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Correlation of Navicular Drop with A-angle in Flat Foot among Nursing Professionals -A Cross-Sectional Study

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Abstract

Introduction: Flat Foot predisposes nurses to work-related musculoskeletal disorders due to their increasing physical demand in a hospital setup. The study aims to investigate the correlation between the Navicular drop and A-angle in flat foot among Nurses. **Methodology:** Hundred and thirty one Female nurses were assessed for flat feet using the Foot Posture Index (FPI), the Navicular drop, Q-angle, and A-angle were measured and recorded. **Results:** There was a statistically significant negative correlation between Navicular drop and A-angle on both sides with right r=-0.622 and left r=-0.81. Also, there is a statistically significant negative correlation observed between A-angle and Q-angle on both sides. **Conclusion:** The A-angle can be used as a prognostic measure in flat foot as an alternative to the other methods currently in practice.

Major Findings: The present study gives information on prevalence rate of flat foot among nursing professionals. **1.** The present study glances on the relationship between Navicular drop and A- angle of foot. **2.** Current study can form clinical implications for nursing professionals.

Keywords: A-Angle, Flat Foot, Navicular Drop, Nursing Community, Q-Angle

1. Introduction

The foot is a bio-kinetic chain connecting the lower limb to the spine *via* the pelvis[1]. The arches of the foot are the Medial Longitudinal Arch (MLA), the lateral longitudinal arch, and the anterior transverse arch. These arches play a significant role in weight-bearing activities such as running and walking[2]. The MLA is vital for the foot's propulsion and shock absorption during walking. The MLA plays an important role in the mid-stance phase of the gait cycle. In the mid-stance phase, the MLA is lengthened and flattened because of the pronation of the forefoot.

Flattening of the medial longitudinal arch is known as Pes Planus. Pes Planus is "the loss of the MLA of the foot where it nearly contacts the ground"[3]. According to Neumann, excessive mid foot pronation can affect the hip, knee and ankle and disrupt the normal dynamic control of these joints. An increase in this ante version causes genu valgus of the knee. Anatomical alterations may cause discomfort because of the knee joint's faulty alignment[4,5]. The anterior process of the calcaneus no longer supports the talar head when the MLA collapses, causing the calcaneus to subluxate posteriorly. The midfoot and forefoot subluxate dorsally and laterally around the talus to counteract this shift in foot posture. Because of this, the anterior process of the calcaneus will elongate the lateral column. The mid foot places an excessive amount of stress on the normal Posterior Tibial Tendon (PTT), and the navicular is shifted dorsolaterally.

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Work-related Musculo Skeletal Disorders (WMSDs) by definition "are a subset of MSK disorders that arise from occupational exposures". In a hospital setup, the nursing population constitutes about 33% and they account for 60% of MSD[6]. The most common biomechanical risk factors seen in nurses for MSD are excessive repetition of particular movements, awkward postures, and heavy lifting. Working in shift duties also disturbs their circadian rhythm and predisposes them to different workload demands. This contributes to the overall impact on their quality of life[6]. The prevalence of ankle foot problems in a 12-month study conducted in Gujarat among nurses was about 27%[6]. A cross-sectional study had shown a prevalence of 20.7% for ankle-foot injuries[7]. According to a review of research done in the 1990's by Daraiseh *et al.*, the prevalence of MSD in nurses ranged from 3.7 to 40%. Since then, a few studies have revealed that the prevalence of foot or ankle MSDs ranges from 1.8% to 74%[8]. Getie K *et al.*, noticed a prevalence of 43.7% ankle-foot pain among nurses with various associated risk factors[9].

The structural deviation in the foot and lower leg leads to a malalignment in the knee, hip, and pelvis region. This excessive pronation increases biomechanical demands on the knee[10] the specific link between tibial rotation and patellofemoral symptoms has not been established. This paper presents a theoretical model which describes the compensation that can occur at the tibiofemoral joint to deal with the excessive tibial rotation. The link between the tibiofemoral compensation and increased patellofemoral compression is delineated. Factors which determine whether this increased compression becomes symptomatic are discussed. J Orthop Sports Phys Ther 1987;9(4). Internally rotating of the lower extremity due to excess foot pronation may induce knee valgus and an increase in Q-angle[11]. An increase in Q-angle adds biomechanical stress because it prevents the patella from moving normally in the femoral groove[12]. In flat foot, the subtalar joint remains pronated which consequently abducts the forefoot and talus and depresses the navicular bone[13]. The navicular drop is ideally measured using a technique described by Brody[14].

