



INFLUENCE OF LEG DOMINANCE ON FLAT FOOT IN HEALTHY ADULTS.

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ABSTRACT

Introduction: Many factors contribute to asymptotically observe flat foot among adults. The aim of this study was to explore the effect of leg dominance in association with flat foot in healthy subjects using plantar arch index and ball kick test.

Method: Hundred and ten adults (18.79 + 1.57) participated in the study, out of which 44.54% were males and 55.45% were females. The subjects were assessed for flat foot using plantar arch index and ball kick test was used for leg dominance.

Result: The results showed 5% subjects with left leg dominance had flat foot and 4% subjects with right leg dominance had flat foot while 4% subjects with left leg dominance and 88% subjects with right leg dominance had no flat foot. Also, there was significance between flat foot and leg dominance.

Conclusion: Thus, there is correlation between flat foot and leg dominance in normal adults aged 18-25 years.

KEYWORDS : flat foot, leg dominance, plantar arch index, ball kick test.

Introduction

The foot is a very complex and unique structure, and comprises numerous bones, ligaments and joints.¹ The foot supports the body weight. Foot also allows the body's weight to fall in centre.² The bones in human feet are arranged to form three arches (medial longitudinal arch, lateral longitudinal arch and transverse arch³). The arches play functionally significant roles by supporting body weight and reducing the impact of the body during running and walking. During standing, the arch not only support weight but also contribute to maintain dynamic postural control and equilibrium.¹ One of the most important roles of the foot is weight bearing, which requires stability and resilience for absorbing impact. The medial longitudinal arch (MLA) and transverse arch provide this stability and resilience. The condition in which the medial longitudinal arch becomes chronically or abnormally low is called Flat foot.⁴

Flat foot is divided into two: Spastic flat foot and Flexible flat foot.⁵ Flexible flat foot: Flexible pronated foot have a normal range of motion of the mid-tarsal joints and have a flattened medial longitudinal arch only on weight-bearing. The presence of arch is noted in non-weight bearing or while standing on toes. Rigid/spastic flat foot: Rigid flat foot have limited mid-tarsal motion and continue to have a flattened arch when non-weight bearing.⁵

The arches of foot add elasticity and flexibility to the foot. They allow the mid-foot to spread and close. An arch absorbs shock, produces strength to push off, and helps to adjust balance, acts as energy store while walking, protects against pressure through the concavity of the arch and aids walking. The fundamental function of these arches is to provide more mobility and to absorb and disperse the shocks from metatarsus to the body. It becomes evident that without these arches, the forces created during walking, running and jumping enters metatarsus transmitting to upper body parts resulting into musculoskeletal problems at joints such as knee and spine. The forces created by the body to be absorbed by the arches, faces a major problem in flat foot. Gradually, there is weakening in usual ability of foot making some changes in the foot structure in such a way that an individual adapts to put toe outwards and heel out of normal condition while walking.^{3,6,7}

There are numerous causes for flat foot. The causes widely can be both congenital and acquired. The most common form being

congenital flat foot; it is mostly asymptomatic and also known as pediatric flexible flat foot. Severe forms such as vertical talus, congenital calcaneus valgus and tarsal coalitions are the rigid ones and also they are symptomatic. Acquired flat foot develops over time and not at the time of birth. There are various factors influencing flat foot overtime, they are: footwear, sitting positions, sleeping positions, compensation for other abnormalities, compensation for tight Achilles tendon or severe rupture of ligaments or tendons in foot. Most common acquired flatfoot is in adults due to posterior tibial tendon dysfunction, which develops with repetitive stress on the main arch supporting tendon over a long period of time or with aging.^{8,9,10,11,12}

The incidence of flat foot is very high in children which decrease with age as the skeletal maturity advances. The feet are flat in infants due to presence of fat. The prominence of arches comes with walking and as the child starts bearing weight.¹³ The arches of foot rapidly develop between two to six years and become structurally mature around 12-13 years.¹⁴ Prevalence of flat feet is higher in children due to ligament laxity and declines with age.¹³ The prevalence of flat feet is reduced in the ages of three to six as walking and other activities of the child causes the fat mass in central arch to disappear. Also the prevalence of flat feet is higher in boys than girls.⁷ The common opinion among researchers is that flat feet may result in the deviation of toe (Hallux valgus). A study has been done in England that rejected this hypothesis. Some of the complications caused by flat feet are related to arch foot functions.⁷ Flat foot is a biomechanical problem consisting of eversion of subtalar complex while weight bearing, along with plantarflexion of talus and calcaneus in relation to tibia, dorsiflexion and abduction of navicular, supination of forefoot and valgus of heel.¹⁵

Contrary to hand dominance, minimal attention has been given to the concept of leg or foot dominance.¹⁶ Leg dominance, in simple ways can be determined by which hand is dominant. If one is left-handed, then one must be left leg dominant. Leg dominance can be determined by 1 or 2 foot item skill test such as kicking a ball or stepping up on a chair. There are many tests of leg dominance that have been based on strength of two legs.¹⁶

Materials and methodology

Methods

Subjects:

A convenient sample of hundred and ten healthy subjects aged 18-25 years (mean 18.79 ± 1.574) participated in observational experiment. 44.54% males and 55.45% females participated in the study. Exclusion criteria of the study were history of arthritis, foot or ankle surgery, diabetes, foot abnormalities, any present cuts on lower extremity. The verbal information about the nature of the study was given and an informed consent was obtained from each participant.

