Original Article

A Study to Compare the Kinematic Chain Exercise Versus Theraband Exercise on Pain for Subjects with Flat Foot

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Abstract

Background: Pes Planus (flatfoot) only becomes a medical issue when symptoms appear. This disease occurs in both young children and adults. When the medial longitudinal arch (MLA) has raised to the point where it cannot be maintained, the flatfoot changes form. This condition causes over pronation of the foot in contrast to normal feet, resulting in heel eversion and moving the weight load inward to compress the MLA.1-2

Purpose: To compare the effectiveness of kinematic chain exercise and TheraBand exercise session among the young adults with flat foot.

Materials and Methods: 30 subjects participated and were taken from Saveetha college of physiotherapy based on specific criteria and assigned to two groups. Pre and post assessment was taken using Numerical Pain Rating Scale [NPRS] and Foot Functional Index Scale [FFI]. The interventions were given for 2 Weeks and the study was conducted from November 2022 to April 2023. .

Results: The study's results revealed that both groups exhibited significant improvements in flat foot, with a p-value < 0.001. However, Group A showed more statistical significance than Group B.

Conclusion: In conclusion, the commencement of two- week intervention plan, kinematic chain exercise showed a marked outcome on pain subjects with flat foot

Keywords: Pes Planus, Kinematic chain, TheraBand, Young adults, FFI , NPRS.

Introduction

Pes Planus (flatfoot) becomes a medical problem when symptoms emerge.In contrast to normal feet, this disorder makes the foot overpronation, causing heel eversion and shifting the weight load inward to compress the MLA. [1-2] Patients with Pes Planus should receive conservative care unless there are signs of rheumatic, intramuscular, genetic, or collagen issues. Pes planus is defined as having a regular arch when not bearing weight or tiptoeing and a flattening arch when standing. [3-5] It inverts the foot and acts as a plantar flexor. Flat feet are more common in people with Neurological or Muscular conditions including Cerebral Palsy, Muscular

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Dystrophy, and Spina Bifida. [6] A flat foot can result in ankle swelling, cramping in the leg or foot muscles, pain in the arch, ankle, heel, or outside of the foot, alterations in gait, pain while walking, and migrating toes. [7] The kinetic chain concept is applied in a range of therapeutic contexts, including as prosthetics and orthodontics, neurorehabilitation, sports medicine, and musculoskeletal medicine. [8]

Closed kinetic-chain (CKC) movement to strengthen and regulate knee muscles Exercises in the OKC are performed with free distal and fixed proximal extremities.[9] The usage of axial-load exercises, commonly referred to as CKC exercises, are now used more frequently than ever before.[10] After post-posterior cruciate or lateral collateral ligament reconstruction or damage, the OKC flexion exercise should be avoided due to moderate to large flexion angles and resistive pressures. [11] The anterior cruciate ligament won't be in danger and the exercise can be used to improve the hamstring muscles. [12]

Kinetic chains can be quickly discovered by biomechanical evaluations like gait analysis. For instance, tibial internal rotation brought on by foot pronation results in knee valgus and hip internal rotation. [13] TheraBand exercises are a safe instrument for improving the nervous-muscular system, muscle strength, and functional capacity. [14] TheraBand is an advanced resistance workout that might boost muscle growth and strength. Resistance training using TheraBand has been shown to improve strength and postural stability. [15,16] TheraBand has been shown to improve strength, mobility, and function while also reducing joint discomfort. [17] TheraBand provides resistance; this resistance is created by stretching force and may strengthen weakened muscles. [(18)] TheraBand strength training may help women avoid muscle disability. [19] TheraBand is being used in an advanced resistance exercise that could help people get stronger and more powerful muscles. [20]

Aim

The study is intended to compare the effect of Kinematic chain exercise and TheraBand. exercise on subject with flat foot with pain in young adults.

Material and Methods

It was an experimental study conducted on 30 subjects. convenient sampling with random allocation method was used in this study. The entire study process was conducted from November 2022 to April 2023. .

