



ECCENTRIC STRENGTH TRAINING VERSUS PILATES ON PAIN AND DYSFUNCTION IN RUNNERS WITH PATELLOFEMORAL PAIN SYNDROME.

Physiotherapy

**Dhanashree
Puralkar**

BPTH Intern, MAEER'S Physiotherapy College, Pune, India

Dr. Bindu Sarfare*

(PT) Associate Professor, MAEER'S Physiotherapy College, Pune, India *Corresponding Author

Dr. Snehal Ghodey

(PT) Principal, MAEER'S Physiotherapy College, Pune, India

ABSTRACT

Background: Patellofemoral joint (PFJ) is frequently affected in runners as when it is subjected to overload; puts stress on the joint by increasing the pressure points and leading to pain. Eccentric training is essential in strengthening weak muscles. Pilates improves flexibility and strengthen muscles strengthening whole body muscles and improve function especially in runners. Hence our project aims to find out which one of the two exercise forms targeted to PFJ, results in greater improvements in pain and physical function.

Methods: After ethical approval 66 participants were involved in the project, Eccentric (n=34) and Pilates (n=32). Anterior knee pain scale and KOOS questionnaire were used as outcome measures. Statistical analysis was done using in stat.

Results: AKPS and KOOS both showed significant improvements ($P < 0.001$) when compared within the groups. When compared between two groups for pain it showed significant p-value- 0.004 showing that eccentric training plays a better role in reducing pain. However, when compared between two groups for functions, p value - 0.530 indicates that both groups are equally effective in improving functions.

Conclusion: Our study shows that eccentric strengthening gave greater results in improving pain within six weeks. However, the functions have equally improved with both the groups.

KEYWORDS

Patellofemoral pain syndrome, Eccentric training, Pilates, anterior knee pain scale, KOOS questionnaire.

INTRODUCTION

Patellofemoral pain syndrome (PFPS) in runners is; linked to damage of cartilage underneath patella, when subjected to overload or overuse of joint which causes pain behind patella; Therefore, also known as runners' knee.⁴ Symptoms include; diffuse peripatellar/retro patellar pain. Ascent/descent stairs, cross leg sitting or squatting.^{2,4} Instability and crepitus with flexion movements is also frequent.^{1,3} Potential causes are; decreased iliotibial band, hamstring & quadriceps flexibility; femoral anteversion, widening of quadriceps angle, atypical mobility of patella and vastus medialis insufficiency.^{1,3} Patellar displacement plays a key role in patellofemoral pain syndrome.³ If repetitive stressful movements during functional activities are performed with these misalignments, it eventually causes pain.² These are relieved using conservative treatment. 25% of athletes stop sports recreation due to pain.⁴ Powers suggests, maintaining hip adduction/internal rotation during weight bearing activities is frequently reported as poor in patellofemoral pain syndrome.² This causes widening of quadriceps angle & lateral patellar contact.² Atrophy /quadriceps weakness is documented as PFPS. Therapeutic exercises improve individuals' function who wants to return back to sports.

Studies show that patients with weak quadriceps found it difficult to perform open kinetic chain exercises like one leg squat. Patients experienced; pain, functions and quality of life improved with rehabilitation.¹ Isometric, isokinetic and isotonic mode are some methods by which strengthening can be done.

Pilates; a form of exercise that is based on body- mind- spirit interaction combined with biomechanics, motor learning and core stability. It is a unique method used for physical fitness which uses the combination of strengthening, lengthening, develop trunk and restore muscle balance.⁵ It improves joint function and reduces pain.⁵ During a Pilates session patient needs to focus on activating specific muscles functionally in a sequence; with control of speed & movement, emphasizing quality, precision with specific attention towards breathing.⁵

Sports injuries commonly involve muscles, ligaments & tendons.⁶ Eccentric training have shown effectiveness in Achilles-tendinopathy & other sports injuries, suggesting its wide prescription in the sports rehabilitation field. Over approximately for last fifteen years use of eccentric training has increasingly gained attention in literature as a specific training modality.¹ Eccentric isotonic exercise plays an essential role in muscle strengthening program as it decreases

reactional forces on patellofemoral joint in case of an individual with weak quadriceps.¹ Pilates & Eccentric training; both have been proved to be beneficial but there are no studies which has compared both the strength techniques on PFPS.