Procedure for assessment of foot:

Plantar arch index:

Procedure:

Subject was initially made to sit in a comfortable position. Each subject was then asked to dip both the foot in the foot tray containing blue ink. Then subject was asked to place the foot on the paper and stand and bend the knee upto 30° . Using footprint test, plantar arch index was calculated as follows:

A line was drawn tangent to the medial forefoot edge and at a heel region. The mean point of this line was calculated. From this point, a perpendicular line was drawn crossing the footprint. The same procedure was repeated for heel tangency. We thereby obtained the measurement of the support width of the central region (A) and the heel region (B).

Support width of central region (A)

Plantar arch index²⁵ = _____

Support width of heel region (B)

Plantar arch indexes greater than 1.15 are regarded as flat foot.

Ball kick test:

Procedure

Subjects were asked to stand in front of a ball. Each subject was asked to kick that ball. The leg with which the ball was kicked was noted as dominant leg.

Data Analysis

STATISTICAL ANALYSIS

MS-Excel-2007 was used to enter the data which was analyzed using instat software. Descriptive analysis for numerical data consists of mean with standard deviation (SD) for various parameters. Fisher's exact test was used to find out the correlation between flat foot and leg dominance. P value less than 0.05 was considered to be statistically significant.

RESULTS

By the careful examination of foot prints of 110 subjects, the presence of flat foot was determined in 8% subjects while remaining 92% subjects had no flat foot irrespective of leg dominance. The significance of fisher's exact test was used in order to check whether the percentage of subjects with flat foot was significantly higher in consideration with leg dominance. The result of the study showed that there is positive correlation between flat foot and leg dominance (p value- <0.0001). The study showed 5% subjects with left leg dominance had flat foot and 4% subjects with right leg dominance had flat foot. While 4% left dominant subjects and remaining 88% right leg dominants had no flat foot.

Plantar arch index is widely used method for flat foot measurement. The mean of foot arch index on left side is 0.59 ± 0.20 which is same as of right side. The normal range of left side foot index was 0.12-1.33 and for right side was 0.19-1.42. there are many researches done stating prevalence of flat foot being 11.25% using foot posture index with 80 subjects with age group 18-25 years, other study was done using arch index on 649 subjects showing 13.9% flat foot with age group 18-27 years and a similar study was done with plantar arch index on 250 sample sizes with the result of 5.2% flat foot.^{26,27,28}

MEAN AND SD OF THE VARIABLES

Variables	Mean \pm SD	
No. Of subjects	110	
% males	44.54%	
% females	55.45%	
Age	18.79 ± 1.57	
Height	165.45 ± 8.17	
Weight	56.21 ± 11.00	
Plantar arch index	Left	0.59 ± 0.20
	Right	0.59 ± 0.20
Ball kick test	Left leg dominance	8.18%
	Right leg dominance	91.81%

Table no. 1: Mean and SD of variables in adults

Variables	Flat foot	No flat foot
Left leg dominance	5 (5%)	4 (4%)
Right leg dominance	4 (4%)	97 (88%)
Total	9 (8%)	101 (92%)

Table no. 2: Correlation between flat foot and leg dominance.

The co-relation between flat foot and leg dominance was found significant. The p value is <0.0001 which is extremely significant according to Fisher's exact test.

Table no. 1 reported the descriptive characteristic of the subjects and cervical measures mean and SD. The inter-relations of the study variables are shown in table no. 2. The relationships between flat foot and leg dominance revealed extremely significant association. There was significant relation between all variables.

Discussion

In the present study 110 subjects were taken out of which 5% subjects with left leg dominance and 4% subjects with right leg dominance had flat foot. Though, the results of the present study showed significant correlation in subjects having flat foot with left and right leg dominance. 8% subjects were having flat foot irrespective of leg dominance and remaining 92% were not having flat foot. 8.18% subjects were left leg dominant and 91.81% subjects were right leg dominant. 5% subjects with left leg dominance had flat foot and 4% subjects with left leg dominance didn't have flat foot. Similarly, 4% subjects with right leg dominance had flat foot and remaining 88% subjects were right leg dominant but didn't have flat foot. The purpose of the present study was to evaluate the influence of leg dominance on flat foot in subjects with age group 18-25 years.

Flat foot is an asymptomatic condition commonly seen in adult population. Adult flat foot is either persistent or develops after skeletal maturity. The medial longitudinal arch is the largest and is the primary structure absorbing impact of weight bearing that occurs during daily physical activities like walking and running.¹⁷

These functional features make clinical examination of this region complex.

