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Role of Arch Correction and Physical Exercise in Improving Pes Planus: A Case Study

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Abstract

Background: Pes planus, commonly referred to as flat foot, is a musculoskeletal condition characterized by a reduction or collapse of the medial longitudinal arch during weight-bearing activities. While it may remain asymptomatic in some individuals, others experience pain, fatigue, and impaired functional performance, particularly during prolonged standing and walking. Flexible pes planus, in which the arch reappears in non-weight-bearing positions, is often responsive to conservative physiotherapy management.

Objective: To evaluate the effectiveness of a structured physiotherapy exercise program focusing on arch correction, strengthening, flexibility, and balance training in a patient with flexible pes planus.

Case Description: A 26-year-old female presented with bilateral foot pain, fatigue, and balance difficulty for a duration of 7–8 months. Clinical examination revealed reduced medial longitudinal arch during standing, bilateral heel valgus, and impaired single-leg balance. The condition was diagnosed as flexible pes planus based on clinical findings.

Intervention: The patient underwent a 4-week physiotherapy program consisting of foot intrinsic strengthening exercises, calf stretching, and balance training. Exercises included short foot exercise, towel curls, marble pick-up, heel raises, calf stretching, and single-leg standing, performed daily with gradual progression.

Outcome Measures: Pain was assessed using the Visual Analog Scale (VAS), while balance and walking ability were evaluated through functional assessment.

Results: Following the intervention, pain reduced significantly from 6/10 to 2/10. Balance improved from poor to functional stability, and walking ability increased with reduced fatigue and discomfort.

Conclusion: A structured exercise-based physiotherapy program proved effective in reducing symptoms and improving functional outcomes in flexible pes planus. The findings support the use of simple, non-invasive interventions as a first-line treatment approach.

Keywords: Pes Planus, Flat Foot, Exercise Therapy, Balance Training, Foot Strengthening, Arch Correction

Introduction / Background

The human foot is a highly specialized structure that plays a fundamental role in maintaining posture, dynamic balance, and efficient locomotion. It acts as a complex biomechanical system designed to absorb ground reaction forces, adapt to varying surfaces, and provide propulsion during gait. Among its structural components, the medial longitudinal arch is particularly important as it contributes significantly to shock absorption, weight distribution, and energy transfer during walking and running. Any alteration in the

integrity of this arch can disrupt normal biomechanics and lead to compensatory changes throughout the lower kinetic chain.

Pes planus, commonly referred to as flat foot, is a postural deformity characterized by partial or complete collapse of the medial longitudinal arch during weight-bearing activities. It is broadly classified into flexible and rigid types, with flexible pes planus being more common. In this condition, the arch appears normal in non-weight-bearing positions but collapses upon standing or functional loading. Although often considered benign in early stages, flexible pes planus can progressively influence lower limb alignment and gait mechanics if left unaddressed.

Clinically, individuals with pes planus may remain asymptomatic; however, many develop symptoms such as foot pain, early fatigue, reduced endurance during prolonged standing or walking, and a sense of instability. These symptoms arise mainly due to altered biomechanics, including excessive pronation, inefficient load distribution, and compensatory overactivity of surrounding musculature and ligaments. Over time, these changes may also affect proximal joints such as the knee, hip, and lumbar spine due to kinetic chain dysfunction.

Several intrinsic and extrinsic factors contribute to the development of flexible pes planus. These include weakness of the intrinsic foot muscles, reduced strength of dynamic stabilizers such as tibialis posterior, tightness of the gastrocnemius–soleus complex, poor neuromuscular control, ligamentous laxity, and prolonged occupational or lifestyle-related weight-bearing activities. Together, these factors reduce the ability of the foot to maintain the medial arch under functional load.

Physiotherapy plays a vital role in the conservative management of flexible pes planus by addressing these modifiable impairments. Exercise-based interventions focus on strengthening intrinsic and extrinsic foot muscles, improving flexibility of the posterior chain, enhancing proprioception, and restoring neuromuscular control of the foot and ankle complex. Balance training and functional re-education further help improve postural stability and gait efficiency. Evidence suggests that structured physiotherapy programs can reduce symptoms, improve functional ability, and prevent progression of deformity.

