Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 30s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

A study to evaluate the Effectiveness of Short Foot Exercises over Conventional in Flexible Pes Planus

Santosh Kr. Rajak[1], Abhijit Kalita[2], Prasenjit Bhattacharyya[3], Ankur Jyoti Bora[4], Dr. Pratap Chandra Sarma[5*]

[1]Assistant Professor, Assam Women's University, Rowriah, Jorhat

[2]Assistant Professor, Associate Dean (I/C), Faculty of Physiotherapy & Rehabilitation, Assam down town University, Guwahati, Assam

[3]Assistant Professor, Assam Women's University, Rowriah, Jorhat

[4]Senior Physiotherapist, Jorhat Medical College and Hospital (JMCH), Jorhat

[5]Faculty of Science and Paramedical Sciences, Assam down town University, Guwahati, Assam, India

[*]**Corresponding author:**

Dr. Pratap Chandra Sarma,

Faculty of Science and Paramedical Sciences, Assam down town University, Guwahati, Assam, India

Email ID: drpratapsarma@gmail.com

Cite this paper as: Santosh Kr. Rajak, Abhijit Kalita, Prasenjit Bhattacharyya, Ankur Jyoti Bora, Dr. Pratap Chandra Sarma, (2025) A study to evaluate the Effectiveness of Short Foot Exercises over Conventional in Flexible Pes Planus. *Journal of Neonatal Surgery*, 14 (30s), 672-678.

ABSTRACT

Background: Adult flatfoot and arch deformities result from disruption of the supporting ligaments as well as from muscle weakness or tightness leading to direct impairments in the arch.As the condition progresses, it causes biomechanical alterations that further impair daily functioning. Studies also show correlation between Cartilage damage of Knee, Low back pain with Pes Planus. Many other studies aimed to correct the medial longitudinal arch with arch supporters, Taping and Faradic foot bath.

Aim: This study aimed to investigate the effects of the short-foot exercise (SFE) on Flexible Pes Planus over conventional methods.

Methodology: This study involved 60 subjects who fulfilled the criteria,with 30 particpants each group ,Group A (n=30, 13 men and 17 women) was Conventional Therapy and Group B (n=30, 14 men and 16 women) was Short Foot Exercise progression. The subjects were each given a consent form. The purpose of the study was explained to all the participants and an informed consent was taken from each subject. Navicular Drop Test was used as an Outcome Measure. Group A performed the SFE. SFE programs were performed 20 minutes a day, 5 times a week, for a total of 4 weeks. The Navicular drop test was compared before and after training.

Result: Group A achieved a mean of 9.8 while Group B achieved a mean of 10.15. Group A showed a reduction of 2.74mm while Group B achieved a 2.95mm. P value and statistical significance: the two tailed p value equals 0.6557, by conventional criteria, the difference observed shows only a weak statistical association, suggesting limited evidence of a true effect.

Conclusion: SFE and Conventional exercises are found to be effective in Flexible Pes Planus however, SFE was found to be clinically more effective than conventional exercise, demonstrating greater reductions in NDT values. Despite the weak statistical relationship observed in the results, the observed trends highlight the need for further research to explore the potential clinical benefits more comprehensively.

Keywords: *Flexible Pes Planus, Flat Feet, Navicular drop test, intrinsic foot muscle, short foot exercises.*

1. INTRODUCTION

Pes Planus (Flat foot) deformity is a chronic foot condition that includes flattening of the medial longitudinal arch (MLA),hindfoot valgus, and midfoot abduction [1],

Flat foot can be classified into two types, Rigid and flexible. In Rigid Pes Planus the MLA remains flat irrespective of position i.e weight bearing or non weight bearing, while in flexible pes planus, MLA develops in non weight bearing positions like sitting, supine etc and diminishes in weight bearing positions. FFF is generally asymptomatic wheras Rigid flat foot is often symptomatic and associated with tarsal coalitions and reduced range of motion at subtalar joint.