Hence; Aim of our study, is to learn the comparative effects of eccentric training versus Pilates on runners diagnosed with patellofemoral pain syndrome.

MATERIALS AND METHODS

Study Design:

Experimental study was performed in stadiums and sports institutions for 6 weeks. TheraBand's, balance pads stepper and chair were needed to perform the protocol. 60 young participants both male & female were included. Each one of them were asked about their past medical history and their present health status. Prior to study they were given consent forms. Participants willing to participate signed the forms.

Inclusion criteria were as follow Insidious onset of symptoms for minimum 4 weeks unrelated to trauma, pain in knee (anteriorly) with any 3 from following list: during/after activity, prolonged sitting, ascending-descending stairs, squatting. Also Pain on palpating patellar facets during double leg squat or pain during step down from 25cm box, Recreationally active (>30 min/d, 3-4d/wk. for past 6 months and exclusive of pain), Pre-diagnosed PFPS and exclusion criteria for our studies were as Patellar dislocation or subluxation, Any previous h/o of musculoskeletal injury and fractures of lower limb or spine, NSAID's/corticosteroids use within 24hrs before testing/o head injury within last 6 months, Pregnancy.

METHOD:

Measuring variables was performed before(pre-test) & after (post-test) protocol. Two groups were made, one group participated in Pilates program for 6 weeks, and the other group in eccentric program, three sessions per week; 1 hour/day. Each exercise session consisted of 15-20 minutes of warm-up and 40 minutes of exercise. The Pilates program was taught and performed on mats. Eccentric training was done using TheraBand Progression of exercises, increases or decreases in sets and repetitions or exercises, and changes in TheraBand resistance, based on patient's feedback, PFP, swelling, and symptoms during rehabilitation progression. Initially they were asked to perform non-weightbearing, muscle strengthening exercises. These exercises were progressed to weight bearing including core & balance exercises. All exercises were performed bilaterally.

Outcome measures:

Kujala questionnaire: Kujala scale is a self-report questionnaire. It is widely used to identify pain and impairment of function. It is a 13-item questionnaire associated to knee complaints. It includes; running, walking, ascending-descending stairs, squatting, prolonged cross leg sitting, jumping related to patellofemoral joint. It also includes features such as; limp, pain on weight bearing activities, swelling, abnormal mobility of patella, limitation in flexion of knee. Its maximum point is 100, lower the score greater the disability.

Categorizations is as follows: Pain: no pain - severe pain, Function: no difficulty - unable

KOOS Questionnaire: It is a questionnaire specific to knee which assesses knee problems which hamper activities of daily living.

It consists; 42-items, divided into 5 subscales; pain, other symptoms, ADL's, functions related to sports activity & quality of life. Sample size calculation was done using $(Z\alpha/2 + Z\beta/2)^2 \cdot (SD)^2 / I^2$. Sampling technique used was Purposive Random Sampling.

Statistical analysis:

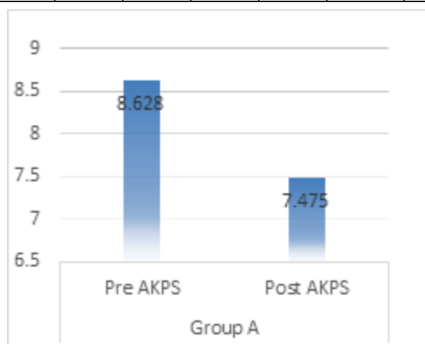
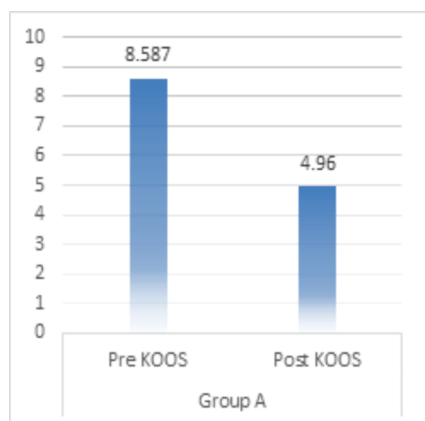
Statistical analysis was done using In Stat (Version 3.05, created 27 September 2000).

