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Correlation between PES planus and genu valgum in young adults-on observational study

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Abstract
Background: Pes planus deformity of the feet alters the lower limb biomechanics and associated with change in tibiofemoral angle of the knee and there is lack of evidence suggest the correlation between pes planus and genu valgum in young adults so this study focusing on correlation between pes planus and genu valgum.
Purpose: Purpose of the study is to determine correlation between pes planus and genu valgum in young adults.
Methods: with inclusion and exclusion criteria 40 subjects with flat foot assessed by using navicular drop test and tibiofemoral angle assessed by 360- degree goniometer and the obtained data is recorded in data collection form.
Results: The Correlation between ND[R] and TFA[R] is -0.07921204, meaning the relationship is negatively weak, further the variables are moving in opposite direction. The Correlation between ND[L] and TFA[L] is 0.005061076, meaning the relationship is positively weak, further the variables are moving in the same direction.
Conclusion: Statistical analysis concludes right pes planus increases leads to decrease in right genu valgum and, left pes planus increases leads to increase in left genu valgum.

Keywords: Sports rehabilitation, pes planus, genu valgun, knee, young adults, rehabilitation, physiotherapy

Introduction
Arch is described as a segmental elevation of foot which is made up of multiple ligaments, muscles and bony articulations. Pes planus is a lowering of medial longitudinal arch of foot and also called as flat foot [1, 2]. Loss of PTT function is the most important contributor to AAFD (Adult acquired flat foot), and its estimated prevalence is thought to be over 3% [3].
There is a functional link between the arches of foot and lower limb biomechanics [2]. A study shows, Moderate and severe Pes planus was associated with nearly double the rate of anterior knee pain and intermittent low back pain, while mild pes planus was associated with no higher rate for these problems [3]. Genu valgum or "knocked knees" are part of the coronal plane deformities of the lower extremity. The majority of patients are asymptomatic and have no functional limitations. This condition can be preceded by flat feet and occasional medial foot and knee pain. Children start developing physiologic genu valgum starting by age 2, and it becomes most prominent between ages 3 to 4. After that, it typically decreases to a stable, slightly valgus position by age 7 years [4]. The tibiofemoral angle was defined as the angle formed in the frontal plane by the anatomical axes of the femur and tibia. a computer program called scodiac that uses lower limb photographs and it gives tibiofemoral angle measurement. The anatomical axis would be considered normal if it is between 5° and 7° of valgus alignment (approximately 6° valgus). Valgus deformity would be >7° [2]. The relationship between pes planus and genu valgum is still unclear [2]. A study shows pes planus is associated with genu varum [2] and another study shows pes planus is associated with genu valgum [1]. Since there is a lack of evidence which supports the association between the pes planus and genu valgum, this study aims to investigate the relationship between pes planus and genu valgum.
There is a biomechanical change in the condition of the pes planus foot, which is foot alignment that changes towards over pronation which will receive more load on the vastus medialis compared to normal feet because of weakened plantar flexor muscles which will

cause tightness in the lateral ankle group muscles so that the lateral ankle will be lifted up with greater pressure to be distributed to the medial ankle, thus making the tibia and femur rotate to the medial section and cause hip adduction. This condition triggers the muscles around the knees and legs to work harder in order to maintain a stable body position. As the foot arches flattens on ground that causes the tibia and femur rotate inwards adding stress on the knee [7].

Procedure

- Students from Cauvery College of physiotherapy of age group between 18-24 years were approached for this study. Subjects were asked to voluntarily participate after informing about purpose and procedure of study and to sign consent form those subjects who are willing to participate was selected based on inclusion and exclusion criteria.
- Tibiofemoral angle measurement (TFA): - bilateral TFA were measured with subjects in supine position, the hips and knees were extended, the patella facing vertically upward, and limb positioned in straight line.
- One arm of the goniometer was aligned to an imaginary line drawn from the anterior superior iliac spine to the middle of the patella (femoral alignment).
- The second arm was aligned to a line joining the middle of the patella to the middle of the ankle (centre point between medial and lateral malleoli).
- The centre of patella served as fulcrum for the goniometer. The TFA recorded in degrees.
- The data obtained from the tibiofemoral angle measurement is recorded in data collection form for both right and left leg
- Navicular drop measurement:- sitting to standing posture, while patient sitting medial malleolus, navicular tuberosity and head of metatarsal were palpated and marked and draw a feiss line and then placing a index card parallel to foot and perpendicular to ground and make a mark in the level of navicular tuberosity in non-weight bearing position on the card and told the patient to stand in full weight bearing position and make a mark in the level of navicular tuberosity on the card, and the navicular drop is measured by inch tape. The data obtained from the navicular drop measurement is recorded in data collection form for both right and left foot.

