Original Article

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Correlation of Foot Posture Index-6 and Navicular Drop Test with Functional Ankle Stability in Running Male Athletes

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Abstract

Human foot posture is highly variable among healthy individuals and ranges from flat- to high-arched. The Foot Posture Index (FPI) is a validated method for quantifying standing foot posture, and is being used in a variety of clinical settings. Therefore objective of the study was to find correlation between Foot Posture Index-6 (FPI-6) and Navicular Drop Test (NDT) with functional Ankle Stability in Running Male Athletes. 60 Male Running athletes participated in the study. Foot Posture Index- 6, Navicular Drop Test, Side Hop Test were performed by them and data was recorded. Correlation between them was determined by Pearson correlation coefficient. Functional Ankle Stability using side hop test were calculated of both the feet and correlation with FPI & NDT. Results showed that there is significant correlation between the foot posture index - 6, Navicular Drop Test and Side Hop Test for ankle stability. Hence it was concluded that the ankle instability is correlated with foot posture & navicular drop in healthy running athletes.

Keywords: Foot Posture Index- 6; Navicular Drop Test; Side Hop Test.

Introduction

Human foot posture is highly variable among healthy individuals and ranges from flat- to high-arched. Differences in muscle activity in people with flat-arched feet may reflect neuromuscular compensation to reduce overload of the medial longitudinal arch [1]. Historically, foot mechanics are considered to contribute to lower extremity malalignment and pathology proximal to the foot via joint coupling with tibial internal rotation [2].

Considering the hypothesized link between foot posture and lower extremity injury, static foot posture is frequently assessed in the clinical setting, with a belief that this may provide indications for biomechanical interventions (e.g. foot orthoses). Commonly employed assessment methods to assess foot posture include, but are not limited to, Navicular drop, resting calcaneal eversion, the longitudinal arch angle and the Foot Posture Index (FPI) [2].

A six-item criterion reference tool (the Foot Posture Index, or FPI) was developed in response to a requirement for a quick, easy and reliable method for measuring foot position in a variety of clinical settings [3]. Navicular drop test is used in evaluating the amount of pronation in runner's foot.

Acute and chronic lateral ankle instability is common in high-demand patient populations. If not managed appropriately, patients may experience recurrent instability, chronic pain, osteochondral lesions of the talus, premature osteoarthritis, and other significant long-term disability. Proposed risk factors include prior ankle sprain, elevated body weight or body mass index, female gender, neuromuscular deficits, postural imbalance, foot/ankle malalignment and exposure to at-risk athletic activity [4].

Subjects with excessive pronation were found to have no difference in invertor strength, but decreased concentric plantar flexion strength when compared to normal's [5]. No studies have been done to identify the relationship of excessive foot pronation or supination and ankle musculature.

However, to our knowledge, no studies have been published to identify if the tools that are used to measure foot posture and stability can be correlated

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and the values of one can be used to predict the value or outcome of other. Therefore the aim of study was to find correlation between Foot Posture Index-6 and Navicular Drop Test with Functional Ankle Stability in Running Male Athletes.

Operational Definitions

1. Runner - A person who runs competitively as a sport or hobby. Ex-a 400 metres runner [6].

Methodology

60 subjects were included in the study fulfilling the iinclusion criteria of runners in age group 15- 18 years, athlete participating in school level running sports since Two and a half year, Dorsiflexors strength normal (5 grade) on MMT Scale, BMI between 18.5 to 24.9 kg/m^2. Any subject with any history of musculoskeletal dysfunction for which athlete is undergoing physicians consultancy which may affect outcome of the study, any history and / or diagnosed cardiovascular disorders, neurological disorders, respiratory disorders, psychosomatic disorders, hormonal disorders & metabolic dysfunction, any history of lower extremity injury and/or surgery for which athlete is undergoing physicians consultancy, and Sprinters (≤400 meters) were excluded [11].

Procedure

Potential subjects were apprised of the procedure and its benefits. Prior to testing, the subjects were familiarized with the testing procedure.

