

Comparative Study on Tibialis Posterior Muscle Strengthening Exercise Vs Quadriceps Muscle Strengthening Exercise in Reducing Pain and Improving the Functional Status for Peoples with Anterior Knee Pain

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How to cite this article: Kavi priya K, Ramana K, Anitha A et. al. Comparative Study on Tibialis Posterior Muscle Strengthening Exercise Vs Quadriceps Muscle Strengthening Exercise in Reducing Pain and Improving the Functional Status for Peoples with Anterior Knee Pain. Indian Journal of Physiotherapy and Occupational Therapy / Volume 18, Year 2024.

Abstract

Background: Flat foot is a condition in which the Medial longitudinal arch (MLA) has a more flattened curve when foot makes full contact with the ground. In medical terms, flat foot is associated with the pronated foot. For people ages 20 to 60, flat foot prevalence is 13.6%. People who have weak posterior tibial tendons are more likely to have flat feet and Flat foot is one of the contributing factors to development of anterior knee pain.

Purpose: To compare the effectiveness of Tibialis posterior strengthening exercise and Quadriceps strengthening exercise among people with anterior knee pain.

Materials and Method: The experimental study included 170 volunteers, both male and female, aged 20-60 years, who were drawn from Martin Physiotherapy Clinic by convenience sample method. informed consent was obtained before beginning the study. The participants were divided into two groups, the Tibialis posterior (n=85) group received Tibialis posterior strengthening exercise, whereas the Quadriceps (n=85) group received Quadriceps strengthening exercise. The intervention was administered five times over the course of six weeks.

Study Period: March 2023 to July 2023.

Results: The collected data was statistically analysed using paired and unpaired t-test, showed significant improvement in Tibialis posterior group than quadriceps group with $p < 0.0001$.

Conclusion: The study concludes that Tibialis posterior strengthening was more effective in reducing pain and improving functional status among peoples with anterior knee pain.

Key Words: Anterior knee pain, AKPQ, Flat foot, Single limb heel rise test, Quadriceps, strengthening, Tibialis posterior strengthening.

Introduction

Pain behind or around the patella (knee cap) when the knee is loaded in flexion or extension is referred

to as anterior knee pain or patellofemoral pain. It is widely observed in physically active young people, and aged people. It is more prevalent in women than

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in men. They have trouble in getting into and out of the squat position, climbing and descending stairs, and sitting for an extended period of time with the knees bent ¹.

Flat foot is a condition in which MLA flattens and the entire sole of the foot becomes flat when contact with the ground. The foot arches develop between the ages of two and six, and they reach structural maturity between the ages of 12 and 13. Flatfoot is classified into 2 types: rigid (symptomatic) and flexible (asymptomatic) flatfoot ². For people ages 20 to 60, the flat foot prevalence is 13.6%. In this study flatfoot is assessed using Clarke's angle by foot prints. The normal angle is 42-54 degree, < 30 degree is severe, 30-35 degree is moderate, 35-41 degree is mild and > 54 degree is high arched foot ³.

Tibialis posterior [TP] is the main stabilizer of MLA and responsible for 75% of MLA integrity and stiffness. The main contributing factor to flatfoot deformity in adulthood is tibialis posterior weakening and dysfunction ⁴. Biomechanics: The subtalar joint's overpronation and excessive hindfoot eversion causes the tibia to twist excessively and alter the patellofemoral force's direction and decrease the patellofemoral joint's contact area, increasing the joint's stress during weight-bearing and results in patellofemoral pain. Excessive internal rotation of tibia and excessive foot pronation morphology may be linked via closed chain coupling ⁵.

Exercises to strengthen the tibialis posterior will improve dynamic balance and lessen pressure on the plantar medial column, improve foot functions, strengthen foot muscles, minimize excessive pronation and are helpful in reshaping the foot ⁶. Exercises that strengthen the quadriceps can help patients with knee discomfort feel better, function better, reduce pain and make them more stable ⁷.

Clinical and functional results were assessed using the Kujala patellofemoral score (KPS) or the anterior knee pain questionnaire (AKPQ) and The single-limb heel rise test.

Aim

The aim is to compare the effectiveness of Tibialis posterior strengthening exercise and Quadriceps strengthening exercise among peoples with anterior knee pain.