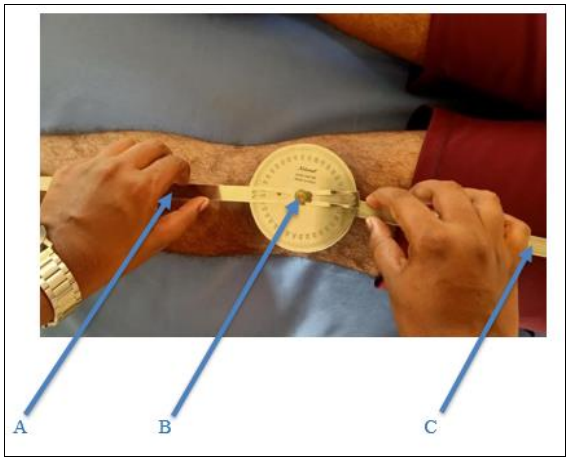

Fig 1: Tibiofemoral angle measurement

A – Movable arm along the axis of tibia, pointing towards the centre of medial and lateral malleolus.
B – Fulcrum on the center of patella.
C – Stationary arm along the axis of femur, pointing towards the ASIS.

Fig 2: Navicular drop measurement

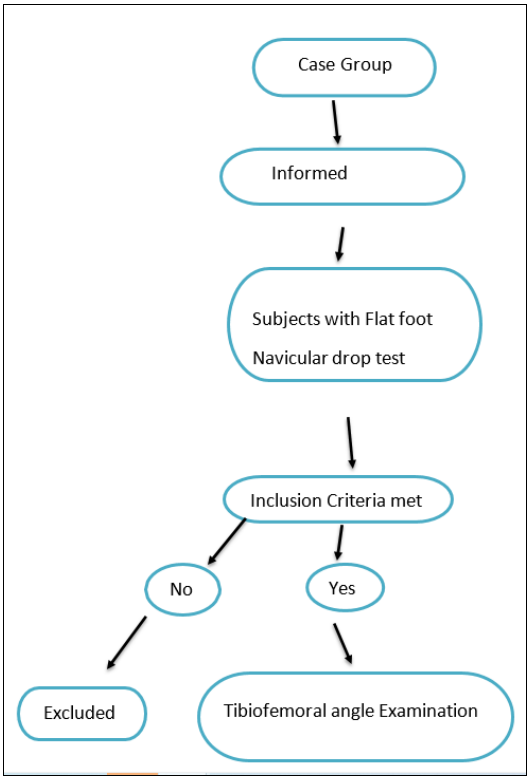

Fig 3: Methodology of the study

Results

Table 1: Height and weight

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Height	145.0	157.0	159.0	162.7	170.2	183.0
Weight	32.00	45.75	55.0	62.35	77.0	108.00
BMI (kg/m2)	15.60	19.50	22.00	23.23	26.95	40.60
ND[R](cm)	0.400	0.700	1.000	1.048	1.225	2.400
TFA[R](degree)	5.000	0.700	8.000	7.825	9.000	11.000
ND[L](cm)	0.500	0.975	1.000	1.120	1.300	2.300
TFA[L] (degree)	5.000	7.000	8.000	8.325	10.000	15.000

