Influence of Flatfoot on Ankle Range of Motion and Dynamic Balance among College Students

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Abstract:-

Background: Flexible flat foot deformity is a condition in which the medial longitudinal arch becomes flat during weight bearing and is restored in non-weight bearing position. It is a quite disabling condition which may lower the properties of foot such as weight transmission, forward propulsion and shock absorption as a result of low medial longitudinal arch. Flat foot may also cause disturbance in both static and dynamic balance of an individual.

Aim: To find whether there is an influence of flat foot on ankle range of motion and dynamic balance in college students.

Methodology: It was an observational type of study of non-experimental design in which both male and female subjects with a bilateral flexible flat foot between the age of 18 and 21 years who had a significant navicular drop and with a normal BMI were selected as participants for the study. The ankle range of motion and dynamic balance of the subjects were obtained. The Universal goniometer was used to measure the ankle range of motion and the Star Excursion Balance Test was used to assess the dynamic balance of the subjects.

Results: The ankle range of motion of the individuals with flat foot was normal. There is a notable difference in the medial, the poster medial and the posterior reach distances of the individuals with flat foot which are considerably less when compared with the normative values of the Star Excursion Balance Test.

Conclusion: The conclusion of this study is that flat foot has no effect on the ankle range of motion but it has an influence over the dynamic balance of the individuals to some extent.

Keywords: **Flat foot, Star Excursion Balance Test, Ankle ROM, Dynamic Balance.**

I. INTRODUCTION

The longitudinal and transverse arches of the foot help in shock absorption and weight transmission and thereby help in the forward propulsion of the body . These arches are absent in infants and are developed, as the child starts to weight bear at the age of 2 to 6 years. When the height of the medial longitudinal arch becomes lowered and almost flat during weight bearing, the sole of the entire foot touches the floor. This is referred to as flat foot. Flat foot can be classified into flexible and rigid types. In case of flexible flat foot, the medial longitudinal arch appears to be normal in non-weight bearing position and becomes flat in a weight-bearing position. If the medial longitudinal arch is not restored even after relieving the weight then it is known as rigid flat foot .

Flexible flat foot is found to be prevalent for about 13.6% among individuals between the ages of 18 and 25 years in India. The medial longitudinal arch is believed to be the key structure contributing to the characteristics of the foot such as propulsion, shock absorption, and weight bearing. In the neutral position of ankle, the axis of the ankle joint passes through the lateral malleolus and medial malleolus through the head of the talus approximately. To walk without any deviations, it is necessary to have at least 10° of dorsiflexion at the ankle joint. The ankle range of motion is mostly restrained by the increase in the length or tension in the soft tissues. Generally, the range of ankle dorsiflexion is less when the knee is in extended position due to the lengthening of the gastrocnemius which is a two joint muscle. The range of dorsiflexion is comparatively more when the knee is in flexed position but this can be restricted by the soleus muscle and posterior part of the joint capsule of ankle joint.

Aim of the Study

The aim of the study is to find whether there is an influence of flat foot on ankle range of motion and dynamic balance in college students.

Need For the Study

Previously studies have been done on the prevalence of flat foot both among both children and young adults.

Although a study for assessing the foot muscle strength and ankle range motion in school children with and without flat foot and studies on the static and dynamic balance among young adults have been done already in other parts of the world, studies investigating the influence of flat foot on ankle range of motion and dynamic balance among young adults in Indian population were lacking. Hence this study was done to find whether there is an influence of flat foot on ankle range of motion and dynamic balance among college students.

II. METHODOLOGY

It is an Non-Experimental, observational study with convenient sampling conducted for 100 samples in SRM Institute of Science and Technology, Kattankulathur

Inclusion Criteria: The age between 18 to 25 years of both gender who has a bilateral flexible flat foot having navicular drop test positive and Normal Body Mass Index.

***Exclusion Criteria* are Those who having** Recent foot injury, Previous surgery in the foot, Peripheral nerve injuries in the lower extremities**,** Individuals with balance impairment such as vertigo and Any other muscular deformities.

Procedure: Both male and female subjects with a bilateral flexible flat foot between the age of 18 and 21 years who had a significant navicular drop and with a normal BMI were selected as participants for the study. The individuals with a recent foot injury, previous surgery in foot and ankle, peripheral nerve injuries in the lower extremities, balance issues such as vertigo etc. and any other muscular deformities were excluded from the study. The procedure is clearly explained to the participant and the consent of the participant is obtained.