RESULTS:

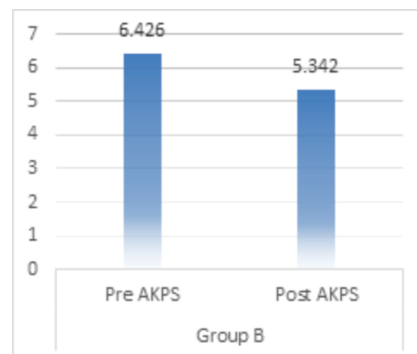
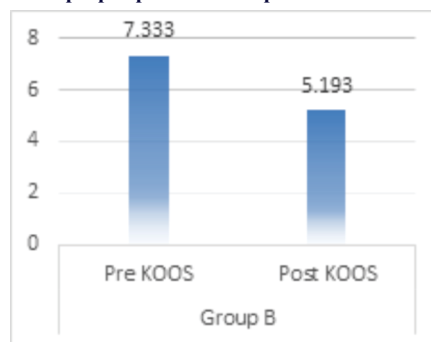
AKPS and KOOS both showed significant improvements ($P < 0.001$) when compared within the groups. When compared between two groups for pain it showed significant p-value- 0.004 showing that eccentric training plays a better role in reducing pain. However, when compared between two groups for functions, p value - 0.530 indicates that both groups are equally effective in improving functions.

Table 1: Changes in pre-post eccentric strengthening protocol.

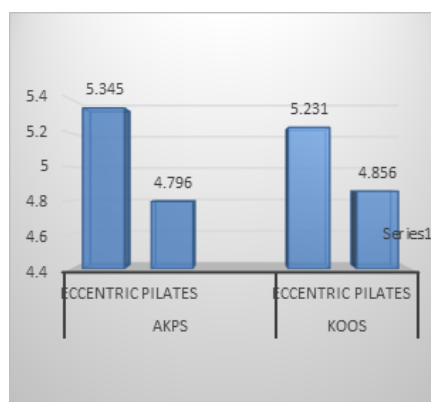
ECCENTRIC GROUP					
Outcome Measure	PRE RX		POST RX		Significance
	MEAN	SD	MEAN	SD	
Anterior Knee Pain Scale	70.345	8.628	81.897	7.475	<0.0001
KOOS Questionnaire	74.634	8.587	91.366	4.960	<0.0001

**Graph 1: Group A pre-post effects on pain****Graph 2: Group A pre-post effects on function****Tables 2: Changes in pre-post Pilates protocol**

PILATES GROUP						
Outcome measure	PRE RX		POST RX		P-VALUE	Significance
	MEAN	SD	MEAN	SD		
Anterior knee pain scale	69.567	6.426	86.100	5.342	<0.0001	Extremely significant
Koos questionnaire	73.017	7.333	88.852	5.193	<0.0001	Extremely significant

**Graph 3: Group B pre-post effects on pain.****Graph 4: Group B pre-post effects on function.****Tables 3: Baseline values of comparison between Eccentric and Pilates:**

Variable	Group				Unpaired t-test		
	Eccentric		Pilates		T-value		
	Mean	SD	Mean	SD			
Anterior knee pain scale	16.533	5.342	11.633	4.796	3.739	0.0004	Extremely significant
KOOS Questionnaire	16.673	5.231	15.850	4.857	0.6318	0.5300	Not significant

**Graph 5: Comparison of Eccentric and Pilates on pain and function.****CONCLUSION**

From this study, it can be concluded that eccentric strengthening gave better results in improving pain within six weeks. However, the functions have equally improved with both the groups.

DISCUSSION

The primary aim of our study was to compare eccentric exercises and Pilates in runners with knee pain for 66 patients with PFP who were randomized into either eccentric (n=34) or Pilates (n=32) focused rehabilitation protocol. There were 6 drop outs. ADL'S include static & dynamic conditions such as sitting or walking; therefore, AKPS and KOOS measure ADL'S.

