



P-ISSN: 2394-1685

E-ISSN: 2394-1693

Impact Factor (ISRA): 5.38

IJPESH 2020; 7(5): 161-164

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www.kheljournal.com

Received: 17-07-2020

Accepted: 27-08-2020

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The effect of retro treadmill walking versus quadriceps strengthening exercise on pain and functional ability in patellofemoral pain syndrome

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Abstract

Background: Quadriceps strengthening exercises and Retro treadmill walking both have been individually advocated for their effect on Patellofemoral pain Syndrome (PFPS) but comparison of these techniques have not been found in studies.

Objective: To study the effectiveness of Retro Treadmill walking on Pain and functional ability in PFPS.

Study Design: Experimental design.

Source of Data Collection: DAV institute of physiotherapy, Yamunanagar.

Methodology: 50 patient of PFPS who fulfilled the inclusion criteria were taken for the study and randomly assigned in two groups: Group A received.

Retro treadmill walking: Group B received Quadriceps strengthening exercises The treatment was given for 28 days. Outcome measures of pain and functional ability were evaluated using VAS and Kujala Patellofemoral scale score on 1st (pre and post intervention), 7th, 14th, 28th (post intervention) day.

Result: Both the groups showed statistically significant improvements in function and pain scoring. However, Retro treadmill walking group showed highly significant improvements in VAS and Kujala Patellofemoral scale scores.

Conclusion: Retro Treadmill walking showed significant improvement in pain and functional ability and therefore should be incorporated in the therapeutic regimen in the rehabilitation of PFPS patients.

Keywords: Retro-treadmill walking, patellofemoral pain syndrome, kujala patellofemoral scale

Introduction

Patellofemoral pain syndrome (PFPS) remains one of the most common musculoskeletal entities encountered by the physiotherapists and sports medicine practitioners ^[1]. It is defined as the presence of pain around the patella, which is associated with activities that load the patellofemoral joint.

PFPS is an umbrella term used to encompass all anterior or retropatellar pain in the absence of other specific pathology which exacerbates during sustained sitting, kneeling, ascending or descending stairs and squatting ^[2]. The onset of PFPS is generally insidious and the progression is relatively slow. Its aetiology is poorly understood³ and still remained an unsolved problem, but several biomechanical factors appear very likely to predispose the condition which includes: tightness of the lateral retinaculum, Quadriceps insufficiency, increased Q angle, increased femoral anteversion, external rotation of the tibia, hyperpronation of the foot, congenital anomalies of the patella ^[4].

Many rehabilitation strategies have been implemented for the treatment of PFPS with the basic goals of maximizing the quadriceps strength and minimizing the patellofemoral joint reaction forces and stress ^[5]. As Quadriceps strengthening has been a standard component in rehabilitation of PFPS various Non weight bearing (NWB) and weight bearing (WB) exercises are designed for quadriceps strengthening. Although according to the studies WB exercises are proved to be significantly effective than NWB exercises as the WB exercises are more functional and require multiple joint movement that further facilitates the functional patterns of muscle recruitments and also stimulates the proprioceptors ^[6].

Researches also indicate that decrease in eccentric quadriceps activity may reduce patellofemoral joint stresses that are often associated with anterior knee pain.

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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 [7].

Previous studies have evaluated effect of backward and forward walking on quadriceps strength. Although, the effectiveness of retro treadmill walking programs on Patellofemoral pain syndrome is not well known. Therefore this study is designed to find effect of retro treadmill walking on patient with PFPS.

Material and Method

Study Design: Experimental design.

Sampling Method: Convenient Sampling Method

Research Setting: D.A.V. Institute of Physiotherapy and Rehabilitation, Yamuna Nagar.

Sample Size: 50 Subjects

Sampling Criteria

Inclusion Criteria

- Age 18 to 35 years
- Prediagnosed case of PFPS [3].
- History of retro or peripatellar pain during physical activities including jumping, squatting, running or stair ambulation or after prolonged sitting with flexed knees. [3]
- Symptoms for atleast two months.
- Presence of atleast one of the following clinical sign: Tenderness on palpation and compression of patella, pain on isometric quadriceps contraction against suprapatellar resistance, pain on resisted knee extension.