The A-angle is a quantitative measurement, originally developed to assess patellar patho mechanics. It quantifies the angle between the patellar orientation and the tibial tubercle[15]. The relationship between the inferior pole and tibial tubercle will vary if any of these two parameters of patellar position change. A study conducted by Arno has shown that the A-angle can be used clinically to assess individuals with patellofemoral dysfunction[15,16]. According to the research, there have been no studies correlating navicular drop with A-angle and A-angle with Q-angle in flat foot among nurses. The objective of the study was to assess the relation of A-angle with navicular drop to understand the lower extremity kinetic chain.

2. Methodology

2.1 Study Design

A cross-sectional study was conducted among the nursing population who met the selection criteria. Informed consent was signed by each participant in the study and was approved by the Institutional Ethics Committee (registered no: ICE/IRB/DSU/MPT/2022/009). Before the study, it was registered in an international clinical trials registry (ClinicalTrials.gov registration no: CTRI/2022/07/044045).

2.2 Participants

A total of 131 female nurses were screened for the study. Nurses were assessed for flat foot using the Foot Posture Index (FPI). 82 participants who matched the inclusion criterion were recruited for the study, their demographic details are given in (Table 1) and their job experience in (Table 2).

Female participants with a mean age of 30.9 years (SD: 5.29). A mean weight of 67.16 kg (SD: 7.02) and a mean height of 1.57 m (SD: 0.07). The average body mass index was 27.24 (SD: 1.98) as mentioned in Table 1.

The mean job experience of the participant was 7.38 years (SD: 4.79), the mean working hours per day was 3 hours (SD: 0.55), and the mean standing hours per day was 3 hours (SD: 0.75) as given in Table 2.

Q-angle, A-angle, and Navicular drop were measured. Participants shoes were observed for the components: Shoe age, heel height, longitudinal profile, cushioning,

Table 1. Demographic data of participants[a]

Variables	Min	Max	Mean ± SD
Age (years)	25.00	46.00	30.95 ± 5.29
Height (m)	1.25	1.76	1.57 ± 0.07
Weight(kg)	40.00	80.00	67.16 ± 7.02
BMI	24.03	32.87	27.24 ± 1.98

[a] The demographic data are presented as Mean ± SD.

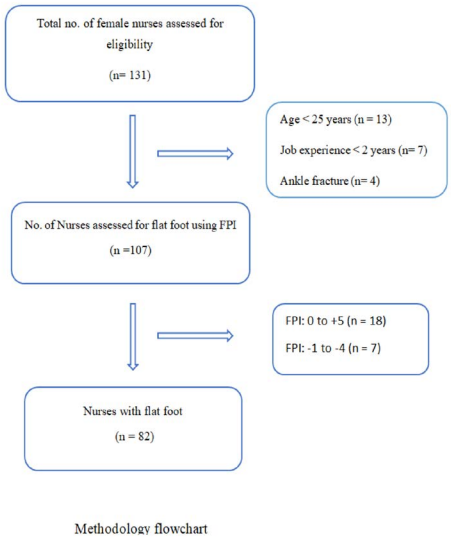


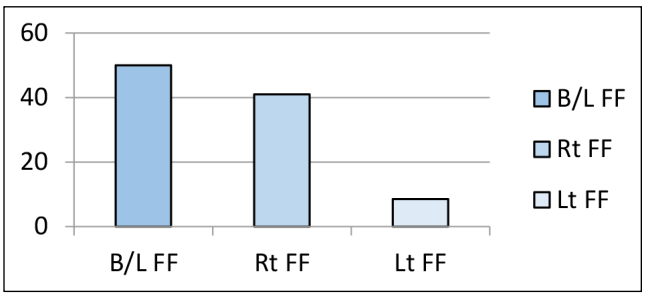
Figure 1. Methodology flowchart[a].

[a]Pictorial presentation of the selection of the participants.

Table 2. Characteristics of Job experiences of participants[a]

Variables	Min	Max	Mean ± SD
Job experiences	2.00	21.00	7.38 ± 4.79
W. hours/day	6.00	9.00	7.50 ± 1.50
S. hours/day	4.00	7.00	5.50 ± 1.50

[a] Data are presented as Mean ± SD.



Graph 1. Prevalence of flat foot[a].

[a]Data are presented in bar graph.

midsole, tread pattern, and outsole wear pattern. Navicular drop, A-angle, and Q-angle were assessed for the participants

[a]Pictorial presentation of the selection of participants.

2.3 Data Analysis

Data obtained in this study was analyzed statistically by using SPSS (version 20). The results are expressed as mean and standard deviation. The correlation between the Navicular drop and A-angle was calculated using the Spearman test and was considered statistically significant whenever (p=0.0001).