Inclusion criteria:

1. Young adults aged between 18-25 years.
2. Subjects of study with Foot pain or discomfort
3. Visible foot deformity
4. Over pronation

Exclusion criteria:

1. Recent Sprained ankle
2. Neurological conditions
3. Normal gait pattern
4. No visible deformity

Outcome measures:

The assessment was performed at baseline (before starting of treatment) and after two weeks of study.

- Numerical Pain Rating Scale (NPRS)
- Foot Functional Index Scale (FFI)

Procedure

30 participants were chosen and divided into two groups according to the selection criteria: participants had to be between the ages of 18-25, both male and female, and they had to score between grades of 0-10 on the numerical pain rating scale (NPRS) and a self-administered index consisting of 23 items divided into 3 sub-scales. Each item is rated on a 0 – 10.Group A underwent 30 minutes of kinematic chain exercise (chest fly using dumbbells, step up forward exercise, wall slide exercise), with each set of exercises consisting of 5-8 repetitions and a 2-minute rest period. TheraBand exercises were given to Group B. For 30 minutes, Group B underwent TheraBand exercises with 5-8 repetitions of each set and a 2-minute rest period between sets. For two weeks, the study was carried out five days per week. The same outcome measure was used for the post-test following the termination of the treatment protocol.

Group A: Kinematic chain exercise

1. Chest fly using dumbbells**.**
    - Position yourself in front of the Swiss ball as it is placed on the ground.

- Roll forward after sitting on the Swiss ball so that the ball is supporting your head, upper back, and shoulders.
- You should stand with your feet shoulder-width apart, firmly planted in the ground.
- Throughout the exercise, keep your spine in a neutral position. Squeeze the dumbbells:
- Keeping your palms facing inward while holding a dumbbell in each hand with an overhand grip, raise your arms straight up above your chest.
- Your elbows should be slightly bent, and your arms should be at shoulder width.
- Pulling your belly button nearer your
- spine can help you engage your core muscles before beginning the exercise.
- Return to the starting position: Squeeze your chest muscles and use them to draw the dumbbells together as you slowly raise your arms back up to the starting position. Maintain a small bend in your elbows throughout the action.

2. Step up (forward) exercise:

- Find a stable bench, step, or platform that is at or just below knee height.
- Standing with your feet shoulder-width apart, face the bench, step, or platform.
- Make sure your entire right foot is firmly planted on the bench by placing it there.
- Keep your posture upright and your core engaged the entire exercise.
- Straightening your right leg, step up onto the bench with a push with your right foot. As you push up, exhale.
- Lift your left foot off the ground and shift your whole weight to your right leg.
- At the peak of the movement, pause briefly and make sure your right leg is fully stretched.
- Get back to where you were by gradually lowering your left foot.

Keep your back completely against the wall the entire time to focus on maintaining perfect form.

3. Wall slide exercise.

- Place your feet hip-width apart and lean on a wall as you stand.
- Ensure that the wall is in contact with your head, upper back, heels, and buttocks.
- Put your arms up against the wall with your palms facing forward and elbows bent at a 90-degree angle.
- Ensure that your elbows are at shoulder height and that your upper arms are parallel to the floor.
- Maintain a neutral spine throughout the exercise by contracting your core muscles.
- To avoid excessive back arching or rounding, keep your lower back forced up against the wall.
- Keep your elbows at a 90-degree angle as you slowly glide your arms up the wall.
- As you raise your arms, keep your wrists, elbows and shoulders in touch with the wall.
- Up until your hands are directly above your shoulders, keep sliding your arms up.
- Be careful not to shrug or let your shoulders roll forward.
- Pause for a little moment in the top position, making sure your shoulder blades are tightly clasped.
- Slide your arms back down the wall to the beginning position as you slowly reverse the motion.