Exclusion Criteria

- History any recent knee surgery [8].
- Severe knee pain that precludes treadmill walking [VAS equal or greater than [7].
- Cardiopulmonary conditions that preclude treadmill exercise [8].
- Neurological disorders affecting gait of the individual.⁸
- Significant recent Injury to or any other pathology of hip, knee, ankle [8].
- Rheumatic disease affecting musculoskeletal system and sensorimotor performance.
- Foot deformity viz. pes planus or cavus with a potential of causing PFPS

Procedure

Subjects fulfilled the inclusion and exclusion criteria were included in the study by taking their written consent and were randomly divided into two groups.

Both groups were given with hot pack for 10 minutes pre intervention and TENS for 20 minutes post intervention.

Group A (Retro treadmill walking Group)

25 Subject in this group were given with retro treadmill walking intervention, they were first made familiarize with backward walking pattern. A practice session of 2-3 rounds over ground was given and later on were made to stand on treadmill and face in the direction opposite to the direction of the moving belt of treadmill such that retro walking movement occurred.

Cardiovascular parameters such as heart rate, pulse rate, respiratory rate and blood pressure were measured before treatment to check for stability in the parameters. [9] Signs of fatigue such as exhaustion, malaise, dizziness, loss of concentration were explained to subjects and asked to informed if found any discomfort.

Practice session was made for retro-treadmill walking, initially with support of hand railings and later on without the 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 5 days and 10% for another 5 days. [10] Speed for back walking was of 2 km/hr for 15 minutes during first 14 days and then progressed 2.5 km/hr for another 14 days.

Group B (Quadriceps strengthening Group)

25 Subjects of this group were given with

1. Quadriceps strengthening exercises. [11]

- Quadriceps isometric exercise. (10 second hold time)
- Straight-leg raising exercises

Both exercises were performed in supine position, with the knee in full extension, to minimize patellofemoral compression forces.

2. Static quadriceps-stretching: Was performed in prone position, by bending the knee and bring the foot up towards the buttocks and hold ankle with hand for 10 seconds.

Exercises were performed once a day with 3 sets of 10 contractions for 28 days.

Both the groups underwent intervention for 4 weeks i.e. 28 days excluding Sundays [8].

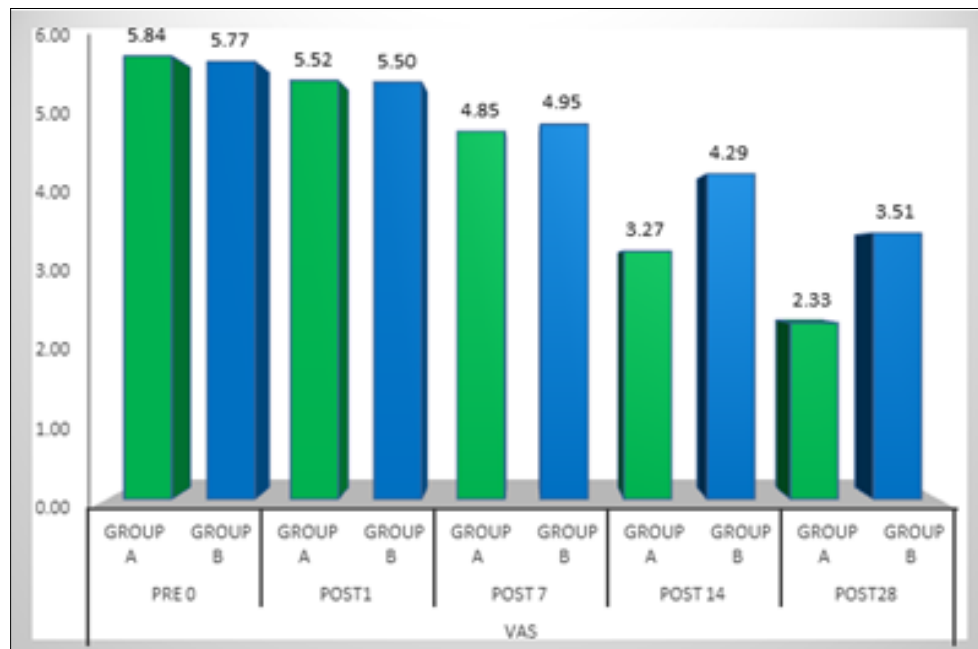
Outcome measures

- **Visual analogue scale** was used to measure pain.
- **Kujala Patellofemoral scale score** was used for evaluating functional ability [12].