3. Results

The prevalence of flat foot among nurses was found to be 50% on bilateral foot, 41% on the right foot, and 8.53% on the left foot as represented in Graph 1.

Navicular drop and A-angle are negatively correlated on both sides with right r= -0.622 and left r= -0.81 among nurses with flat foot (Table 3).

Correlation between Navicular drop with A-angle on the right and left foot are seen in Table 3.

Negative correlation observed between A-angle and Q-angle on both sides with right r= 0.5168 and left r= -0.8062 among nurses with flat foot (Table 4).

Correlation between Q-angle and A-angle on the right and left foot are seen in Table 4.

4. Discussion

The lower extremity is a kinetic chain; deviations at the foot ultimately have an impact on the knee and hip joints. The objectives of our study were to understand the correlation between Navicular drop and A-angle in flat foot among the nursing population.

As per the literature, it is known that excessive pronation creates biomechanical deviation at the tibiofemoral joint. During weight-bearing activities, the supporting structures at the tibiofemoral joint get over worked to compensate for excessive pronation of the foot. This in turn causes femoral internal rotation on the tibia, there by affecting the patellofemoral joint[10,17] the specific link between tibial rotation and patellofemoral symptoms has not been established. This paper presents a theoretical model which describes the compensation that can occur at the tibiofemoral joint to deal with the excessive tibial rotation. The link between the tibiofemoral compensation and increased patellofemoral compression is delineated. Factors which determine whether this increased compression becomes symptomatic are discussed. J Orthop Sports Phys Ther 1987;9(4). Since the landmark used for evaluating A-angle is the tibial tubercle and inferior pole of the patella, we hypothesize that the pronation of the foot and the resultant internal rotation of the tibia changes the orientation of the tibial tubercle

Table 3. Correlation between Navicular drop with A-angle on the right and left foot[a]

Correlation	Spearman R	p-value
Rt. ND and A angle	-0.6224	0.0001*
Lt. ND and A angle	-0.8125	0.0001*

[a] Navicular drop and A angle are negatively related on both right and left foot which are statistically significant (p=0.0001)

Table 4. Correlation between Q-angle and A-angle on the right and left foot[a]

Correlation	Spearman R	p-value
Rt. Q angle and A angle	-0.5168	0.0001*
Lt. Q angle and A angle	-0.8062	0.0001*

[a] Q-angle and A-angle are negatively related on both right and left foot which are statistically significant (p=0.0001)

and deviates the patella laterally. This lateral displacement could change the position of the inferior pole of the patella[18,19]. The change in patellar alignment and tibial tubercle leads to a change in the A-angle when the foot is in pronation[20].

As per the literature search, there is a lack in the study concerning the correlation between Q-angle and A-angle. Q-angle and A-angle are used for the assessment of the patellofemoral joint. Biomechanically, pronation of the foot rotates the tibia internally thereby changing the orientation of the tibial tuberosity. This increases the distance between ASIS and the mid-point of the patella consequently increasing the Q-angle. Since the tibial tuberosity is a common landmark for both the Q-angle and A-angle, as anticipated, our study has documented that a change in the tibial tuberosity orientation will increase the Q-angle and decrease the A-angle.

Our study attempted to assess the correlation between age and A-angle. However, the results did not indicate any relationship between the two and hence it may be interpreted that A-angle does not change with age. Further research in this direction may be necessary for more conclusive remarks on this.

Remarkably, it has been noticed that there is no significant correlation between standing hours and FPI in existing studies. However, a previous study by Getie K *et al.,* observed an increase in ankle and foot pain (43.7%) in nurses. Another study by Reed LF has mentioned prolonged standing and walking (up to 10 hours), as contributing factors for foot or ankle MSDs.

Hence, we conclude that the A-angle can be used as a prognostic measure in flat foot as an alternative to the other methods currently in practice.

4.1 Strength of the Study

This is one of the few studies that has focused on the Navicular drop with A-angle and A-angle with Q-angle in flat foot among nurses. The study was successful in exploring the correlation of Navicular drop with A-angle in flat foot among nursing professionals.

4.2 Limitations

The present study holds certain shortcomings. In our study, the extrinsic factors of flat foot like BMI, standing hours, and footwear related to WMSDs in nurses were observed. A flat foot can be caused due to muscle imbalance surrounding the ankle joint. In the future, intrinsic factors such as muscle strength and tightness can be examined to rule out the cause of flat foot in nurses. Categorizing nurses as per their age and department.

5. Conclusion

The anatomical expression of A-angle can be used as a tool for prognostic measure of flat foot among nurses which would further aid the conservative management of the same. Hence, this would substantiate the need for lifestyle modification and coping strategies to counteract the flat foot deformity at its initial stage.

6. Author Designation

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