Materials and Method

- Chair
- Towel
- Theraband
- Ball
- Yoga Mat

It was an experimental study conducted on 170 subjects with anterior knee pain, aged between 20-60 years. The Subjects were chosen from Martin Physiotherapy Clinic and Pain Management Centre. Convenience sampling method was used in the study.

Study Period: March 2023 to July 2023.

Inclusion Criteria

- Both Male and Female
- Age group: 20-60 years
- Subject with flat foot along with anterior knee pain
- Single limb heel rise test repetition between 0-3
- AKPQ score less than 100
- Clarke's angle less than or equal to 30 degree

Exclusion Criteria

- Subjects with previous knee injury
- Knee OA
- Subjects with recent history of surgery
- Recent fractures
- Neurological deficit of legs
- Open wounds

Outcome Measure

- Anterior Knee Pain Questionnaire:

The entire questionnaire consists of 13 items, asks about how the pain is in daily activity and also asks about symptoms. The lowest score is 0 (severe), and the maximum point is 100 (absence of symptoms) ⁸.

- Single Limb Heel Rise Test:

The tibialis posterior muscle weakness is assessed with this test. The patient balances himself against the wall using their arms throughout the test and attempts to raise the affected foot onto its toes by

elevating the opposite foot off the ground. Patients with weak muscles aren't able to perform a single repetition or more than three repetitions as normal people can perform 8-10 repetitions⁹.

Procedure

The experimental study included 170 participants of age group 20-60 years, both male and female were recruited through Footprint analysis, Single limb heel rise or endurance test and AKPQ based on inclusion and exclusion criteria. All the participants were provided with an information sheet and informed consent were obtained before commencing the study. The Participants were allocated into 2 groups using a convenience sampling method. The Tibialis posterior group (n=85) received Tibialis posterior strengthening exercise whereas the Quadriceps group (n=85) received Quadriceps strengthening exercise. The intervention was given 5 times for a duration of 6 weeks.

- Tibialis Posterior Group

The subjects of Tibialis posterior group were given the following exercises and these exercises were performed in sitting or standing for 30 minutes, weekly 5 times for a duration of 6 weeks.

1. Foot Adduction Resistance Exercise:

Ask the subject to sit in a chair with their feet flat on the ground. Then one end of the TheraBand is fixed around the feet, and the other end of the band is held by me to maintain resistance, and the subject is advised to abduct the feet and hold for 5 sec. Ask to repeat the exercise. (10 reps x 3 sets)

2. Foot Supination Resistance Exercise:

Ask the subject to place his one leg at the end of the stair with the knee in a bent position. Then ask them to perform maximum foot supination and hold it for 5 seconds. Ask them to repeat the exercise. (10 reps x 3 sets)

3. Heel Raise Exercise:

Ask the subject to stand on a wall or chair, with both hands, hold onto for support. Then ask them to Lift their heels up from the floor until they feel tightness in the back of the leg and ask them to hold for 5 sec and return to the floor slowly. Keep their

toes on the floor and their knees straight. Ask them to repeat the exercise. (10 reps x 3 sets)

4. Calf Raise Exercise:

Ask the subject to place both their feet flat on the ground as they stand sideways against a wall, keeping arches in a nice neutral posture. Then ask them to put their one hand against the wall to help them to stay balanced and ask them to place a ball in between their ankles just above medial malleoli. Then ask them to lift the heel to a maximum height and pause for 5 seconds. Then slowly ask them to return to the starting point and arches don't collapse inward as they put their feet back on the ground. Ask them to repeat the exercise. (10 reps x 3 sets)

5. Single Leg Calf Raise:

Ask the subject to raise up onto toes and hold this position for 5 seconds before lowering back down. Ask them to repeat the exercise (10 reps x 3 sets)

- Quadriceps Group

The subjects of Quadriceps group were given the following exercises and these exercises were performed in sitting, lying or standing for 30 minutes, weekly 5 times for a duration of 6 weeks.