A study was conducted in India on normal healthy volunteers between the age group of 25 to 40 years, it was observed that the prevalence of flat feet was 24.59% in males and 22.04% in females. [2]

Factors like Occupation, Obesity and Age are associated with Flat feet. Injuries to foot ligaments, decreased cross sectional area of intrinsic muscle are also associated with Pes Planus. [3,4,5,6,7]

Changes in foot posture leads to changes in body biomechanics [5-7]. Studies have shown that the presence of pes planus foot deformity is associated with medial compartment knee osteoarthritis [5-7]. A significant difference was observed in the incidence of pes planus in healthy subjects and subjects with osteoarthritis with 22% and 42% respectively [5]. Further more, 38.3% of females studied had both knee medial and lateral compartment osteoarthritis in the presence of pes planus [7]

Static support, including foot orthoses, represents a prevalent medical intervention for issues associated with flatfoot. A previous study revealed that 50% of patients exhibiting symptoms related to flatfoot were managed through the use of foot orthoses to elevate the medial longitudinal arch and rectify deformities [5]. Nevertheless, a systematic review and meta-analysis conducted in 2018 suggested that the effects of foot orthoses on flatfoot were constrained, and the influence on foot kinematics remained contentious [6]. Besides depending on foot orthoses for arch support, fortifying the foot muscles may offer dynamic support.

Foot orthoses are commonly utilized to elevate the medial longitudinal arch (MLA) in order to relieve stress on the spring ligament and to address flat foot deformities [1,11]. Extrinsic and intrinsic foot muscles (IFM) contribute to the support of the medial longitudinal arch within the active subsystem [7]. The IFM, with their origins and insertions positioned in the foot, such as the abductor hallucis, flexor digitorum brevis, and quadratus plantae, are significant in providing direct stabilization to the arch [8].

The short-foot exercise (SFE) is among the most recognized exercises aimed at fortifying the IFM and comprises the contraction of these muscles to draw the first metatarso phalangeal joint towards the calcaneus and elevate the medial longitudinal arch without flexing the toes [7,9]. Several studies have indicated that the use of foot orthoses is effective in rectifying pes planus [6, 15].

Although numerous literature sources advocate for the use of foot orthoses and the short-foot exercise for the management of pes planus, this study sought to examine the effects of the short-foot exercise (SFE) on Flexible Pes Planus. The objective of the study was to assess the efficacy of SFE in comparison to traditional methods.

2. METHODOLOGY

This study involved 60 subjects who fulfilled the criteria, were divided into two groups 30 participant each Group A (n=30, 13 men and 17 women) was Conventional Therapy and Group B (n=30, 14 men and 16 women) was Short Foot Exercise progression. The subjects were each given a consent form. The purpose of the study was explained to all the participants and an informed consent was taken from each subject. Navicular Drop Test was used as an Outcome Measure. Group A performed the SFE. SFE programs were performed 20 minutes a day, 5 times a week, for a total of 5 weeks. The Navicular drop test were compared before and after training.

The study obtained Ethical clearance from (Ref. No. IEC/dth/2019/MS/14) from the Institutional ethical committee

Outcome Measurement: Navicular Drop test: Each subject was asked to sit in relaxed position with hip and knee flexed at 90 degree and the foot gently placed flat on a firm supporting surface For assessing Pes Planus, the subject was first positioned in relaxed sitting position i.e. non weight bearing position. Using a small rigid ruler, the height of the navicular bone was measured from the floor to the most prominent part of navicular tuberosity when in the neutral talar position. Again the height of the navicular bone was measured in standing position i.e. weight bearing .The difference in measurement is the navicular drop and drop >10mm will be regarded as pes planus. Navicular Drop test was used as a Diagnostic and prognostic tool. Diagnostic tool as it was used to identify the subjects with Pes Planus and Prognostic tool as an outcome measurement to assess the intervention of conventional and Short foot Exercise in the study.

Written informed consent was obtained from the participants. Individuals who fulfilled the inclusion criteria were included in the study. Participants were informed about the purpose of the study. The treatment protocol and its duration were explained to the patients.

Inclusion Criteria:

Subjects diagnosed as Pes Planus with NDT(> 10 mm)

Exclusion Criteria:

Subjects with Surgeries in lower limb like Arthroplasty, Knee Surgeries like ACL reconstruction, pregnant Women, Deformities in lower limb, Subjects with Neuromuscular disorder, limb length discrepancy

The procedure of Conventional Therapy and Short Foot Exercise was explained to the subjects.

