Backward walking, which is the ability to move backward, it allows the body to be positioned to accommodate various tasks. The Backward locomotion (walking or running) leads to decrease in patellofemoral joint compressive forces and protect Anterior Cruciate Ligament (ACL) from overstretching, it also decreases the eccentric loading of the knee extensors, thus it has gained popularity as a part of program to rehabilitate certain knee injuries [2].

However, there has not been any clinical trial conducted to support or refute the positive effects of backward treadmill walking in altering pain and quadriceps strength in subjects with knee pain. Thus, this study aimed at examining the effects of backward treadmill plain walking on pain and quadriceps muscle strength in subjects presenting with knee pain and quadriceps insufficiency.

The performed study explored the effectiveness of retro-treadmill (backward) walking and Quadriceps strengthening as a rehabilitative tool for the subjects with complaint of knee pain. The study includes a total of 30 subjects (both males and females belonging to the age group of 25 to 55), duly screened on the basis of inclusion and exclusion criteria. The study involves the usage of Visual Analog Scale (VAS) and handheld dynamometer for the evaluation of pain and muscle strength, respectively. Based on the performed work it is found that a better level of treatment success is achieved in the experimental group compared to that in the control group.

The Observed results of experimental group compared to that in the control group for VAS (66.7% and 33.3%, respectively, for $p< 0.05$), and for Quadriceps muscle strength (57.8% and 42.6%, respectively, for $p< 0.05$).The analysis of the results recommends that the patients undergone through knee rehabilitation should undergo retro-treadmill walking in their rehabilitation protocol.

***Index Terms**- Anterior Cruciate Ligament (ACL), Closed Kinetic Chain (CKC), Visual Analog Scale (VAS), Quadriceps strengthening, Retro-treadmill*

INTRODUCTION

Knee pain is one of the most common conditions seen in outpatient physical therapy clinic and is certainly one of the most challenging tasks[1,2]. Quadriceps weakness is common in patients with knee osteoarthritis and may contribute to the substantial functional deficits that occur with disease progression[3].

Many rehabilitation strategies have been implemented for patients with knee pain and quadriceps insufficiency (which ones.....). In general, the goals of knee pain rehabilitation are to maximize quadriceps strength while minimizing the patellofemoral joint reaction forces and stress[4].Most people respond favorably to conservative intervention at end of sentence with the most common treatment being quadriceps strengthening using non weight bearing and weight bearing exercises[5]. Weight bearing exercises are more functional than non-weight bearing exercises because they require multi-joint movement, facilitating a functional pattern of muscle recruitment and stimulate proprioceptors. Because of these, clinicians often recommend weight bearing exercises in rehabilitation of knee pain patients[6,7].

Quadriceps strengthening has been a standard component in rehabilitation of those with anterior knee pain[3]. However, extensor mechanism rehabilitation may aggravate knee symptoms if activities that contribute to biomechanical overload are included[1].

Walking, running, jumping, climbing and arising from chair all incorporate closed kinetic chain components. Graded walking provides a functional exercise that improves muscular activity around the affected joints, employs an appropriate range of motion and provides a controlled environment which minimizes the possibility of further damage. The functionality of both forward and backward walking in rehabilitation is quite obvious. However, it has been suggested that backward walking may offersome benefits beyond those experienced through forward walking alone[8,9]

Researches also indicate that there is decrease in eccentric quadriceps activity during backward gait which may reduce patellofemoral joint stresses that are often associated with anterior knee pain[10]. In addition, large increases in the activity of knee extensors during backward upslope walking may be useful for strengthening these muscles, a frequent goal in knee rehabilitation[8].

However, there has not been any clinical trial conducted to support or refute the positive effects of backward treadmill walking in altering pain and quadriceps strength in subjects with knee pain. Thus, this study aimed at examining the effects of backward treadmill plain walking on pain and quadriceps muscle strength in subjects presenting with knee pain and quadriceps insufficiency.

METHODOLOGY

The study was carried out in the Ortho-surgery Department of All India Institute of Medical Sciences (AIIMS), Physiotherapy unit, India.