1. Knee Isometric:

Ask the subjects to lie on their back and towels were used to prop up their knees. Then ask the subject First to contact the hamstring by digging heel into the bed and then tense the quad by pushing the back of the knee into a rolled towel, ask them to hold for 5 sec and repeat the exercise. (10 reps x 3 sets)

2. Short Arc Quads:

Ask the subjects to lie on their back and towels were used to prop up their knees. Then ask them first to contact the hamstring and slowly to straighten their bent knee until it is straight. Then ask them to lift their leg without bending and pause for 5 seconds then slowly lower their leg and ask to repeat the exercise. (10 reps x 3 sets)

3. SLR:

Ask the subject to lie on the floor and bend one leg and other leg in straight. Then ask them to raise

up the straightened leg off the floor. Then ask them to hold at the top for 5 seconds and then lower their legs down. Ask them to repeat this exercise. (10 reps x 3 sets)

4. Seated Knee Extension:

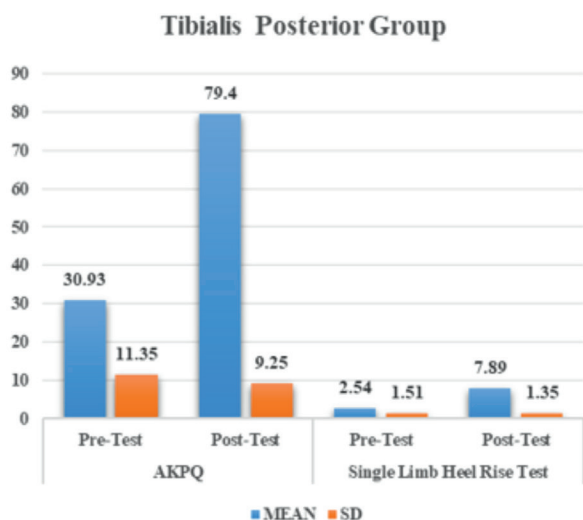
Ask the subject to sit up tall in a chair. Then ask them to lift the affected leg straight and tell them to hold for 5 seconds, then ask them to put the legs down and repeat the exercise. (10 reps x 3 sets)

5. Wall Squat:

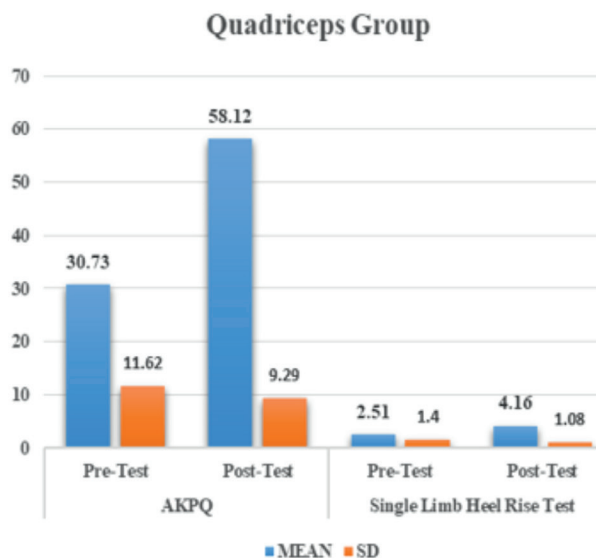
Ask the subject to stand straight, with their backs against walls and their feet shoulder-width apart. Ask them to bend their knees slowly to a 45-degree angle. Then ask them to slide back down the wall for a count of five and hold the position for 5 seconds. Then ask them to Slide up the wall and repeat the exercise. (10 reps x 3 sets)

Data Analysis

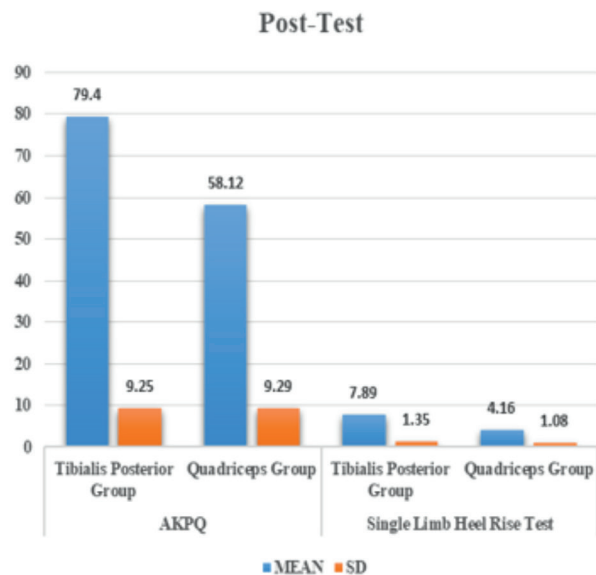
The mean and standard deviation (SD) were applied to all parameters. The significant differences between pre-test and post-test measures of the same group were analysed using a paired t-test and the post-test values of both the groups were analysed using the unpaired t-test to examine significant changes between two groups.