Total duration of the treatment: 4weeks, 5 session / week, once a day

Time: 10 min/session

Total number of sessions: 20

Conventional Therapy (Group A):

This group consisted of candidates who followed an intrinsic muscle strengthening protocol

i. Heel raises: Patient was in standing position and has to perform heel raises 20 times. (without shoes)

ii. TA Stretching: The patient was taken in supine position Researcher was positioned to side of the patient and applied a passive stretch leading to 30 sec hold and was repeated 5 times each session. Toe Spreading exercises: The patient was in sitting or standing position and shall be instructed to stabilize the ball of the foot on the ground while lifting and spreading out the toes, Frequency: 20 times, intensity: 5 sec holds, type of contraction: isometric contraction.

iii. Toe extension exercises: The patient was in sitting or standing position and was instructed to lift the big toe against the floor. Frequency: 20 times, intensity: 5 sec holds, type of contraction: isometric contraction.

Short Foot Exercise Progression (Group B): This group was consisting of candidates which were following an intrinsic muscle strengthening protocol. Short foot exercises: i. The candidates placed the foot flat on the ground, and draw the metatarsals inwards creating an arch with progression. Frequency: 20 times, intensity: 5 sec holds, type of contraction: isometric contraction.

Short Foot Exercise Progression (Group B):

Short Foot Exercise Progression	**1st Week**	**2nd Week**	**3rd Week**	**4th Week**
Position of Lower Extremity	Sitting	Bilateral Standing	Unilateral Standing	Standing on an unstable platform
Repetitions	4 weeks 5 Sessions / week Once a day			

Figure 1 Navicular Drop test

Figure 2 Short Feet Exercise

Figure 3 Unilateral Standing

Figure 4 Standing on a unstable platform

Inferential Analysis:

