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Original Research Article

Comparison of Navicular Height in Females with and without Mechanical Arch Foot Pain

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ABSTRACT

Introduction: Medial longitudinal arch (MLA) and the position of foot is a risk factor for many foot and lower extremity injuries. Navicular drop test is a reliable method to assess the optimal functioning of MLA.
Objective: Compare the difference in navicular height in females with mechanical arch foot pain with normal females.
Methodology: 50 participants were selected and were randomly allocated to two groups based on the presence of mechanical arch foot pain into group A and B. In sitting position the navicular tuberosity was palpated and the height of navicular tuberosity was measured from the ground.
Results: There was a significant difference in navicular height in females with mechanical arch foot pain compared to normal females.
Conclusion: Navicular height measurement is an optimal method for assessing the functioning of MLA that can be a causative factor for foot pain.
Implication: The position of foot and medial longitudinal arch can be a causative factor for foot pain.

Key words: navicular height, mechanical arch foot pain, medial longitudinal arch (MLA).

INTRODUCTION

Human foot is subjected to excessive amount of stresses and strains as it is cramped in ill fitting shoes, made to walk on rough surfaces and face lot of constant trauma and misuse. Foot is a complex structure consisting large number of bones, ligaments, tendons and muscles. However the arches are integral part of anatomical construction of the foot. Arches are made of metatarsal bone, tarsal bones and are supported by the ligaments. Out of the three arches the medial longitudinal arch in particular creates space for soft tissues, which acts as springs, particularly the thick plantar aponeurosis. As these soft tissues have elastic properties ground reaction forces are distributed and thus reduces risk of musculoskeletal damage and can organize forces during gait cycle reducing the cost of walking and particularly running when vertical forces are higher. The function of arches depends on many factors like the shape of the foot, [(1)] structure of the bones, [(2)] stability of the ligaments, [(3,4)] and the amount of muscular fatigue around the arches [(5)] and along with this some other factors like type of footwear, [(6,7)] age and gender [(8)] also have some influence on the formation of Medial longitudinal arch. High or low arch foot (pes cavus and pes planus) are considered as a risk factor for many sports related overuse injuries. Williams [(9)] reported that runners with high arches had greater incidence of injuries on ankle involved more bony structures, and on the

lateral side of the ankle, while runners with low arches had more injuries on knee, involved more soft tissue structures and on the medial side of the knee. The literature also suggests that the position of foot is also a risk factor for exercise related injuries. Dahle [(10)] has reported that knee pain was more common in football players with pronated or supinated foot types when compared with neutral foot type. Another study by Tong [(11)] reported that High-arch and flat foot types are associated with lower extremity injuries, however the strength of the relationship between two was low. Brody [(12)] introduced static navicular drop test to assess the optimal function of medial longitudinal arch in runners. Navicular drop method has shown moderate to good reliability for estimating position of foot and arches. [(13-15)] As the position of foot and arches are one of the risk factor for foot pain and related lower extremity injuries Hence the objective of this study is to find out that the difference in navicular height in subjects with mechanical arch pain with the normal subjects in order to find out the role of medial longitudinal arch in causing the mechanical arch foot pain.

MATERIALS & METHODS

Study design: The present study was a single blind randomized control trial with convenience sampling. 50 female collegiate students aged between 18-30 years were recruited and were randomly allocated to two groups based on inclusion and exclusion criteria.

Inclusion criteria: Inclusion criteria for the study was a) Females of age group between 18-30 years b) history of foot pain while weight bearing from last 3 to 18 months c) Pain in the mid foot region d) Able to provide informed consent. Exclusion criteria for the study was: a) History of recent fracture around foot and ankle b) any deformity around foot and ankle c) sensory impairment in the lower extremity d) Any circulatory deficits in the lower limb e) any neurological condition affecting balance and co-ordination e) arthritis of the foot f) Foot surgery in last 12 months g) Localized heel pain typical of Plantar fasciitis h) History of Diabetes mellitus or Diabetic complications or Peripheral arterial disease or systemic inflammatory disease.

Procedure

The participants were randomly allocated to two groups: Group A with foot pain and Group B without foot pain. Height and weight of the participants were noted. The participants were explained about the procedures for the study and were asked to sit comfortably on a chair and then asked to place foot on the floor; the navicular tuberosity was then palpated and marked with the marker. The perpendicular distance between the floor and navicular tuberosity was measured by a measuring tape to note the navicular height. Three readings were taken for each subject and mean was calculated for analysis.

Fig. 1: Procedure for measuring the navicular height (in mm)

Data Analysis

Mean of the three readings of navicular height was calculated. Unrelated t-test was used to calculate the differences in the navicular height between the two groups.

RESULTS

The results showed that there was a statistically significant difference between navicular height in females with mechanical arch foot pain when compared to navicular height of normal female subjects ($p<0.0001$). The results showed increase in

navicular height in females with mechanical arch foot pain. Table 1 shows the results mean and standard deviations of age, BMI and navicular height for group A and B.

Table 1: Comparison between Group A & B

Subjects	Group A		Group B		t value	p value
	Mean	SD	Mean	SD	20.01	<0.0001
Age	20.08	1.84	23.16	3.54		
BMI	20.26	2.19	20.18	1.98		
Navicular height	51.16	1.59	39.48	2.44		

DISCUSSION

Foot is an important part of the body and medial longitudinal arch playing an important role in maintaining integrity of the foot. The results of the study represents that there was a difference in navicular height in females with mechanical foot pain as compared to females without foot Pain. Various studies have established the relationship between navicular height and pain. The result of the present study also suggests that increased navicular height population is more prone to mechanical arch foot pain. [16] Burns J et al 2005 has reported 60% of the subjects with pes cavus had high proportions of the foot pain. Another study has reported that both the low and high arch feet have been associated with increased risk of injuries. (Burns et al 2005a). [17] However one study reported contradicting results in professional runners that arches lower or higher than normal medial longitudinal arch is not a definite risk factor for sports-related injuries. [18] This may be due to complexity of the foot structure and its adaptability to new situations encountered during sporting activities. Hence it can be suggested the differences in the navicular height in females with foot pain can be attributed to malfunctioning of medial longitudinal arch that may further predisposes the females for increased risk of injuries in lower extremity. However other factors affecting the navicular height like congenital causes, heel cord contracture, improper footwear limiting toe movements, ligamentous laxity, Marfan syndrome, hip abductor weakness genu valgum, change in work environment like excessive standing or walking also contributes to it and must be considered to establish the actual cause of navicular drop in order to prevent the individuals to increased risk of injuries.

CONCLUSION

It can be concluded that the difference in navicular height in females with mechanical arch foot pain is because of the abnormal functioning of medial longitudinal arch.

Limitations

The small sample size and only female participants was a limitation and the leg dominance was not measured.

Future scope

Study with large sample size with mixed population, type of footwear can produce results that can be generalized to the population.

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