Graph-1: Comparison of pre-test and post-test values of AKPQ and single limb heel rise test in tibialis posterior group



Graph-2: Comparison of pre-test and post-test values of AKPQ and single limb heel rise test in quadriceps group



Graph-3: Comparison of post- test values of AKPQ and single limb heel rise test in tibialis posterior group and quadriceps group

Result

This experimental study included 170 participants of age group 20-60 years, both male and female who had anterior knee pain. They were divided into two groups: the Tibialis posterior group (n=85) received treatment for posterior tibialis strengthening activities, and the Quadriceps group (n=85) received The Anterior Knee Pain Questionnaire (AKPQ) and

Single Limb Heel Rise Test scores were analysed before and after 2 weeks of therapy to provide pre-test and post-test values, respectively for a six-week period using t-test.

The AKPQ post-test mean value in Tibialis posterior group was 79.40 (+9.25), while it was 58.12 (+9.29) in the Quadriceps group. The Single limb heel rise test post-test mean value in Tibialis posterior group was 7.89 (+1.35), while it was 4.16 (+1.08) in the Quadriceps group. This indicates that the Tibialis posterior group is significantly higher than the Quadriceps group, with a P value of < 0.0001. (Graph -3).

Statistical analysis of the AKPQ and Single limb heel rise test post-test results revealed that Tibialis posterior group and Quadriceps group showed similar statistically significant differences. As a result, the Tibialis posterior group exceeds the Quadriceps group statistically.

Discussion

The purpose of the study is to evaluate and compare the efficacy of tibialis posterior strengthening exercise and quadriceps strengthening exercises in decreasing pain and enhancing functional outcome in peoples with anterior knee pain.

The experimental study included 170 participants of age group 20-60 years, both male and female were recruited through Footprint analysis, Single limb heel rise and AKPQ based on inclusion and exclusion criteria. All the participants were provided with an information sheet and Informed consent was obtained before commencing the study. The participants were allocated into 2 groups. The Tibialis posterior group (n=85) received Tibialis posterior strengthening exercise whereas the Quadriceps group (n=85) received Quadriceps strengthening exercise. The intervention was given 5 times for a duration of 6 weeks. The outcome measures were AKPQ and Single limb heel rise test assessed before the initiation and after 6 weeks of treatment.

Tibialis posterior group and Quadriceps group showed similar statistically significant differences in the AKPQ and Single limb heel rise test post-test findings (Graph 3). This study discovered that tibialis posterior muscle strengthening exercise is particularly

beneficial in lowering pain and improving functional status in those with anterior knee pain.

In 2021, Luoman Ali conducted a Quasi-experimental trial. The study involves 30 male and female participants ranging in age from 15 to 35 years. Group A (n=15) received exercises to strengthen hip muscle, while Group B received exercises to strengthen knee muscle. The study lasts 6 weeks, with 25 sessions per week. He concludes that hip muscle strengthening exercises are beneficial ¹⁰.

In 2019, Alexandar Hott, MD et.al conducted a randomized controlled trial. The study included 112 patients ranging from 16 to 40 years of age, with symptoms lasting more than 3 months, were separated into three groups. The first group (n=39) given education along with isolated hip exercise, the second group (n=37) given knee exercise, and the third group (n=36) given free physical activity for 6 weeks, concludes that these exercises are not effective in decreasing pain ¹¹.

In 2021, Kisacik, Pinar et.al conducted a randomized control study. 30 subjects were separated into two groups. The control group received hip and knee stretching and strengthening activities, while the SFE group (n=15) received the same exercise with SFE. Both groups were given exercise intervention twice a week for six weeks and concluded that exercise programs that included additional SFE had a good effect. Increased hip extensor strength may potentially be associated with enhanced SFE stabilization ¹².

Conclusion

This study concludes that the two workouts employed in this study, Tibialis posterior strengthening exercise and Quadriceps strengthening exercise, are beneficial in reducing pain and impairment. In persons with anterior knee pain, Tibialis posterior strengthening exercise is more effective than quadriceps strengthening exercise in reducing pain and boosting functional status.

Ethical Clearance: Taken from Institutional ethical committee. ISRB number- 03/ 039/ 2022/ ISRB/ SR/ SCPT

Funding: Self

Conflict of Interest: Nil

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