Table 1: Gender Distribution

	Group A	Group B
Male	17	19
Female	13	11

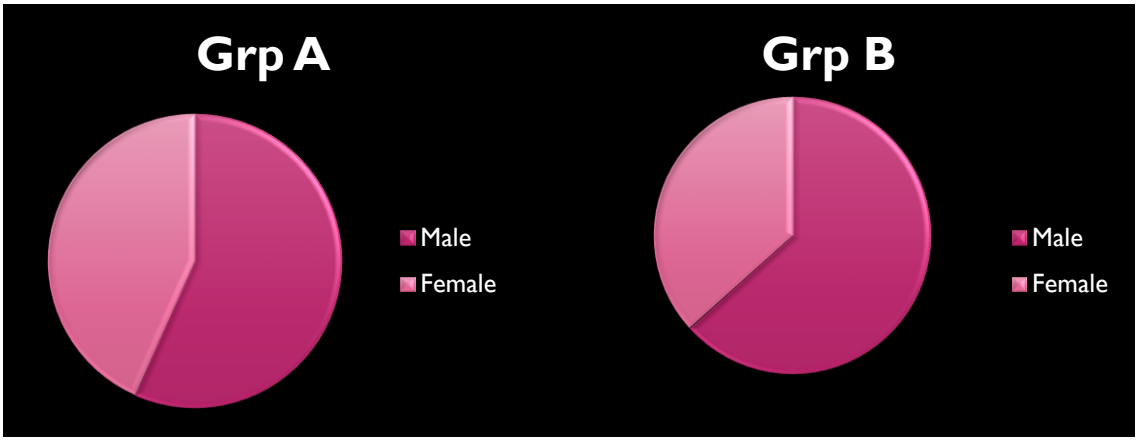


Fig: Pie Chart; Showing Gender Distribution in Group A and Group B

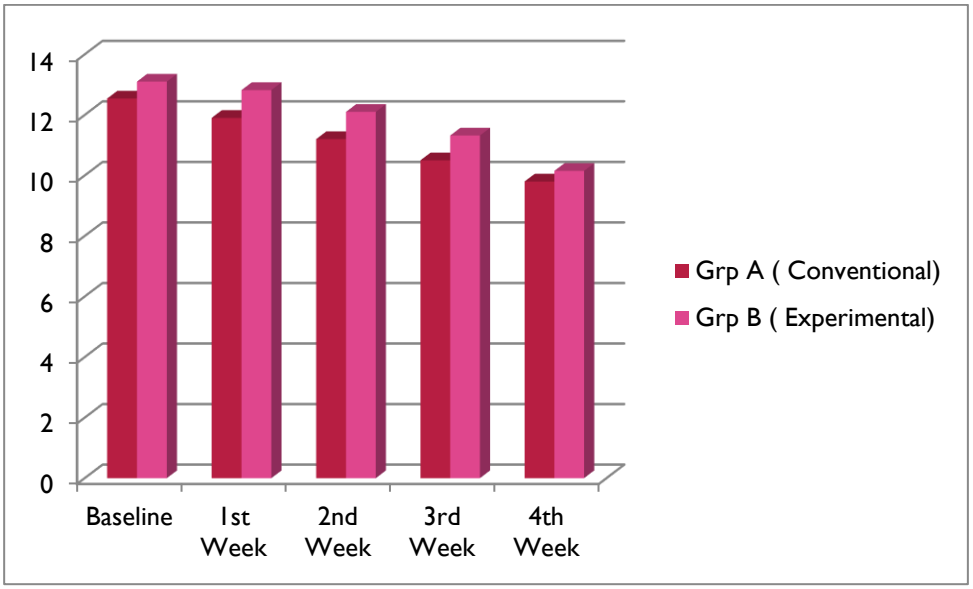
Table 2. Demographic details: Mean Age, Height, Weight and BMI details in Group A and B

	Age	Height	Weight	BMI
Grp A	**36**	**167.11**	**68.84**	**24.67**
Grp B	**38**	**162**	**72**	**27.4**

Table 3. Mean difference of NDT values in Group A and B

	Grp A (Conventional)	Grp B (SFE progression)
Baseline	12.54	13.1
1st Week	11.9	12.82
2nd Week	11.2	12.1
3rd Week	10.5	11.32
4th Week	9.8	10.15

The mean NDT value for Group A before treatment was 12.54 and 13.1 for Group B, After 4 weeks of rehabilitation in both groups, Group A achieved a mean of 9.8 while Group B achieved a mean of 10.15. Group A showed a reduction of 2.74mm while Group B achieved a 2.95mm. Both the groups showed a steady decline in 4 week based protocol in NDT values, which indicates a good prognosis.



Graph: Mean Navicular Drop test values for Group A and Group B from Baseline to End of 4th Week

Statistical Analysis:

P value and statistical significance: the two tailed p value equals 0.6557, by conventional criteria, this difference is considered to be not statistically significant. Confidence

Interval : The mean of Group one minus Group two equals -0.3500

95% confidence interval of this difference from -1.9134 to 1.2134

3. DISCUSSIONS

The research was conducted to evaluate the effectiveness of the short foot exercise in comparison to conventional methods in Flexible Pes Planus. The subjects were randomly assigned to two categories, conventional and Experimental. The mean NDT value for Group A (Conventional) prior to treatment was 12.54mm and for Group B(SFE Progression) it was 13.1mm. Following 4 weeks of Rehabilitation for both groups, Group A recorded a mean of 9.8 mm, while group B noted a mean of 10.15mm. Group A exhibited a decrease of 2.74 mm whereas Group B attained a reduction of 2.95mm. The Conventional group fell below the recognized threshold of 10mm with a mean decrease of 2.74mm, while experimental group approached the 10 mm threshold of NDT at 10.15mm with an average reduction of 2.95mm, which surpasses the conventional groups 2.74 mm. Both groups demonstrated a consistent decline in NDT values over the 4 week protocol, suggesting a favorable prognosis, which shows the importance of performing Short feet Exercise in Individuals with Flexible Pes Planus and the

studies mentioned above back up the evidence.

Intrinsic muscle exercises, like SFE, serve a significant function in static balance, such as standing on one leg, and the foot strength is a crucial in adjusting posture. [20] According to a conducted by Goldmann et al effects of toe flexion exercises was investigated in normal subjects, and showed that they lead toe enhancement in walking, running, and jumping.[21] Research conducted by Kelly et al, showed that the activation of AbdH was greater in whilst standing on 1 leg rather than standing on both legs, and that higher level of coordination occurred with other surrounding muscles during medial-lateral sway. Prior researches corroborates our results regarding impact of SFE.

