

Original article

Effectiveness of Pilates training in improving hamstring flexibility of football players

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Abstract:

Objective: The kick force is effective only if the flexibility of the muscle is in accord. The stretching capacity of tendons, ligaments and capsule are very limited due to the function of articular stabilization. Pilates exercises are to be performed to improve muscular flexibility with greater movement breadth, strength and fluency. Lack of flexibility is a limiting factor for performance and being a facilitator for muscular injuries. **Materials and Methods:** Goniometer, Sit and reach table and Exercise mat. 30 football players were randomly distributed into two groups, Pilates group (n=15) and control group (n=15). Control group was given Ballistic, PNF and Static stretching exercises and Pilates group was given Pilates protocol respectively. Both the groups were trained 5 times a week for 4 weeks, 30 minutes each session. Pre and post outcome measures of Goniometer and sit and reach test were taken. **Results:** The Pilates group training reported a higher level of improvement than control group ($p < 0.05$).

Keywords: pilates; hamstring; flexibility; goniometer; sit and reach test

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Introduction

Playing football is a high performance sports that requires speed, strength, agility and endurance. For players to remain on top of physical condition they need to be trained properly¹. A successful kick is usually defined in terms of velocity of the ball which needs greater swing limb, foot speed or the accuracy of direction of kick, which relies on the position of the non-kicking foot and hip apposition at impact². The cause of a hamstring injury is both intrinsic and extrinsic factors. The factors regarded in poor strength include imbalances between legs, fatigue and decreased flexibility³.

The shear nature of the game requires explosive movements and quick changes of direction, expecting the body parts to produce great force in short time. During a football match, hamstrings are required to control knee extension, through controlled lengthening of the tissue and for rapid shortening of the muscle which bursts of hip extension for propulsion. These constant changes from one function to the next leave the hamstrings vulnerable to injury. In a flash, the intensity and force required by a player's actions can surpass the mechanical limits tolerated by the muscle tissue and injury ensues. Foot ball players who have experienced

injuries during their careers attest that such injuries can be long standing and reoccurring⁴.

Hamstring strains are common injuries in sports characterized by maximal sprinting, kicking and sudden accelerations like foot ball. Hamstring strains account about 16–23% of injuries in football players². There is evidence showing that previous hamstring strains and age are independent risk factors for new hamstring strains⁴. Poor hamstring muscle flexibility, muscle fatigue and insufficient warm-up, have also been suggested to predispose to hamstring strains^{3,4}.

Flexible muscles perform better than tight muscles⁵. The important factors like flexibility, muscle strength and control are often ignored by athletes at their peril. Joints or series of joints used to produce particular movements are considered to have both static and dynamic flexibility. Flexibility is joint specific and sport specific. It has two components, static and dynamic stretching that are ballistic and PNF⁶.

Static stretching has been used throughout the years for two main reasons, injury prevention and performance enhancement. Dynamic flexibility describes the use of the desired velocity. Static stretching increases the range of motion and relieves muscle tightness and stiffness, it improves postural imbalances and also

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increase localized blood flow to the muscles⁷.

Joseph Pilates called his method as 'Contrology', because he believed his method uses the mind to control the muscles. Pilates training is intended to improve general body flexibility and by emphasizing core strength, posture, and coordination of breathing with movement⁸.

Pilates is marked to athletes and people with medical conditions such as rheumatoid arthritis with the claims that it balances strength and flexibility, helps prevent injury and enhances functional ease of movement⁹. Therefore, this study was designed to assess Pilates training that is associated with increasing flexibility.

Inclusion criteria^{5,10}: Age between 17 to 20 years, both male and female, Body Mass Index Range of 21-25, only football players.

Exclusion criteria⁵: Lack of full participation in team's training activities, history of previous muscle injury for a period of 6 weeks, lower limb fracture, post surgical condition and neurological pathology.

Materials required: Goniometer, Sit and reach table and Exercise mat.

Outcome measures:

Goniometer^{5,11,12}:

Goniometer is used to measure Hamstring Flexibility.

Testing Position: Supine or reclined with hip and knee in neutral rotation

Stabilization: Trunk and pelvis stabilized by body weight and position

Goniometer Axis: Lateral epicondyle of the femur, Proximal Arm: Parallel to the long axis of the femur & pointing at the greater trochanter. Distal Arm: Parallel to the long axis of the fibula and pointing at the lateral malleolus.

Movement: The hip and knee are flexed as the heel moves toward the buttock.

Expected ROM: 135°

Sit and Reach test^{5,13}:

Procedure: The starting position for Sit and Reach test is sitting on the floor with shoes removed, feet flat against the table, and keeping legs straight.

Reach forward and push the fingers along the table as far as possible. The distance from the finger tips to the edge of the table represents the score for that person. As the 'sit and reach' table has an overhang of 15 cm, a person who reaches 10 cm past their toes scores 25 cm. It is important to have several warm-up attempts first, and to record the best score.

