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Effectiveness of comprehensive exercise program and short foot exercises in patients with pes planus condition: A case study

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Abstract
Background: Pesplanus refers to feet that have a visibly depressed medial longitudinal arch, sometimes in conjunction with rearfoot eversion. The medial arch absorbs and evenly distributes forces when the body is bearing weight in the upright posture and serves as a flexible base of support for the entire body.
Objective: A case study is to evaluate the effectiveness of comprehensive exercise program and short foot exercises in patients with pes planus condition.
Method: 23-year-old female pesplanus patient was provided an individualized therapy for 3 sessions per week for 6 weeks. Outcome measures included Navicular drop test and Chippaux smirak index.
Result: The result of the study showed significant improvement in medial longitudinal arch height and Chippaux smirak index values.
Conclusion: The findings of this study concluded that comprehensive exercise program and short foot exercises are effective in treating a patient with pesplanus condition.

Keywords: Comprehensive exercise, flat foot, navicular drop height, pesplanus, physical therapy, short foot exercise

Introduction
A Pesplanus refers to feet that have a visibly depressed medial longitudinal arch, sometimes in conjunction with rearfoot eversion [1]. The medial arch absorbs and evenly distributes forces when the body is bearing weight in the upright posture and serves as a flexible base of support for the entire body [2]. Flat foot can be classified into two subtypes: flexible flat foot and rigid flat foot. In flexible flat foot, the medial longitudinal arch is present in open kinematic chain conditions (non-weight-bearing) and lost in closed kinematic chain conditions (weight-bearing). Rigid flat foot has a loss of the medial longitudinal arch height in both open and closed kinematic chain conditions [3].
The causes of adult pes planus include posterior tibial tendon dysfunction, tarsal coalition, peroneal spastic flat foot, mid foot laxity, iotrogenic, charcot foot or neuromuscular flat foot and post traumatic arthritis. In Pesplanus it is associated with intrinsic muscle weakness as well as proximal muscle weakness. It is often difficult to identify the exact reason of flat foot in every individual because of the existence of various factors associated with developing it [4].
Pesplanus could be present as symptomatic or asymptomatic. Pesplanus is considered pathological only when symptomatic. Ankle/foot complex and the lower extremities are areas where pain is more common. Pain is generally located in the medial part of the hindfoot, along the posterior tibial tendon, sometimes associated with effusion into the tendon sheath. Pain may be plantar and deep, suggesting spring ligament lesion. Even so, such pain may be caused by another pathology, such as talocalcaneal synostosis coalition or talonavicular, subtalar or mediotarsal osteoarthritis. There may be difficulty in walking and an altered gait pattern [1, 5].
A Comprehensive exercise program includes calf stretch, ankle movements and gluteal muscle strengthening. As pesplanus is associated with weakness of proximal muscles so strengthening of these muscles may help. By giving Gluteal muscle strengthening, the gluteal muscles (Maximus, medius, and minimus) stabilize the hip by counteracting gravity's hip adduction torque and maintain proper leg alignment by eccentrically controlling adduction and internal rotation of the thigh.

Gluteus muscle weakness causes internal rotation of the hip joint, resulting in foot pronation. Re-activating the gluteal muscles will re-establish correct muscle recruitment patterns and enhance strength and performance. Active exercise intervention has extra advantages over passive supports because of better foot arches caused by strengthening of the intrinsic foot muscles [6].

Short foot exercise (SFE) is commonly used as a therapeutic exercise to strengthen intrinsic foot muscles. SFE is a training used to create a medial longitudinal arch by pulling the first metatarsal bone head to the heel without bending or excessively extending the toes (Fig 2). The short foot exercise is beneficial to improve biomechanical position of the foot, short foot exercise is used in improving the postural stability as well as strengthening the plantar muscles [7].

Fig 1: Resting dome length

Fig 2: Shortened dome length

Pesplanus is a condition characterized by a loss of medial longitudinal arch; therefore, it is critical to improve the medial longitudinal arch of the foot. A comprehensive exercise program and short foot exercises, might have a positive effect on improving medial longitudinal arch as well as navicular drop height in patients with flat foot. So it is important to provide an exercise intervention that is best suitable for patients with Pesplanus. The finding of this study can be beneficial for patients with Pesplanus deformity, so that treatment method can be applied in patients with pesplanus if the results are found to be positive. Hence the need was identified to find out effectiveness of comprehensive exercise program and short foot exercise on pesplanus deformity.