According to Graham et al stabilizing the distal segment during closed chain exercises decreases the shear force on the moving proximal joint while ensuring stability in the movement of the proximal joint. Notably, squatting is classified as a closed chain exercise that includes flexing and extending the ankle joint, knee joint and hip joint, necessitating inter contraction of adjacent muscles and stability in the distal segments, like the foot and ankle.[22,23] However, bearing weight in individuals with flat feet enhances subtalar joint pronation, leads to navicular drop and reduces foot stability with a descending MLA.[24]In closed chain exercises for the Knee joint, the precision of knee joint movement was enhanced as the SFE aided in foot stability and coordinated well with the adjacent muscles. Conversely, the SFE did not exhibit a notable increase in precision during open chain exercises because open chain exercises are not connected to ankle stability.

Among the intrinsic foot muscles, the abductor hallucis garners significant attention due to its multiple functions. It is thought that the recovery of this muscle is crucial in addressing pes planus. The abductor hallucis muscle contributes to weight-bearing and propelling the body forward during push-off in walking. The flexor hallucis brevis muscle supports the medial longitudinal arch during the terminal stance in walking to ensure foot stability. Therefore, training the abductor hallucis might aid in decreasing navicular drop height and enhancing the longitudinal arch angle.

It was challenging to suggest a smallest meaningful effect for the two outcome measures in this research because they were strictly biomechanical instead of symptomatic or functional measures that patients might have been able to express opinions on regarding the clinical value of improvements of various degrees. However, these biomechanical outcome measures are worth considering as they represent the severity of the condition and the visual appearance of the foot. More importantly, enhancements in these biomechanical outcomes presumably signified a delay in the advancement to more severe flat foot, which often becomes symptomatic and can influence gait. The results of the research will also attract attention from those who view excessive pronation as a factor contributing to lower extremity injuries. [25]

The limitation of the study was the absence of physiological evidence to a evaluate the Intrinsic muscle thickness, which represents a financial constraint of the study. We recommend to the further studies investigating components of Knee along with improved physiological evidence.

4. CONCLUSION

SFE and conventional exercises are found to be effective in Flexible Pes Planus however, Short Feet Exercise found to be marginally better than conventional exercise.

Acknowledgement:

1. Santosh Kr. Rajak Carried out the research work as partial fulfillment for completing his structured doctorate of Philosophy(phD) programme under the supervion of Dr. Pratap Chandra Sarma. He supervised the entire work and helped in designing the methodology. Abhijit Kalita helped in drafting the manuscript and reviewing the literature. Prasenjit Bhattacharyya and Ankur Jyoti Bora helped in conceptualizing the study and also helped in data collection.
2. **Acknowledgement:** The authors would like to thank all the study subjects for their participation and duly acknowledge all the clinicians who have helped for collection of samples

Conflict of interest : None

REFERENCES

[1] Toullec E. Adult flatfoot. Orthop & Traumatol: SurgRes. 2015; 354 101(1): 11-17. doi: 10.1016/j.otsr.2014.07.030

[2] K Vijayakumar, S Senthilkumar, Rameshkumar Subramanian. A study on relationship between BMI and prevalence of flat foot among the adults using foot print parameters. International Journal of Advanced Research. 2016; 4(5):1428-1431.

[3] Shibuya N, Jupiter DC, Ciliberti LJ, Vanburen V, La Fontaine J. Characteristics of Adult Flatfoot in the United States. J Foot Ankle Surg. 2010; 49(4): 363-368. doi: 10.1053/j.jfas. 2010.04.001

[4] Jankowicz-Szyman´ska A, Wódka K, Kołpa M, Mikołajczyk E. Foot longitudinal arches in obese, overweight and normal weight females who differ in age. Homo. 2018; 69(1-2): 37-42. doi: 10.1016/j.jchb.2018.03.001.

[5] Troiano G, Nante N, Citarelli GL. Pes planus and pes cavus in Southern Italy: a 5 year study. Ann Ist Super Sanita. 2017;53(2): 142-145. doi: 10.4415/ANN_17_02_10.

[6] Mansour R, Teh J, Sharp RJ, Ostlere S. Ultrasound assessment of the spring ligament complex. Eur Radiol. 2008; 18(11): 2670-2675. doi: 10.1007/s00330-008-1047-1.