The demographic data such as Name, age, gender, height, weight and BMI of the participants were obtained. The Navicular drop test is used to assess the flat foot. The ankle range of motion and dynamic balance of the subjects with navicular drop were obtained. The Universal goniometer is used to measure the ankle range of motion and the Star Excursion Balance Test was used to assess the dynamic balance of the subjects.

Outcome Measures

1. GONIOMETRY
2. STAR EXCURSION BALANCE TEST

Measurement of Ankle Dorsiflexion Measurement of Ankle Plantar Flexion Range of Motion of the Participant range of Motion of the Participant

III. STATISTICAL ANALYSIS

The mean and standard deviation for the ankle dorsiflexion, plantar flexion range of motion and the reach distances of all the direction of the Star Excursion Balance Test were calculated and tabulated. The IBM Statistical Package for Social Science was used to calculate the mean and standard deviation.

Table I

Comparison of Ankle Range of Motion of Individuals with Flat Foot with Normal Values of Ankle Range Of Motion

ANKLE RANGE OF MOTION	NORMAL RANGE in degrees	FLAT FOOT	
		RIGHT	LEFT
DORSIFLEXION	15-20	22.1±2.66	21.84±2.27
PLANTAR FLEXION	20-50	43.66±6.43	44.37±6.48

There were no considerable differences in the ankle range of motion of the individuals with flatfoot when compared to normal ranges of ankle dorsiflexion and plantar flexion.

Table II

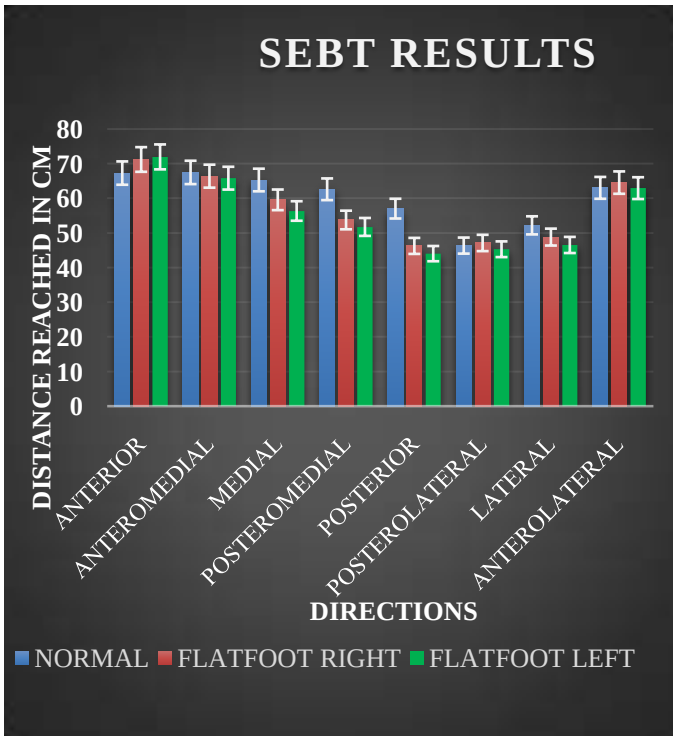
Comparison of Normative Values of Star Excursion Balance Test With the Distance Reached By the Individuals with Flat Foot

DIRECTION	DISTANCE REACHED IN CENTIMETERS		
	NORMAL VALUES	FLAT FOOT RIGHT	FLAT FOOT LEFT
ANTERIOR	67.35±8.42	71.28±9.77	72.03±8.65
ANTEROMEDIAL	67.54±10.1	66.46±10.29	65.88±9.84
MEDIAL	65.35±8.53	59.62±9.66	56.40±9.34
POSTEROMEDIAL	62.67±11.1	53.80±11.21	51.79±10.96
POSTERIOR	57.08±8.16	46.31±9.90	44.08±7.98
POSTEROLATERAL	46.40±11.4	47.16±11.52	45.35±10.28
LATERAL	52.25±8.69	48.86±12.65	46.58±9.10
ANTEROLATERAL	63.08±10.5	64.60±10.33	63.00±11.28

The distances reached by the individuals with flatfoot were slightly less in the medial, posteromedial and posterior directions when compared to the distances which are considered to be normal in those directions