Analysis: Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

Study set up: Pachaiyappa Arts & Science College, Chennai, YMCA College of Physical Education, Chennai.

Procedure

We designed a single blind, randomized control trial. Were 30 football players are randomly selected for the study, Pilates group (n=15) and Control group (n=15).

Pilates group:

Subjects were administrated with Pilates training five times a week for a period of four weeks. The total duration of each session is about 30 minutes a low resistance exercise^{5,14}.

Protocol 1

1. Leg Circles⁹

Starting Position: Lie down on the mat with flat back, arms lying on sides with palms down, knees bent so that feet are flat on the floor.

Action: Lift one leg up, creating 90-degree angle with the floor. Bend the knee slightly as it will help to work better on the thigh muscles. The other leg stays bent stationary on the floor. On the inhale, move the elevated leg in a clockwise motion, engaging the abdominal and thigh muscles. The circle should not be bigger than two in diameter. On the exhale, complete the circle. Stop and hold the position for just a moment before starting the next circle. Done for 20 circles.

2. Leg up and down¹⁵

Starting Position: Lie on the sides and line up the ears, shoulders, hips, knees and ankles. Prop the head up on to the hand; ensure to lift the ribs away from the mat so that the back and neck stay in alignment. The front hand rests firmly, palm down on the mat in front of chest.

Action: Move the legs slightly forward to the hips. This will help to protect the lower back. Rotate the legs out slightly from the hips, in Pilates stance. Procedure repeated for 20 times.

3. Scissors¹⁵

Starting Position: Lie down on the mat with back flat against the floor and belly button pressing down to the spine. Place hands flat on the floor to support the weight.

Action: Bring knees into chest and extend both legs straight up in air, with toes pointed towards the sky. The back and spine should form a 90 degree angle. Slowly bring the legs higher until they are above the head and lift the spine off the ground. Move the left leg towards the head while moving the right leg down towards the ground. The legs will resemble a pair of scissors. Inhale and exhale while moving the right leg towards the head and the left leg towards the ground. Procedure repeated for 10 times.

4. Side Kick⁹

Starting Position: The shoulders should be stacked on top of the other, as should the hips. Shoulders and hips are in a line and the knees and ankles are a slightly in front.

Action: Lengthen the top leg up towards the ceiling, smoothly with control. Ensure that the pelvis does not tilt back to let the leg go up. Keep the hip bones stacked. Procedure repeated for 30 times.

5. The Saw¹⁵

Starting Position: Sit on the mat; spread the legs pointing the toes up.

Action: Raise the arms out to the side until they are parallel to the floor. Make sure the arms are straight. Cross or saw, by twisting the abdomen to the right. Touch the right pinky to the smallest toe on the left foot. Inhale and return to the starting position. Just reach as far as possible. The goal is to stretch until a little burn is felt. Twist so that the left pinky touches the smallest toe on the right foot. Procedure repeated for 10 times.

6. Spine Stretch⁹

Starting Position: Sit straight on the Sit bones keeping legs extended about shoulder width apart and feet flexed.

Action: Inhale and extend the arms out to the front, up to shoulder height. Exhale while lengthening the spine to curve forward. Now a deep C-Curve is being formed. Allow a deep release in the hips while keeping the shoulders down and reach the fingers towards the toes. Inhale and reach a slightly further until feeling the complete stretch. Exhale while initiating the return by using lower abdominals to bring the pelvis upright. Procedure repeated for 10 times.

7. Shoulder Bridge¹⁵

Starting Position: Lie on the back with knees bent and feet in parallel. If the back is working too hard, the height of the pelvis is to be modified.

Action: Bridge the pelvis off the floor with legs. Exhale with a hollow and lift the left thigh and extend leg to the ceiling. Inhale and lower straight leg to the floor with maintaining the bridge. Exhale and extend left leg back to the ceiling. Return foot to the floor Exhale with a hollow and lift the right thigh and extend leg to the ceiling. Inhale and lower straight leg to the floor with maintaining the bridge. Exhale and extend right leg back to the ceiling. Return foot to the floor. Lower the pelvis back to original position. Procedure repeated for 10 times.

8. Neck Pull¹⁵

Starting Position: Lie on the back keeping spine relaxed on the floor. Pull the navel in towards the spine.

Action: Tuck the chin in towards the abdominals. The ideal pose is to keep the chin touching the top of the

chest. Place the hands behind the head keeping the elbows pointing outward in between wall and ceiling. Position the elbows to look like the wings of a butterfly in mid-flight. Begin the neck pull by moving upward slowly. Continue leaning forward until the elbows touch the knees. Keep this position for few seconds and then roll backward. The neck should stay elongated throughout the exercise so that the neck muscles are stretched. Procedure repeated for 10 times.

9. Pilates Push Up¹⁵

Starting Position: Standing with good Pilates posture.