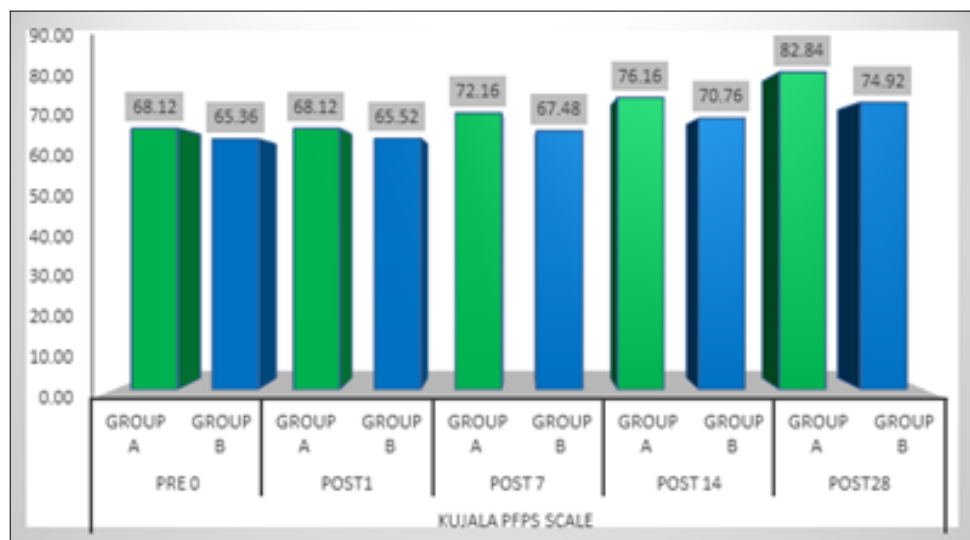
Outcome measures were recorded on 1st (pre and post intervention), 7th, 14th, 28th (post intervention) day.

Data Analysis and Results

Data was analyzed using the software SPSS-15.0. Unpaired & Paired T- was applied to compare outcomes between & within the groups.



Graph No. 1: Comparison of VAS between the Groups



Graph No. 2: Comparison of Kujala PFPS Scale Score between the Groups.

Discussion

This study emphasized on the use of backward treadmill walking to see its effects on pain and functional outcomes in subjects with patellofemoral pain. Its effects were seen against a conventional quadriceps exercises. Both the groups showed statistically significant improvements in function and pain scoring. However, Retro walking group showed highly significant improvements in reducing pain and improving functional ability.

The subjects in the retro treadmill walking group showed highly statistically significant improvement in Kujala patellofemoral scale and VAS. Rationale behind such significant effect could be that during backward walking the rate of patellofemoral joint compressive force loading has found to be significantly slower in later period of stance phase. This reduced rate of loading facilitates the accommodation and prevents the susceptibility to injury of articular cartilage that is rate sensitive to loading due to its viscoelastic properties [8].

The key to this difference could be also due to the fact that retro walking incorporates a closed kinetic chain or weight bearing rehabilitation. WB rehabilitation is more functional

than NWB exercises because they require multi joint movement, facilitate a functional pattern of muscle recruitment and stimulate proprioception. It is also known that exercise exerts its effects on the brain through several mechanisms, including neurogenesis, mood enhancement, and endorphin release. For persons with chronic pain, exercise may decrease fear/avoidance beliefs, leading to increase function and improved conditioning [13].

Biomechanically, muscles around ankle and knee reversed their action during retro-walking. In retro-walking, knee gives the primary power producer with co-contraction of quadriceps and hamstring and ankle plantar flexors works as shock absorber. In retro-walking, shear force at knee joint directed anteriorly whereas it moves posteriorly in forward walking [14]. Additionally, retro-walking causes significantly reduced patellar compressive force than forward walking [15].

Retro locomotion also known to improve the flexibility of hamstrings [16]. Since hamstrings tightness has been shown to be frequently associated with PFPS. Thus, improved flexibility might have also contributed to improvements although length of hamstrings was not measured pre and post intervention.

On within the group analysis, Conventional quadriceps exercise group also showed significant improvements in pain and function scoring. This could be due to the fact that any activity induced pain perceived within the patellofemoral joint is an indication of supra-physiologic loading event that will subvert normal healing mechanisms. Very often, the mere act of decreasing loading to within a joint's current diminished envelope of function after a supra-physiologic loading event leads to resolution of pain and restoration of function and restoration of tissue homeostasis ^[17].

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