Graph I

Comparison of Normative Values of Star Excursion Balance Test With the Distance Reached By the Individuals with a Flat Foot



IV. RESULTS

TABLE I shows the comparison of ankle range of motion of the individuals with flat foot with the normal values of ankle range of motion. The ankle dorsiflexion and plantar flexion range of motion of the individuals with the flat foot was normal and there is no influence of flat foot on ankle range of motion. **TABLE II** and **GRAPH I** show the comparison of normative values of the Star Excursion Balance test with the distance reached by the individuals with the flat foot. The distance reached by the individuals with the flat foot is considerably less in the medial, postero-medial and posterior directions, when compared to normative values of the Star Excursion Balance test and the distance reached in the anterior direction, was slightly greater than that of the normative values. The distance reached in the other directions were likely to be similar to the normal values of those directions. Thereby implying that flat foot has an influence on the dynamic balance of the individuals.

V. DISCUSSION

The purpose of this study is to find whether there is any influence of flat foot on the ankle range of motion and dynamic balance among the population of college students. The fallen medial longitudinal arches cause alterations in the biomechanics of the entire lower limb as the weight from the ankle joint is distributed to the foot in an uneven fashion. The students who are maintaining a poor posture while standing for a prolonged period of time, get adapted to that abnormal posture which leads to alterations in the hip, the knee and the ankle joints. A foot with a low arch can generate a maladjusted kinetic and kinematic pattern in the course of propulsive and landing phases of gait.

Katsuhito Nagano et al. stated that these alterations in the biomechanics may intrude the role of the medial longitudinal arch in protecting the ankle joint and other joints of lower limb such as the knee and the hip, which in turn may cause osteoarthritis of these joints, disability of the lower extremities and other potential soft tissue injuries such as anterior cruciate ligament injuries. **Mohamed Ibrahim Ali et al.** have concluded that the dynamic balance of the individuals with flat foot was lesser when compared to normal individuals. Poor dynamic balance in individuals with flat foot may be due to reduced muscle mass which can cause a collapse in the biomechanics of responses of the muscle and deficits in the mechanisms of stability [20]. **Lubetzky V. Anat and Kramer A.Patricia** have reported that the individuals with a low medial longitudinal arch reached farther distances in the Star Excursion Balance Test. **Karen P. Cote et al.** have stated that participants with flexible flat foot were incapable of retaining the rigid support during weight bearing. They have reported that the subjects with flexible flat foot reached relatively farther distance in the anterior and anteromedial directions on Star Excursion Balance Test when compared with the distance reached by the subjects with high arched foot .

In this study, it is observed that there are no significant differences in the ankle dorsiflexion and plantar flexion range of motion of the students with flat foot when compared with the normal values of ankle dorsiflexion and plantarflexion. This implies that flat foot has no influence over the ankle range of motion. However, the distances reached by these individuals with flat foot in the Star Excursion Balance Test were shown differences in the medial, posteromedial, posterior and anterior directions. In the medial, posteromedial and posterior directions, the distance reached by the participants were comparatively less and in the anterior direction of SEBT, the participants reached slightly farther than that of the distance which is considered to be normal in that direction. The participants reached the posterior and posterolateral limbs of the star with some difficulty while comparing with the other six directions.

Additionally, it is also noted that there were gender differences in the distances reached in the Star Excursion Balance Test. The female participants reached slightly farther distances when compared to the male participants. When height is taken into consideration, the participants with a height of 171-180 cm reached farther than that of the individuals with the height of 161-170 cm and 151-160 cm. The reason behind this may be the difference in leg length of the individuals. Flat foot has some sort of influence on the dynamic balance of individuals. Thus, the conclusion of this study is that flat foot does not have an effect on the ankle

range of motion of the individuals but have an influence on their dynamic balance ability to some extent.

VI. CONCLUSION

This study is concluded that there were no considerable differences in the ankle range of motion in individuals with flat foot. Flat foot does not affect the ankle range of motion. On the contrary, there is an influence of flat foot on the dynamic balance of the individuals with flat foot to some extent.

LIMITATIONS are The sample size was small, there was no equal participation of both the genders, Data collected were compared with normative values, Only SEBT was used to assess the dynamic balance and only individuals with normal BMI were included.

RECOMMENDATIONS are the number of samples can be increased**,** the age range can be reduced, One gender can be studied for homogeneity, Comparison between individuals with and without flat foot and Individuals with same height can be studied.

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