[7] Angin S, Crofts G, Mickle KJ, Nester CJ. Ultrasound evaluation of foot muscles and plantar fascia in pes planus. Gait Posture. 2014; 40(1): 48-52. doi: 10.1016/j.gaitpost.2014.02.008.

[8] Abourazzak F.E, Kadi N, Azzouzi H, et al. A positive association between foot posture index and medial compartment knee osteoarthritis in moroccan people. Open Rheumatol J. 2014;8:96-99.

[9] Gross KD, Felson DT, Niu J, et al. Association of flat feet with knee pain and cartilage damage in older adults. Arthritis Care Res. 2011;63(7):937-944.

[10] Guler H, Karazincir S, Turhanoglu AD, et al. Effect of coexisting foot deformity on disability in women with knee osteoarthritis. J Am Podiatry Assoc. 2009;99(1):23-27

[11] Banwell, H.A.; Thewlis, D.; Mackintosh, S. Adults with flexible pes planus and the approach to the prescription of customised foot orthoses in clinical practice: A clinical records audit. Foot (Edinb) 2015, 25, 101–109. [CrossRef]

[12] Desmyttere, G.; Hajizadeh, M.; Bleau, J.; Begon, M. Effect of foot orthosis design on lower limb joint kinematics and kinetics during walking in flexible pes planovalgus: A systematic review and meta-analysis. Clin. Biomech. 2018, 59, 117–129. [CrossRef]

[13] R.L. Bordelon, Correction of hypermobile flatfoot in children by molded insert, Foot Ankle 1 (1980), 143–150

[14] M.M. Jennings and J.C. Christensen, The effects of sectioning the spring ligament on rearfoot stability and posterior tibial tendon efficiency, J Foot Ankle Surg 47 (2008), 219–224

[15] McKeon, P.O.; Hertel, J.; Bramble, D.; Davis, I. The foot core system: A new paradigm for understanding intrinsic foot muscle function. Br. J. Sports Med. 2015, 49, 290. [CrossRef]

[16] Kelly, L.A.; Cresswell, A.G.; Racinais, S.; Whiteley, R.; Lichtwark, G. Intrinsic foot muscles have the capacity to control deformation of the longitudinal arch. J. R. Soc. Interface 2014, 11, 20131188. [CrossRef]

[17] McKeon, P.O.; Fourchet, F. Freeing the foot: Integrating the foot core system into rehabilitation for lower extremity injuries. Clin. Sports Med. 2015, 34, 347–361. [CrossRef]

[18] N.W. Elftman, Nonsurgical treatment of adult acquired flat foot deformity, Foot Ankle Clin 8 (2003), 473–489

[19] A.K. Leung, A.F. Mak and J.H. Evans, Biomedical gait evaluation of the immediate effect of orthotic treatment for flexible flat foot, Prosthet Orthot Int 22 (1998), 25–34

[20] Menz HB, Morris ME, Lord SR. Foot and ankle characteristics associated with impaired balance and functional ability in older people. J Gerontol A Biol Sci Med Sci 2005;60:1546–52.

[21] Goldmann JP, Sanno M, Willwacher S, et al. The potential of toe flexor muscles to enhance performance. J Sports Sci 2013;31:424–33. [25] Kelly LA, Kuitunen S, Racinais S, et al. Recruitment of the plantar intrinsic foot muscles with increasing postural demand. Clin Biomech (Bristol, Avon) 2012;27:46–51

[22] Graham VL, Gehlsen GM, Edwards JA. Electromyographic evaluation of closed and open kinetic chain knee rehabilitation exercises. J Athl Train 1993;28:23–30.

[23] Palmitier RA, An KN, Scott SG, et al. Kinetic chain exercise in knee rehabilitation. Sports Med 1991;11:402–13.

[24] Cobb SC, Tis LL, Johnson BF, et al. The effect of forefoot varus on postural stability. J Orthop Sports Phys Ther 2004;34:79–85.

[25] Mulligan EP, Cook PG. Effect of plantar intrinsic muscle training on medial longitudinal arch morphology and dynamic function. Man Ther. 2013;18:425 430