Methodology

Case description

A 23 year old female who presented at a tertiary hospital in Southern Karnataka gave the history of pain over medial longitudinal arch of the bilateral foot which was radiating up to the knee since 1 year. There was no history of fall or any trauma to the foot. The pain was insidious in onset and progressive in nature. It was difficult for her to walk on uneven surfaces and also complains of knee pain while climbing stairs. She visited local hospital where medications were given, but since there was no improvement she was referred for Physiotherapy. Physiotherapy intervention was done for 30 minutes per day, 3 days a week over a six-week period.

Clinical findings

Patient underwent an initial examination which included demographic data, brief history of present illness and physical examination. Range of motion of bilateral foot was within the normal range. A navicular drop test was performed, it showed a difference of 12mm in bilateral ankles and it was revealed that the patient has reduced arches in the feet and pronation of bilateral ankles was observed. According to chippaux smirak index percentage was 52 which indicated second degree flat foot.

Outcome measures

Navicular Drop Test

The navicular drops test (NDT) is a valid and reliable measure for individuals with flatfoot (ICC values ranging from 0.914 to 0.945) {12]. NDT was used to assess the variations in medial longitudinal arch height. The subject was placed in a sitting position with feet flat on firm surface and with knees flexed to 90 degrees, aligning the second toe and knee to maintain a neutral subtalar joint position.

Measurements of the distance from the ground to the navicular tuberosity were taken in this non-weight bearing position. Subsequently, participant stood with feet shoulder-width apart, bearing weight equally on both feet, while the measurement was repeated. Using a plane ruler and a 3-5 index card, the height difference of the navicular tuberosity between the sitting and standing positions was repeatedly measured three times, and the average value was utilized for analysis. A difference of >10mm is considered significant excessive foot pronation.

Chippaux Smirak Index

The correlation test and intraclass correlation coefficient showed that Chappaux Smirak index (CSI) were valid and reliable in diagnosing flat foot. The sensitivity and specificity of CSI is 10.71%and 100% [13]. CSI was used whether the collected foot prints were associated with flat foot. It was obtained from ink foot prints. The subject's footprints was taken and Chippaux smirak index was calculated where it was obtained by dividing the minimal distance of the midfoot by the maximal distance of the forefoot. CSI% = (Greatest forefoot width / smallest mid foot width) x 100(ICC >0.9). In chippaux smirak index, higher the percentage higher the disability.

Intervention

The patient underwent combined exercise program consisted of alternative sessions lasting 45 minutes, conducted 3 days per week over a six-week period.

Short- term goals were to strengthen intrinsic foot muscles, improve arch stability and to enhance proximal muscles strength. Long term goal is to improve the functional activities.

Short foot exercise: The methodology for implementing Short Foot Exercises (SFE) as sensory-motor training to address flatfoot conditions involved several steps. Initially, SFE involved a demonstration of the exercise techniques by therapist along with verbal instructions. Subsequently, the participant assumed a seated position on a height-adjustable chair with their hip, knee, and ankle joints flexed to 90 degrees. The participant was then instructed to pull the head of the first metatarsal bone toward the heel without curling the toes, maintaining this position for 20 seconds to form the medial longitudinal arch (MLA) and repeating the same 10 times. The exercise was executed in the following table:-

Table 1: Short foot exercise

Exercises	Progression	Position	Intensity	Frequency	Duration
Performing SFE individually on each foot	1 to 2 weeks	Sitting	20 seconds Hold-Relax (×10)	3 days per week	18 Sessions
Performing SFE individually on each foot	3 to 4 weeks	Standing	20 seconds Hold-Relax (×10)	3 days per week	18 Sessions
Performing SFE simultaneously on both feet	5 to 6 weeks	Standing	20 seconds Hold-Relax (×10)	3 days per week	18 Sessions

Fig 3: Short foot exercise in sitting position **Fig 4:** Short foot exercise in standing position

Comprehensive exercise program: A comprehensive exercise program was administered which included active dorsiflexion and plantarflexion, gluteal muscle strengthening exercises and calf stretches. Exercises were progressed after 2 weeks with alteration in the position and/or an increase in hold time and number of repetitions. The intervention was performed at three sessions per week for six week.