After that Examiner examined each athlete individually to fill up the *Foot Posture Index* himself. Subjects were divided into 3 subgroups- supinated (-1 to -5), neutral (0-5), and pronated (6 & above), on the basis of their FPI- 6 scores [11,12].

After five minutes of rest Subject was placed in the sitting position and *Navicular Drop Test* was conducted with their feet flat on a firm surface with their knees flexed to 90* and ankle in neutral position. While maintaining this position index card was placed in the inner aspect of the hind foot, with the card placed vertical on the ground passing the Navicular bone. The most prominent point of the Navicular was marked on the card.

After five minutes of rest the athlete was asked to perform warm up of about 5 minutes followed by *Side Hop Test* to measure ankle stability. The warm up consisted of 5 minutes of jogging.

Each Participant was instructed to hop on one limb laterally over a 30-cm distance. One repetition constituted of hopping laterally 30 cm and back to the starting location. Each participant completed 10 repetitions and was instructed to do so as quickly as possible. Test was conducted on concrete floor. Three trials were taken with rest in between of one minute. Average of the three trials was selected for the statistical analysis. If a participant fell, put the contralateral foot down, missed the stopwatch pad, or did not completely clear the 30-cm distance while hopping the trial was rejected and the participant repeated the trial again [7,8,9,10].

The Outcome Measures recorded were scores of Foot Posture Index- 6, scores of Navicular height and Side Hop Test time.

Results

60 Male running athletes with mean age 16.13 ± 1.09 years, Height 64.4 ± 5.05 inches and weight 54.7 ± 10.4 were taken to carry out the study. Following results were obtained in the study.

Table 1: Relationship (correlation coefficient) of FPI- Right with HOP -Right

Fpi-Right	N	Hop Right
Supinated	10	r = 0.262*, p=0.043
Neutral	26	r = 0.144, p=0.481
Pronated	24	r = 0.875*, p=0.000

*correlation coefficient value significant at p<0.05

Table 2: Relationship (correlation coefficient) of FPI – Left with HOP- Left

Fpi- Left	N	Hop- Left
Supinated	10	r = 0.297*, p=0.04
Neutral	26	r= 0.174, p=0.394
Pronated	24	r= 0.734*, p=0.000

*correlation coefficient value significant at p<0.05

Table 3: Relationship (correlation coefficient) of NDT- RIGHT with HOP- Right

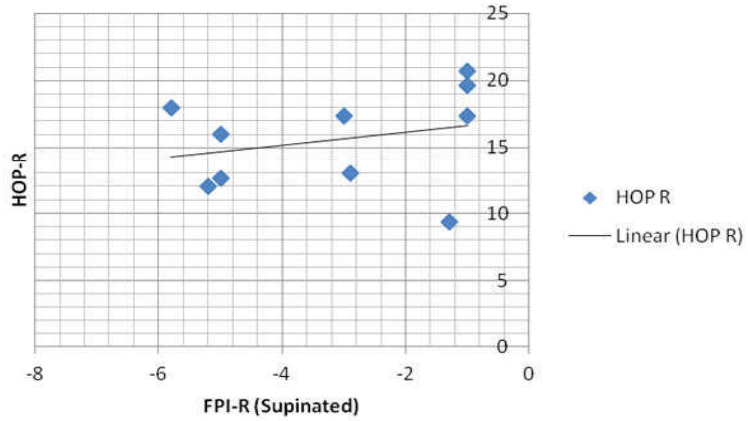
	N	HOP-Right
NDT- Right	60	r =0.305*, p=0.017

*correlation coefficient value significant at p<0.05

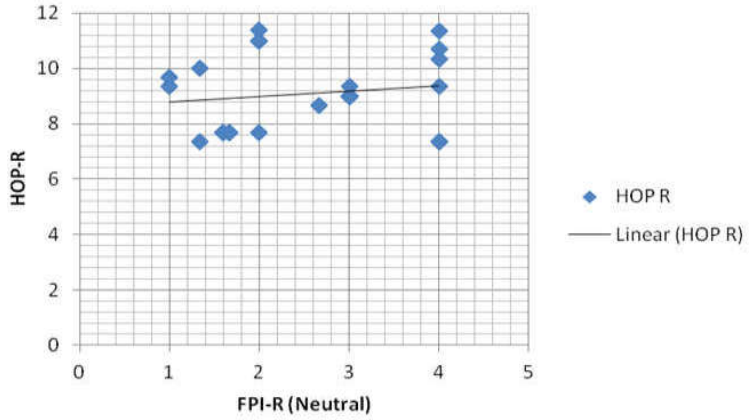
Table 4: Relationship (correlation coefficient) of NDT-Left with HOP Left