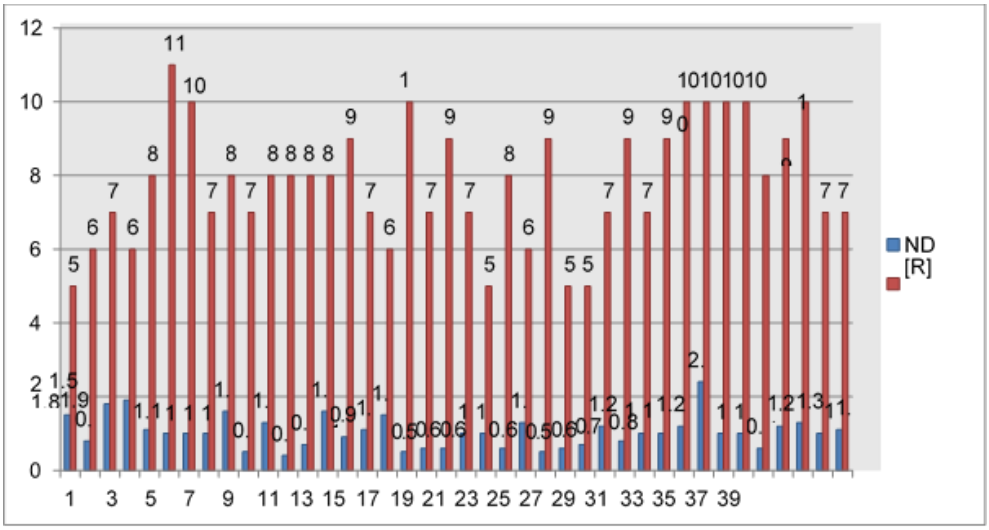

Fig 4: Bar diagram of Navicular Drop [Right Foot] and Tibiofemoral Angle [Right Knee]

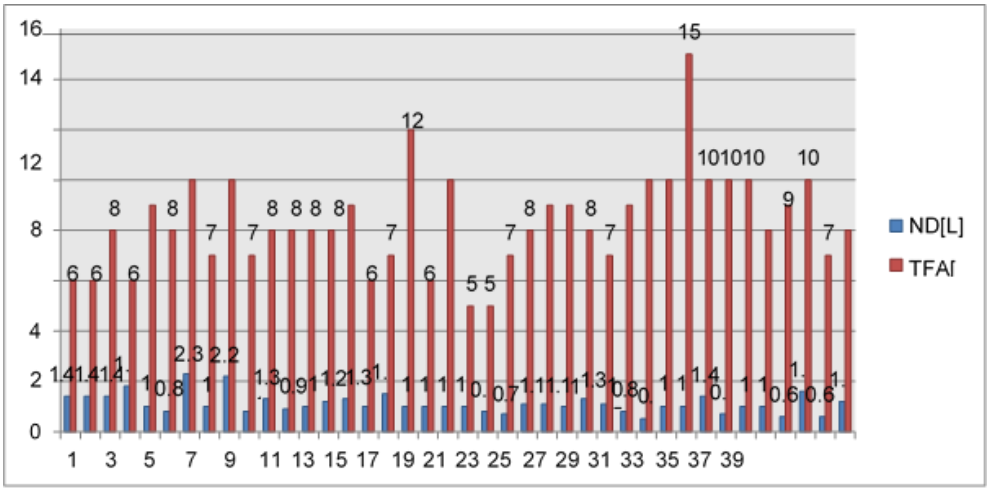

Fig 5: Bar diagram of Navicular Drop [Left Foot] and Tibiofemoral Angle [Left Knee]

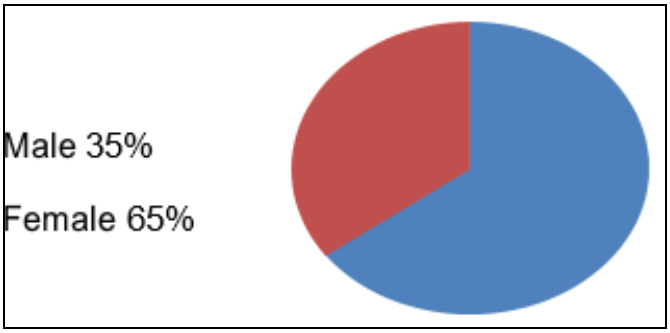

Fig 6: Pie chart of distribution of measurements based on gender

Objective of the problem: To test whether ND[R] implies TFA[R].
Test Results:
***H*0**: ND[R] and TFA[R] are not related.
V/S*H*1: ND[R] and TFA[R] are related.

Test Statistic(W) Value	p- value
0	1.174e-14

Since p-value is less than 0.05, we reject the null hypothesis ***H*0**, that is ND[L] and TFA[L] are related

Test Results
ND[L] and TFA[L] are not related.
V/S
ND[L] and TFA[L] are related.