Table 2: Comprehensive exercise program

Exercises	Weeks progression	Position	Intensity	Frequency	Duration
Active exercise					
▪ Plantarflexion ▪ Dorsiflexion	1 to 6 weeks	Sitting position	20 reps × 2 sets	3 days per week	18 Sessions
Gluteal muscle strengthening					
▪ Hip abduction	1 to 2 weeks	Side lying Prone lying	10 to 15reps × 2 sets	3 days per week	18 Sessions
▪ Hip extension	3 to 6 weeks	Side lying prone lying	15 to 20reps × 2 sets		
▪ Range of motion exercises ▪ Calf stretches	1 to 6 weeks	Supine lying	10 minutes	e	18 Sessions

The three session per week were prescribed to occur on Monday, Wednesday and Friday.

Results

Pre and post intervention values:

Outcome measure	Pre-test value		Post test value	
	Right foot	Left foot	Right foot	left foot
Navicular drop test	12mm	12.1mm	9mm	9mm
Chippaux smirak index	52%	52.2%	41%	41%

Impression: Pre-post comparison of navicular drop test and chippauxsmirak index showed significant improvement.

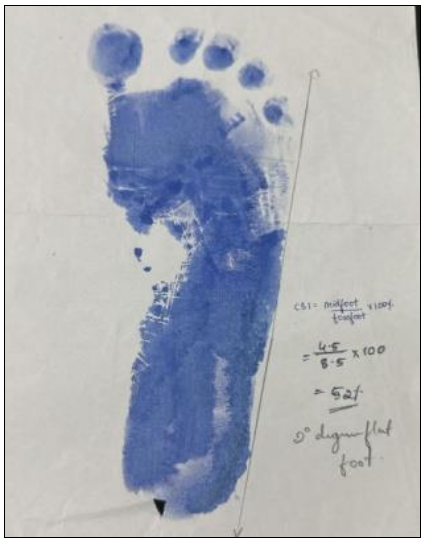

Fig 5: Pre test values of CSI

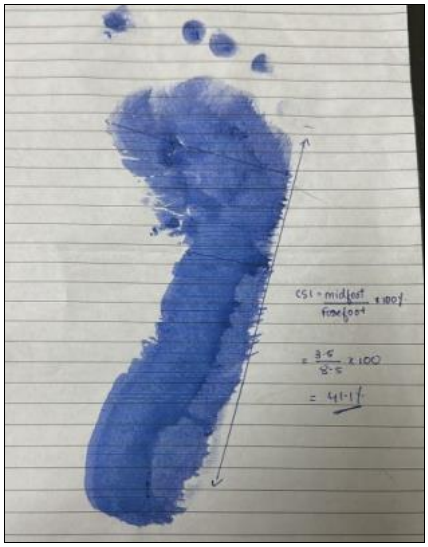

Fig 6: Post test values of CSI

Discussion

The present study was to find out the therapeutic influence of comprehensive exercise program and short foot exercises on medial longitudinal arch in patients with pesplanus condition.

Gluteus muscle weakness internally rotates the hip joint, leading to foot pronation. Re-activating the gluteal muscles can help restore proper muscular recruitment patterns and improve strength and performance.However active exercise intervention has additional advantages over passive supports because of the improved foot arches due to strengthening of the intrinsic foot muscle. This was supported by a study conducted by Tanya Brijwasi *et al*. (2022) [9] were they highlighted that navicular drop height and longitudinal arch angle improved substantially after 6 weeks of a comprehensive exercise program in people with flexible flat foot. Similar study was done by Sayu aryantariputrithanaya *et al*. (2021) [10] were they concluded that comprehensive physiotherapy program improves medial longitudinal arch height and thereby foot posture, of an adolescent with bilateral flexible flat foot.

In this present study application of SFE showed improved result in medial longitudinal arch, it was found that 6 weeks of short foot exercise training is effective in improving the medial longitudinal arch in patients with pesplanus condition. This study was supported by Shigeyuki hara *et al*. (2022) [7] were they evaluated the effectiveness of short foot exercises in patients with flat foot which they concluded that short foot exercise significantly improves medial longitudinal arch height. Another study done by Dongchul moon *et al*. (2021) [8] were they reviewed the efficacy of short foot exercises in the balance rehabilitation among flat foot patients and showed that short foot exercise is effective in improving postural balance.