This study was done on subjects with complaints of knee pain leading to hindrance in functional activities, reporting at the physiotherapy unit of orthopedics department, AIIMS. A total of 30 subjects were included in the study after screening for the inclusion and exclusion criteria. Subjects were included in the age group of 25 – 55 years, both males and females were included.

The inclusion criteria (criteria related to the inclusion of the subject in the study) involves 1. Retro- or peripatellar pain from at least two of the following activities: squatting, prolonged sitting, stair climbing, running, kneeling; 2. Insidious onset of pain without a history of trauma persisting for at least 4 weeks; 3. Pain during patellar compression test, patellar grind test or medial/lateral patellar facet tenderness and 4. No professional sports activity by the subjects. 5. quadriceps insufficiency, 6. even post operative cases of 5month or older history of Anterior Cruciate Ligament (ACL) reconstruction were included.

Criteria's leading to the exclusion of the subject from the study involves, infective knee disease, knee replacement, history of patellar subluxation or dislocation, cardiopulmonary disease, neurological diseases affecting balance and coordination, significant recent injury to the hip, knee or ankle, rheumatic disease affecting sensorimotor performance.

Subjects were randomly allocated to the Control group (Group A) and the Experimental group (Group B). Subjects in Group A were given static quadriceps and the conventional closed kinetic exercises (knee bending with heel touching the couch, wall sliding, pressing wall with foot) and were advised to do 10 repetitions of each exercise, 3 sets in a day for a period of 10 days as home programme .

Subjects in Group B were given the retro-treadmill walking intervention with Closed Kinetic Chain (CKC) exercises. These subjects were first familiarized with the backward walking pattern on level ground such that during backward walking the toes strike the ground first instead of the heel. Subjects in Group B were asked to walk in backward direction for 2 to 3 rounds over ground. Then the subjects were made to stand on the treadmill and face in the direction, opposite to the direction of the moving belt of treadmill such that retro walking movement is induced.

Practice session for the subjects of Group B were made, for retro-treadmill walking, initially with support of hand railings and later on without the support. They were asked to rest for 5 to 10 minutes, and then continue with their backward walking treatment protocol. The protocol followed was backward treadmill walking with a speed of 2 km/hr. for 5 minutes during first 5 days and then progressed to a speed of 2.5 km/hr for another 5 days, thus completing the 10 days intervention. In addition, Group B subjects were made to do the same set of Closed Kinetic Chain (CKC) exercises as assigned to Group A. Interventions in both the groups were given for a period of 10 days daily.

Outcome measures of pain and muscle strength were taken to assess the effect of intervention. Pre experimental measures of quadriceps strength and knee pain were obtained in both groups i.e. Group A and Group B.

Pain intensity was marked on a 10 cm Visual Analogue Scale (VAS –an analog scale, used to measure knee pain) for both groups. The subjects followed a 10 day's treatment program. At the end of the 10th day, the muscle strength and pain intensity tests were repeated.

DATA ANALYSIS

On comparing baseline characteristics between two groups no statistical difference was found between the two groups indicating that there is homogeneity in the groups at the baseline

All subjects recruited for the study (n=30) completed the study course. Subjects were allocated equally in both the groups i.e., Group A and Group B. The Groups comprises of 16 males and 14 females' subjects.

Table 1: Basic Characteristics of Both the Groups

Characteristics	Group A (Control)	Group B (Experimental)
No. of subjects	15	15
No. of Males/Females	7/8	9/6
Mean Age (years)(S.D.)	36.6 (9.47)	38.8 (8.55)
Mean Height (cm.) (S.D.)	164.8 (10.4)	162.5 (11.8)
Mean Weight (Kg) (S.D.)	72.6 (10.05)	66.8 (10.7)

Student's t test was used to analyze the difference for VAS (pain) and Quadriceps strength between the experimental and the control group A paired t-test was used to analyze the difference for the VAS Score and Quadriceps strength between the experimental and the control group

The paired 't' test analyzed for VAS scores difference in control group at baseline and post 10 days of intervention (MD=1.97, SD=0.64) showed significant difference in pain in these subjects with the control group intervention.