Test Statistic(W) Value	p- value
0	1.091e-14

Since p-value is less than 0.05, we reject the null hypothesis, that is ND[L] and TFA[L] are related.
Examining the relationship between ND and TFA Strength of the relationship of ND[R] and TFA[R] The Correlation between ND[R] and TFA[R] is -0.07921204, meaning the relati onship is negatively weak, further the variables are moving in opposite direction Strength of the relationship of ND[L] and TFA[L] The Correlation between ND[L] and TFA[L] is 0.005061076, meaning the relati onship is positively weak, further the variables are moving in the same direction.

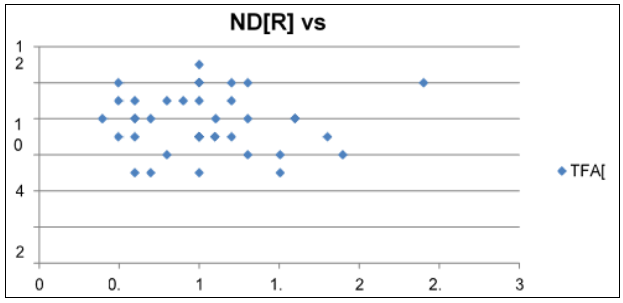

Fig 6: ND[R] vs

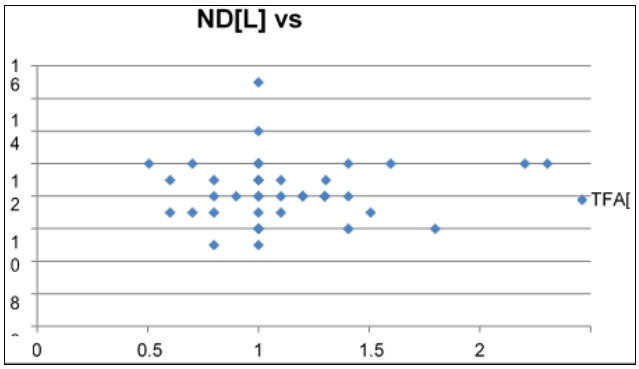

Fig 7: ND[L] vs

Discussion

The purpose of the study was to determine the correlation between the presence of pes planus and genu valgum in young adults where 40 participants of age between 18-24 years participated in this study. There is correlation between pes planus and genu varum but studies suggest there is a biomechanical relation between pes planus and genu valgum and there is a sufficient data source or studies of pes planus and genu valgum in adolescents and adults but there is a lack of data to access in young adults. This study strengthens the studies about correlation between flat foot and genu valgum to screen and to find out flat foot disorders and anterior knee pain disorders in young adults.

The study was conducted in Cauvery collage of physiotherapy where students were selected based on inclusion and exclusion criteria.

Tibiofemoral angle is measured by SCODIAC program which uses the photographs of lower limb [2] and radiographs but in the clinical practice tibiofemoral angle is measured using standardized steel goniometer which is reliable and cost-effective method. The navicular drop is measured using blank card and inch tape and it is the most reliable method.

The data obtained from Navicular drop test and Tibiofemoral angle measurement is statistically correlated with Wilcoxon sign rank test using R i386 software version 3.3.1, the data of navicular drop and tibiofemoral angle of right foot and leg shows week negative relationship and navicular drop and tibiofemoral angle of left foot and leg shows week positive relationship.

Limitations of the study

A purposive sample of 40 subjects were included in this study more random sample and larger number of subjects are recommended to detect correlation and there may be a possible error during tibiofemoral angle and navicular drop measurements, keeping all the study's consideration there were limitations concerning due to current covid-19 pandemic situation.

Clinical implications

The data of the study is useful in screening and early diagnosis of flat foot disorder, genu valgum and anterior knee pain disorders and conditions, with the help of this data.

Conclusion

With regards, this study focused on investigating correlation between pes planus and genu valgum. According to this study results there is a correlation between pes planus and genu valgum. There is lack of studies investigated the correlation between flat foot and knock knee and this study has significant data source to strengthen the studies about correlation between flat foot and genu valgum to screen and early diagnosis of flat foot disorders and knee conditions. Statistical analysis concludes that, right pes planus increases lead to decrease in right genu valgum and, left pes planus increases leads to increase in left genu valgum.

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