Given the functional importance of the medial longitudinal arch in lower limb biomechanics and the potential for long-term musculoskeletal consequences, early identification and conservative management of flexible pes planus is essential. Therefore, this case study aims to evaluate the effectiveness of a structured physiotherapy exercise program in improving pain, balance, and functional ability in a patient with flexible pes planus.

Case Description

A 26-year-old female presented to the physiotherapy department with complaints of bilateral foot pain and fatigue, particularly after prolonged standing and walking. The symptoms had been present for approximately 7–8 months and had shown a gradual, progressive increase in intensity over time.

The patient described the pain as a dull, aching discomfort located along the medial aspect of both feet. The pain was insidious in onset and non-radiating in nature. It was aggravated by weight-bearing activities such as prolonged standing, walking, and household chores, and was relieved partially with rest and removal of footwear. She also reported a feeling of heaviness and discomfort in the feet after routine daily activities.

In addition, the patient complained of reduced endurance during walking, early onset of fatigue, and difficulty maintaining balance, especially on uneven surfaces. She noticed that her symptoms were more pronounced towards the end of the day, which significantly affected her functional capacity and daily

routine activities. She also reported occasional instability while walking for longer durations, although no history of falls was present.

There was no history of trauma, fracture, surgery, or systemic illness such as diabetes, rheumatoid arthritis, or neurological conditions. No history of similar complaints in the past was reported. The patient did not report any numbness, tingling sensations, or referred pain.

Overall, the symptoms were suggestive of a biomechanical overload pattern affecting both feet, leading to functional limitations in mobility, endurance, and balance during daily activities.

Clinical Examination

On observation, the medial longitudinal arch appeared visibly reduced during weight-bearing in standing, with a noticeable flattening of the arch compared to the non-weight-bearing position, suggesting a flexible component. Bilateral heel valgus alignment was observed, indicating excessive pronation of the subtalar joint. Forefoot abduction was also mildly evident, contributing to altered foot alignment and compromised stability during stance.

Postural assessment revealed a pronated foot posture bilaterally, with increased medial weight-bearing. The overall alignment suggested biomechanical inefficiency of the foot during static and dynamic activities.

On palpation, mild tenderness was elicited along the medial border of both feet, particularly over the navicular region and along the medial longitudinal arch. No swelling, warmth, or signs of inflammation were noted.

Range of motion assessment showed that ankle joint movements were within functional limits; however, tightness of the gastrocnemius–soleus complex was evident, as indicated by reduced dorsiflexion flexibility. This tightness was considered a contributing factor to altered foot mechanics and compensatory pronation.

Muscle assessment indicated relative कमज weakness of intrinsic foot muscles and possible reduced strength of dynamic stabilizers such as tibialis posterior, contributing to inadequate support of the medial arch.

Functional assessment revealed:

- Poor single-leg balance, indicating impaired proprioception and postural control
- Reduced endurance during walking, with early onset of fatigue
- Difficulty maintaining stability during dynamic tasks
- Altered gait pattern with increased pronation during stance phase

These findings indicated compromised neuromuscular control and inefficient load distribution across the foot.

Based on the clinical presentation and examination findings, the condition was identified as flexible pes planus.

A structured conservative physiotherapy management plan was formulated with the primary goals of reducing pain, improving muscular support of the medial longitudinal arch, enhancing flexibility, restoring balance and proprioception, and improving overall functional capacity during daily activities.

Intervention

The patient underwent a structured physiotherapy program for a duration of four weeks, with daily exercise

sessions. The intervention focused on strengthening intrinsic foot muscles, improving flexibility, and enhancing balance and neuromuscular control.