We hypothesized better results on pain and dysfunction with eccentric protocol than the Pilates protocol. Greater results for pain were shown by eccentric group; However, functions are enhanced equally statistically in both groups.

Extremely significant p value <0.001 was obtained when pain and function were compared within the group.

Patellar maltracking results in altered contiguity in the joint due to muscle imbalance and altered body mechanics leading to PFPs in turn causing discomfort & stiffness.¹ Thus, VMO is unable to produce enough force and quadriceps fatigue sets in. EaCharupen, PhD,^{*} Chetan D. Nayak et al studies showed that the knee extension peak torque value decreased. Smooth control of quadriceps with eccentric contraction is difficult due to weakness of muscle in eccentric part of ADL's.¹ Thomee R et al; study showed; there was an increase in torque production with eccentric tightening as compared to isometric.¹ Quadriceps strength training can be done by isotonic/isometric mode.¹ Generally patients complain of pain during ADL's so therefore training the quadriceps in dynamic activity may improve their dynamic function.¹ As it has been studied concentric contraction of the quadriceps produce a greater torsional movement, and weakness during eccentric period may lead to increase in reactive forces in PFJ.¹

Knee pain can be treated by taping and bracing and reduce pain and improve function.¹ Although EaCharupen, PhD,^{*} Chetan D. Nayak et al; study showed that when they gave eccentric strengthening in isotonic mode using BTe primus machine there was an increase in the strength of the muscle however they are less active as indicated by EMG studies.¹ The percentage time was increased (percentage of time that a subject will be able to control the forces effectively during the treatment.¹ The active motor unit are thereby reduced as the CNS is able to derive benefit from the muscles to generate tension and decrease energy cost. Therefore, motor control plays a crucial role in the rehabilitation.¹ The goal is to teach the participant to make a better use of muscle stabilisers.¹

Subjects showed an improvement in pain score, functional component score on KOOS questionnaire which can be considered to be clinically significant. Better quadriceps control improves daily activities as seen with KOOS questionnaire.

One of the reasons, for improved strength may be exercises performed caused muscle activation & did not target 1 particular muscle.⁶ Reed Ferber, PhD, ATC, CAT(C)*; Lori Bolgla, PhD suggested that combination of hip and knee protocols works better. Their studies have shown that pain has improved within four weeks of strengthening of hip knee muscles and functions were improved by six –eight weeks.⁶ Open and closed chain exercise along with balance exercises given in combination directly target the muscles.⁶ Pain was decreased in both the groups. Probably motor control plays a role in pain relief. Another possibility may be that increase in strength may alter the contact location and reduce stress on knee Joint reliving vulnerable areas.⁶ This may also reduce pain and damage to tissues in coming times. Isotonic exercises play a big role in day to day activities, although eccentric training has resulted in significant outcome. Increased rotation of femur under the patella while standing results from altered motor control from the hip abductors and rotators.^{8,11} Faulty positioning of the femur during wt.-bearing activity may alter the kinematics of PFJ resulting in pain reduced functions, developing Patellofemoral Pain syndrome.⁸

Pilate's exercise improves strength, flexibility, postural awareness and balance by stretching and strengthening muscles.² It uses different strategies to control posture that may result in improved strength, balance, coordination, and/or biomechanics.² Increased postural stability may show positive clinical outcome following patellofemoral pain treatment.¹¹ Increased CoP displacement following the intervention may be due to increased joint proprioception.¹¹ By focusing on hip and core strength training during Pilates, there is

increase in joint proprioception and therefore increase in CoP displacement and greater torque production at the hip joint. The subjects wanted to challenge themselves to a greater degree after the protocol.¹¹ However, it is debatable whether the changes function is due to the absence of pain during the activity or improvements in strength.

Eccentric training directly targets muscles and does strengthening whereas Pilates help to strengthen minor muscles, eventually strengthening major muscles. Thus, Pilates used relatively simple muscle-strengthening protocols compared with those used in the eccentric group. Therefore, eccentric exercises should be a major part of treatment in the rehabilitation protocol of PFPs.

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