GROUP B: Thera band exercise

1. Plantar flexion /inversion

Flexion:

- Sit down on a chair or a flat surface with your legs out in front of you.
- Loop one end of the TheraBand around the ball of your foot while holding the other end in your palms.
- Keep your foot relaxed and pointing up while the TheraBand provides resistance.
- Pointing your toes away from you, slowly

press your foot downward against the band's resistance.

- Hold this position for a few seconds, then gradually return to the beginning position.

Inversion:

- Sit down on a chair or a flat surface with your legs outstretched.
- TheraBand instructions state to fasten one end to a sturdy object, such a table leg, and then wrap the other end around the outside of your foot. other end around the outside of your foot.
- Hold the band firmly in place with your hand to keep it taut. Start by placing your foot in a calm, neutral position.
- Slowly shift your foot inside by pushing the bottom of your foot toward your body's midline while fighting the band's resistance.
- Hold the position with your body facing inward for a few seconds.
- then gradually let go to return to the beginning position.

2. Tibialis Posterior Strengthening:

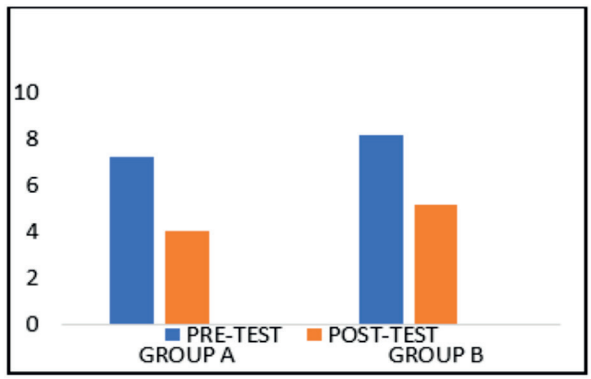
- Legs extended in front of you while seated on a chair or bench.
- The other end of the TheraBand should be wrapped around the top of your foot, just below the toes, and fastened to a strong object, such as a table leg.
- Make sure the band is fastened firmly.
- Ensure that your back is straight, and your core is active.
- Flex your foot slowly upward while pulling against the TheraBand's resistance.
- Only elevate the front of your foot while keeping your heel on the ground.
- The tibialis posterior muscle should be the object of this movement. Hold the flexed position for a few seconds before releasing gradually and going back to the beginning position.

3. Calf stretching in long sitting**:**

- Sit with your legs outstretched in front of you on the floor.
- While holding the opposite end of the TheraBand in your hands, wrap one end around the ball of your foot.
- To maintain proper posture, raise your shoulders and contract your abs.
- Pull the TheraBand gently towards you while slowly flexing your foot and pointing your toes towards your torso.
- Feel the stretch in your calf muscle and hold the stretch for 15 to 30 seconds. Relax the pressure a little bit to let your foot return to its neutral position.
- On each foot, carry out the stretch 2 to 4 times.

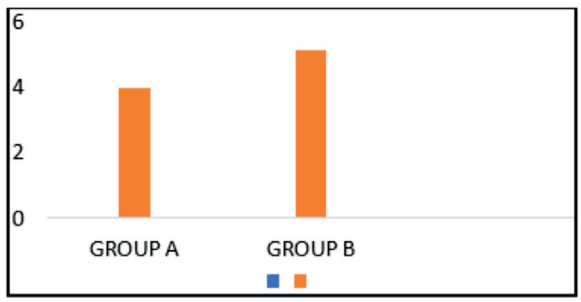
Throughout the stretch, keep in mind to breath deeply and relax your muscles.