The collapse of the medial longitudinal arch, whether partial or total, might impair the lower extremity kinematics during normal movement. These alterations often lead to various disorders such as IT band syndrome, Achilles tendinitis, Knee pain and low back pain. SFE mainly focuses on strengthening the intrinsic foot muscles which are the primary local stabilizers of the foot. This present study was supported by Ching Huang *et al*. (2022) [11] who concluded that SFE is an essential tool for foot alignment in flatfoot patients.

Limitations and future scope

This study had several limitations: only the medial longitudinal arch was measured, without considering pain; strengthening exercises were included, but strength was not measured; the study duration was limited to 6 weeks, leaving long-term effects unknown; and no follow-ups were conducted after the intervention period.

Further research can be conducted with larger population with larger duration, with different outcome measures with different exercise therapy interventions for individuals with pesplanus. Comprehensive exercise program and short foot exercises are backed by several studies on its effectiveness on medial longitudinal arch height, foot alignment and postural balance. Comparative study with other interventions like sensory motor training, towel curl exercises can be done in future studies.

Conclusion

The findings of this study concluded that comprehensive exercise program and short foot exercises are effective in treating a patient with pesplanus condition.

References

1. Ravichandran H, Shetty KS, Shetty SA. Effects of concentric and eccentric exercises in the rehabilitation of flexible flat foot-A randomized trial. Saudi Journal of Sports Medicine. 2022;22(2):74-81.
2. Banwell HA, Mackintosh S, Thewlis D. Foot orthoses for adults with flexible pes planus: A systematic review. Journal of Foot and Ankle Research. 2014;7:1-8.
3. Patel M, Shah P, Ravaliya S, Patel M. Relationship of anterior knee pain and flat foot: A cross-sectional study. International Journal of Health Sciences and Research. 2021;11(3):86-92.
4. McCormack AP, Ching RP, Sangeorzan BJ. Biomechanics of procedures used in adult flatfoot deformity. Foot and Ankle Clinics. 2001 Mar 1;6(1):15-23.
5. Gross KD, Felson DT, Niu J, Hunter DJ, Guermazi A, Roemer FW, Dufour AB, Gensure RH, Hannan MT. Association of flat feet with knee pain and cartilage damage in older adults. Arthritis Care & Research. 2011;63(7):937-944.
6. McCormack AP, Ching RP, Sangeorzan BJ.

Biomechanics of procedures used in adult flatfoot deformity. Foot and Ankle Clinics. 2001;6(1):15-23.
7. Hara S, Kitano M, Kudo S. The effects of short foot exercises to treat flat foot deformity: A systematic review. Journal of Back and Musculoskeletal Rehabilitation. 2023;36(01):21-33.
8. Moon D, Jung J. Effect of incorporating short-foot exercises in the balance rehabilitation of flat foot: A randomized controlled trial. Healthcare. 2021;9(10):1358. MDPI.
9. Brijwasi T, Borkar P. A comprehensive exercise program improves foot alignment in people with flexible flat foot: A randomized trial. Journal of Physiotherapy. 2023;69(1):42-46.
10. Thanaya SA, Jamaluddin CN. Comprehensive physiotherapy program improves the medial longitudinal arch of a male adolescent with bilateral flexible flat foot: A case report. Physical Therapy Journal of Indonesia. 2021;2(2):54-60.
11. Huang C, Chen LY, Liao YH, Masodsai K, Lin YY. Effects of the short-foot exercise on foot alignment and muscle hypertrophy in flatfoot individuals: A meta-analysis. International Journal of Environmental Research and Public Health. 2022;19(19):11994.
12. Zuil-Escobar JC, Martínez-Cepa CB, Martín-Urrialde JA, Gómez-Conesa A. Medial longitudinal arch: Accuracy, reliability, and correlation between navicular drop test and footprint parameters. Journal of Manipulative and Physiological Therapeutics. 2018;41(8):672-679.
13. Juniartha IP, Damayanti Tinduh D, Nugraheni N, Pawana IP, Rosy Setiawati R, Melaniani S. The validity and reliability of various footprint analyses in flatfoot diagnosis of competitive athletes. Bali Medical Journal. 2023;12(1):851-856.