Exercise Program

1. **Short Foot Exercise:** This exercise was aimed at activating intrinsic foot muscles responsible for maintaining the medial longitudinal arch. The patient was instructed to draw the metatarsal heads toward the heel without curling the toes.
2. **Towel Curls:** The patient used her toes to grip and pull a towel placed on the floor. This helped strengthen toe flexors and intrinsic muscles.
3. **Marble Pick-Up:** Small objects (marbles) were picked up using the toes and placed into a container. This improved fine motor control and muscle activation.
4. **Heel Raises:** Bilateral and later unilateral heel raises were performed to strengthen the calf muscles, which contribute to foot stability and arch support.
5. **Calf Stretching:** Stretching of the gastrocnemius and soleus muscles was performed to reduce tightness and improve ankle flexibility.
6. **Single-Leg Standing:** Balance training was incorporated to improve proprioception and neuromuscular coordination.

Progression

The exercises were gradually progressed by:

- Increasing repetitions
- Adding single-leg variations
- Increasing duration of balance tasks

The overall goal was to restore optimal foot mechanics and improve functional stability.

Outcome Measures

To evaluate the effectiveness of the intervention, both subjective and functional measures were recorded before and after the treatment.

Pain Assessment

Pain intensity was measured using the Visual Analog Scale (VAS), ranging from 0 (no pain) to 10 (worst pain).

Balance Assessment

Balance was assessed functionally using single-leg standing ability and overall postural stability.

Walking Ability

Walking tolerance and fatigue levels were evaluated based on patient-reported functional performance.

Results

At the end of the four-week intervention, the patient demonstrated significant improvement in symptoms and functional ability.

Pain levels reduced from 6/10 to 2/10 on the Visual Analog Scale, indicating a marked decrease in

discomfort during daily activities.
Balance showed noticeable improvement. The patient, who initially had difficulty maintaining single-leg stance, was able to perform balance tasks with better control and stability.
Walking ability also improved considerably. The patient reported reduced fatigue and was able to tolerate longer periods of walking without discomfort.

Outcome Table

Parameter	Before	After
Pain (VAS)	6/10	2/10
Balance	Poor	Improved
Walking Ability	Limited	Better

Overall, the patient demonstrated enhanced functional performance and increased confidence in daily activities.

Discussion

The improvements observed in this case can be attributed to the combined effect of strengthening, flexibility, and balance training.
Strengthening of intrinsic foot muscles through exercises like the short foot exercise played a key role in supporting the medial longitudinal arch. These muscles act as dynamic stabilizers and help maintain proper foot alignment during weight-bearing activities.
Heel raises contributed to strengthening the gastrocnemius-soleus complex, which assists in controlling pronation and improving push-off during gait.
Calf stretching helped reduce muscle tightness, allowing better ankle mobility and reducing compensatory stress on the foot.
Balance training improved proprioception and neuromuscular coordination, which are essential for maintaining stability and preventing excessive foot collapse.
Together, these interventions helped restore normal biomechanics, reduce stress on the medial arch, and improve overall function.
The results support existing evidence that conservative physiotherapy is effective in managing flexible pes planus, especially when initiated early.

Uniqueness

The uniqueness of this case lies in the use of a purely exercise-based approach without reliance on orthotic devices or external support.
The program was:

- Simple
- Cost-effective
- Easy to perform at home

This makes it highly practical for individuals who may not have access to advanced treatment options.

Conclusion

This case study demonstrates that a structured physiotherapy exercise program can effectively reduce pain

and improve functional outcomes in individuals with flexible pes planus.
The intervention successfully addressed muscle weakness, flexibility deficits, and balance impairments, leading to improved arch support and walking ability.
These findings support the use of conservative, non-invasive physiotherapy as a first-line approach in managing flexible flatfoot.

Limitations

- Single patient case study
- Short duration of intervention (4 weeks)
- Lack of long-term follow-up
- Limited objective measurement tools

Scope

- Can be applied to a larger population
- Can be combined with orthotic interventions for enhanced results
- Long-term studies are needed to evaluate sustained outcomes
- Future research can include objective gait and pressure analysis

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