Data Analysis



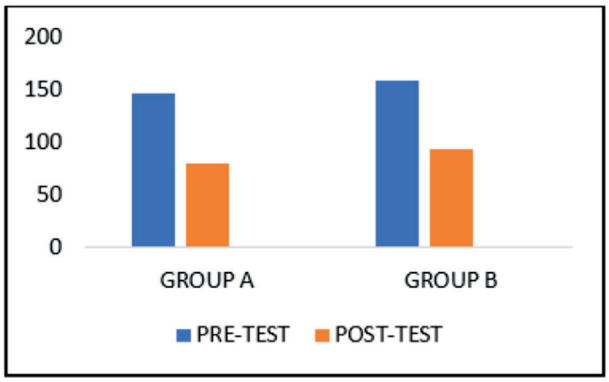
GRAPH-1

INTERPRETATION: **Graph-1** shows the Comparison of Pre-test and Post-test values of Group A and Group B using NPRS.



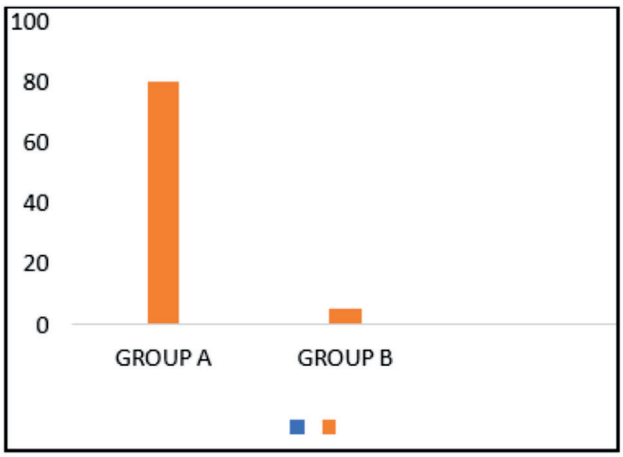
GRAPH-2

INTERPRETATION: **Graph-2** Comparison of post-test values of GROUP A and Group B using NPRS.



GRAPH-3

INTERPRETATION: **Graph-3** Comparison of Pre-test and Post-test values of Group A and Group B using FFI.



GRAPH-4

INTERPRETATION: **Graph-4** Comparison of Post-test values of Group A and Group B using FFI.

Result

- The results of the study demonstrated significant improvements in pain reduction for individuals with flat foot who underwent either kinematic chain exercise or TheraBand exercises.
- The pre-test to post-test analysis revealed a substantial decrease in pain intensity, as assessed by the Numerical Pain Rating Scale (NPRS), for both groups.
- Furthermore, foot health is measured by Foot Functional Index (FFI) to measure foot health, after the interventions.
- Comparing the two intervention groups, Group A (kinematic chain exercise) exhibited a greater reduction in pain intensity and a more pronounced improvement in foot health compared to Group B (TheraBand Exercises).
- These findings suggest that kinematic chain exercise may be a more effective approach in alleviating pain and enhancing functional outcomes for individuals with flat foot.
- Overall, the study highlights the positive impact of both interventions on pain and foot health in individuals with flat foot, with kinematic chain exercise results.

Discussion

The flat foot group exhibited a significantly decreased kinetic index without visual input. The more effective postural stability in the control group might be due to efficient compensatory strategies utilized without visual input to maintain one leg standing.

The management of flatfoot has been the subject of much research. Rao and Joseph asserted that wearing appropriate footwear could assist in arch normalization in their examination of the effects of footwear on the flatfoot. In the closed kinematic chain task, a significant difference in the accuracy of knee joint motion was observed between the flexible flatfoot and control groups.[21]

In addition, there was a significant difference in the accuracy of knee joint motion between the closed and kinematic chain task in the flexible flatfeet group. A comprehensive 2-week exercise program improved the longitudinal arch angle and navicular drop height among adults with flexible flatfoot more than active flexion of the foot and plantar flexion alone.

Conclusion

The study's findings demonstrate that Kinematic Chain exercise is more effective than TheraBand exercise in reducing pain in subjects with flat foot in young adults. The results show that after the training, there are significant improvements in foot function, pain levels, and balance.

Ethical clearance: Taken from the institutional ethical committee. ISRB number-03/ 061/ 2022/ ISRB/ SR/ SCPT.

Funding: Funding

Conflict of interest: Nil

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