The paired 't' value analyzed for VAS scores difference in Experimental group between baseline and post 10 days intervention (MD=3.43, S. D=1.07) showed significant difference at 0.01 level ($p<.01$) indicating that there was a marked difference in pain scores in these Subjects post retro-treadmill intervention The 't' value analysed for difference in pain VAS between the two groups at baseline and post 10 days intervention showed significant difference at 0.01 level ($p<0.01$)

The paired 't' value analyzed for Quadriceps muscle strength difference within the control group at baseline and post 10 days of intervention, showed a significance difference (Before – MD = 4.31, SD = 2.85; After – MD = 6.21, SD =2.79) at 0.05 level ($p<.05$) indicating that there was a significant improvement in Quadriceps muscle strength of subjects in control group with conventional closed kinetic chain exercises.

The paired 't' value analyzed for Quadriceps muscle strength difference within the experimental group at baseline and 10 days of intervention (Mean deviation-MD, Standard deviation - SD) (Before – MD = 9.68, SD = 3.62 ; After – MD = 11.12, SD =5.36) showed a significant difference at 0.01 level ($p<.01$) indicating that there was a marked improvement in muscle strength of Quadriceps in the subjects with knee pain post retro-treadmill intervention.

The 't' value analyzed for difference in quadriceps muscle strength between the two groups at baseline and post 10 days intervention showed significant difference at 0.01 level ($p <0.01$)

Subjects in experimental group showed significantly better results than subjects in control group.

RESULTS

The VAS pain score decreased significantly after the intervention (6.68±1.62 to 3.37±1.50, p=0.001 in the experimental group; and 6.31±1.25 to 4.81±1.79, p=0.005 in the control group) as shown in Table 2. Pain reduction was significantly greater in the cases compared to the subjects in the control group (p=0.032) (Table 3). A significantly better level of treatment success was also achieved in the experimental group compared to that in the control group (66.7% and 33.3%, respectively, $p< 0.05$).

TABLE 2: COMPARISON OF PAIN INTENSITY BASED ON VAS MEAN BEFORE AND AFTER INTERVENTION IN BOTH GROUP

Groups	VAS (before)	VAS (after)	P value
Control (Group A)	6.31±1.25	4.81±1.79	0.005
Experimental (Group B)	6.68±1.62	3.37±1.50	0.001

TABLE 3: COMPARISON OF PAIN INTENSITY BASED ON VAS MEAN BEFORE AND AFTER INTERVENTION BETWEEN GROUPS

VAS Groups	Mean±SD	P value
Before		
Control (Group A)	6.31±1.25	
Experimental(Group B)	6.68±1.62	0.266
After		
Control(Group A)	4.81±1.79	
Experimental(Group B)	3.37±1.50	0.032

The Quadriceps muscle strength increased significantly after the intervention (9.68±3.62 to 11.12±5.36, p=0.001 in the experimental group; and 4.31±2.85 to 6.21±2.79, p=0.005 in the control group) as shown in Table 4

TABLE 4.: COMPARISON OF QUADRICEPS MUSCLE STRENGTH, BASED ONMEAN BEFORE AND AFTER INTERVENTION

Groups	**Quadricep Strength** *(before)*	**Quadricep Strength** *(after)*	***P* value**
Control (Group A)	4.31±2.85	6.21±2.79	0.005
Experimental (Group B)	9.68±3.62	11.17±5.36	0.001

A significantly better level of treatment success was also achieved in the experimental group compared to that in the control group (57.8% and 42.6%, respectively, p< 0.05).

CONCLUSION

Statistically it is observed that, interventions lead to a significant improvement in the pain reduction and muscle strengthening of the subjects under study. The intervention comprises of backward walking on treadmill, which indicates its effectiveness, when incorporated as a therapeutic regime. Based on the performed study is concluded that the patients undergone through knee rehabilitation should undergo retro-treadmill walking in their rehabilitation protocol.

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