Action: Inhale, keep the shoulders down while bringing the arms straight up over the head. Exhale and allow arms to follow the ears while nodding the head and begin to roll down towards the mat. As rolling down, pull the abdominals in and curve the spine until hands reach the mat. Knees may be bent toward the end to get the hands to the mat. Walk out to plank pause at front support / plank lower toward the mat, return to plank, walk back, roll up to standing, exhale and use the abdominals to slowly return the pelvis to the upright position and allow the rest of the spine to roll up, vertebrae by vertebrae to end in a standing position. Inhale to lift arms. Procedure repeated for 10 times.

Control group^{16,17}: Subjects were administered with Ballistic, PNF and Static stretching exercises for the hamstring muscles five times a week for a period of four weeks. Warm up and cool down exercises for five minutes each.

Starting Position: Long sitting position on a firm surface, keeping one leg straight, bend the other leg at the knee level, placing the sole of the foot on the medial aspect of the leg that is remaining straight.

Action: The subjects pull themselves up and lean forward and toward the foot of the straightened leg until they feel a stretch in the hamstring. In standing position for stretching, the individual has to place the stretching leg forward on an elevated surface and simultaneously bending forward at the waist i.e. without flexing the spine to achieve an adequate stretch. Keep the straightened leg relaxed, pointing the subject toes up.

Repetition: The subjects hold the stretch for 30 seconds, and slowly releases. Each exercise for 30 seconds, hold 15 seconds to relax with 3-5 repetitions. The total duration of the exercise program is 30 minutes.

Statistical Analysis

Statistical analysis was performed using SPSS software package version 20 was used for evaluation; values were presented as means± standard deviation, student 't' test was used to analyze the effectiveness of flexibility on Pilates using goniometer and sit and reach test.

The mean value of Pilates Group in pretest is 120.9

Comparison of Pilates and control group using Goniometer and Sit and Reach test

Goniometer	Pre test		Post test		t -value	Significance
	Mean	SD	Mean	SD		
Control group	124	4.9857	126.07	3.1615	-1.39	0.18
Pilates group	120.9	4.1814	134.23	2.0986	-5.349	0.000
Sit and Reach	Pre test		Post test		t -value	Significance
	Mean	SD	Mean	SD		
Control group	34	2.2756	34.57	2.3135	-0.778	0.450
Pilates group	33.47	1.5864	40.7	1.9068	-11.05	0.000

and mean value of the post test is 134.23. The increase of the mean value proves that there is an improvement in hamstring flexibility through Goniometer. The mean value of Pilates Group in pretest is 33.47 and mean value of the post test is 40.7. The improvement of the mean value proves that there is an improvement of hamstring flexibility through Sit and Reach.

The mean value of Control group in pretest is 124 and mean value of the post test is 126.07. The improvement of the mean value proves that there is a mild improvement of hamstring flexibility through Goniometer. The mean value of Control group in pretest is 34 and mean value of the post test is 34.57. The improvement of the mean value proves that there is a mild improvement of hamstring flexibility through Sit and Reach.

The study was an experimental study. Statistical analysis was carried out by using student 't' test. Pre and post test comparison of both group, experimental as well as control group were carried with the help of paired 't' test. Comparison of post test on experimental and control group were carried out with the help of independent 't' test. A 'P' value of less than 0.05 was considered to be significant. The 't' test is used for testing the significance of difference between the means of two different samples of same size. When the mean value of the group statistics is calculated then the result of both can be evaluated. The mean value of both the groups for Goniometer, and Sit and Reach proved that the improvement of flexibility was more in the Pilates athlete when compared to Control group athlete. Statistical significance was accepted at $p < 0.05$.

Thus it shows that there was statistically significant improvement in hamstring flexibility after Pilates training.

Discussion

Pilates group showed improvement in terms of hamstring flexibility in football players. It was supported by studies done by Flávia Bertolla, a study on effects of training program using the Pilates method

in flexibility (n=20) indoor soccer athletes⁵, Bruno Manfredini Baroni examined the effect of hamstring flexibility over a period of two weeks through Pilates training and they showed better results. A.P. Marques, suggests that stretching programs performed three times a week yield better gains in flexibility than those performed once a week and similar to those performed five times a week, when the goal is the improvement in flexibility and range of motion¹⁸. Jari Ylien, did a study on effect of stretching on hamstring muscle compliance, they concluded stretching improved passive straight leg raise with no change in muscle compliance. Muscle viscoelastic properties and strength were preserved despite improved straight leg raise¹⁹.

It is well known that gain in flexibility involve biomechanical, neurological and molecular mechanism that determines a long-term result. After the Pilates training, this kind of exercise makes the muscle elastic gradually; as stated by Flavia Bertolla⁵. Control group showed mild improvement in hamstring flexibility in football players. This can be attributed to static stretching which control group has received. This improves in value based on changes in the relationship between length and tension.

Conclusion

The study was found to be apparent that Pilates training has improved hamstring flexibility when compared to that of static stretching. The result shows that Pilates training can successfully be incorporated in a flexibility training program to improve the hamstring flexibility of football players.

Ethical approval: The study design was approved by Ethics Committee of AIMST University, Malaysia

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Conflict of interest : None declared

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