Flat foot is characterised as partial or complete loss of medial longitudinal arch. Flatfoot is a condition in which the medial longitudinal arch is depressed or collapsed. If the foot becomes deformed, the foot adapts to perform its functions under the conditions of deformity¹⁸. The medial longitudinal arch is controlled with the assistance of the bone structures, ligaments, and the extrinsic and intrinsic muscles of the foot.¹⁸ It is obvious that without these arches, the forces that are created by walking, running and jumping enter to the metatarsus and then these forces are transmitted to upper parts of the body may result in many problems in different joints such as knee and spines. There are structural changes observed in foot, individual adapts to walk with toe outwards and heel out of normal condition while walking.⁷

Dominance, it is the tendency to prefer consistent usage of

dominant side in performing several tasks throughout the day knowingly or unknowingly. There are articles suggesting dominant side have quantified reaction time, movement time and final position accuracy of rapid aimed movements. This makes the muscles on dominant side to work more causing dystrophy in muscles of dominant side. One of the study also noted that majority of the humans are right footed for mobilization tasks but left footed for tasks requiring postural stabilization. There is a literature showing left leg is superior in producing strength in right handers.¹⁹ The present study showed positive correlation in between flat foot and leg dominance. There were 5% subjects with left leg dominance and 4% subjects with right leg dominance had flat foot.

Conclusions

This study suggests that there is significant association between flat foot and leg dominance in individuals with age 18-25 years. Foot arch index used to diagnose flat foot showed significance with leg dominance.

Limitation and Recommendations

The limitation of this study is the study can be done on large scale considering the tasks used to decide the leg dominance. In this study information regarding potentially relevant factors like family history of flat foot was not gathered. A perspective of longitudinal study is needed to demonstrate the influence of leg dominance and advancing age on incidence of flat foot.

REFERENCES

1. Anzai et al., Effects of Foot Arch Structure on Postural Stability; Clin Res Foot Ankle 2014, 2:2
2. Lees, lake, Klenerman : shock absorption during forefoot running and its relationship to medial longitudinal arch height. Foot ankle int, 2005, 26: 1081–1088.
3. B d chaurasia's: human anatomy-volume 2, pg no: 159-161.
4. Kitaoka, Luo zp; three-dimensional analysis of flatfoot deformity: cadaver study. Foot ankle int, 1998, 19: 447–451.
5. David h. Perrin: the injured athlete-3rd edition: pg no:441-442.
6. Kerrf, bennett , bibby sr, et al; the spring in the arch of the human foot. Nature. 1987 jan 8-14;325(7000):147-9.
7. Armin Abtahian, Sina Farzan; A study of the prevalence of flatfoot in high school children; Biomedical Research 2016; 27; 1-7.
8. V. Senadheera, B. M. Nawagamuwa, et. al.; prevalence and associated factors of flatfoot among 6 to 10 aged children in central province of sri lanka ;1-11 Int J Physiother. Vol 3(3), 310-315
9. Hyperpronation and foot pain; the physician and sportsmedicine 32;8 (august 2004)
10. Mickle kj, steele jr, munro bj; the feet of overweight and obese young children: are they flat or fat? Obesity (silver spring). 2006 nov;14(11):1949-53.
11. Napolitano c, walsh s, mahoney, et al; risk factors that may adversely modify the natural history of the pediatric pronated foot. Clin podiatr med surg. 2000 jul;17(3):397-417.
12. Erol k, karahan ay, kerimoglu u, et al; an important cause of pes planus: the posterior tibial tendon dysfunction. Clin pract. 2015 feb 5;5(1):699. Doi: 10.4081/cp.2015.699. Ecollection 2015 jan 28.
13. Ashok Aenumulapalli et al., Prevalence of Flexible Flat Foot in Adults: A Cross-sectional Study; Journal of Clinical and Diagnostic Research. 2017 Jun, Vol-11(6): AC17-AC20.
14. Miss. Tejashree Bhoir, Dr. Deepak B. Anap, et. al.: Prevalence of flat foot among 18 -25 years old physiotherapy students: cross sectional study; Indian Journal of Basic and Applied Medical Research; September 2014; Vol.-3, Issue- 4, P. 272-278.
15. C.I. Eczema, U.O. Abaraogu, et. al.: flat foot and associated factor among primary school children: a cross sectional study. Hong Kong Physiotherapy Journal; 2014; 32, 13-20.
16. S. Spry, C. Zebas, M. Visser; What is leg dominance?
17. Tome, nawoczinski, flemister, et al.: comparison of foot kinematics between subjects with posterior tibialis tendon dysfunction and healthy controls. J orthop sports phys ther, 2006, 36: 635–644.
18. Whitman : a study of the weak foot, with reference to its causes, its diagnosis, and its cure: with an analysis of a thousand cases of so-called flat-foot. J bone joint surg am, 1896, 1:42–77.
19. Rafael Bahamonde, Josh Weyer, et. al.: effects of leg dominance on the single leg hop functional test in non-injured adults; 30th Annual Conference of Biomechanics in Sports – Melbourne 2012; 31-34.