	N	HOP-Left
NDT-Left	60	r = .518, p=0.000

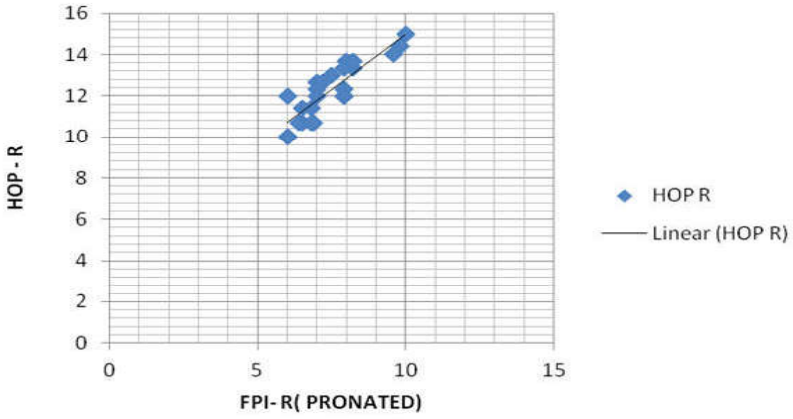
*correlation coefficient value significant at p<0.05



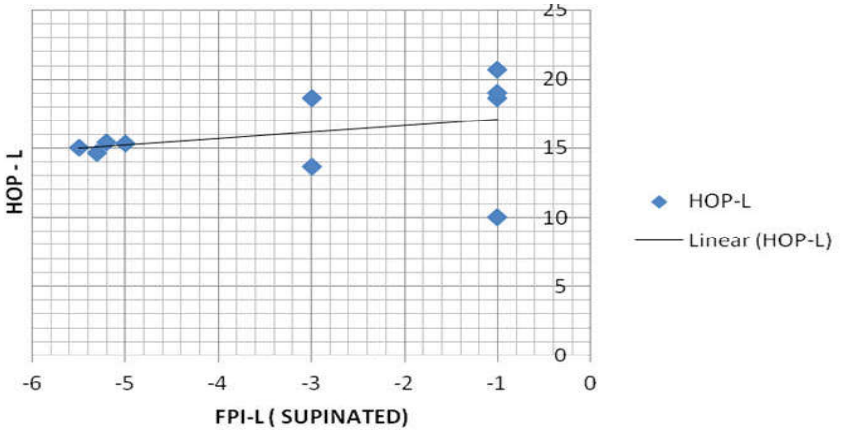
Graph 1: Correlation of FPI-R (Supinated) with HOP-R



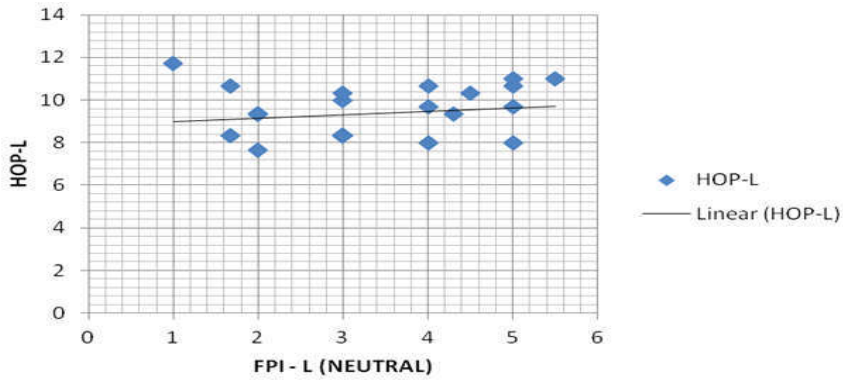
Graph 2: Correlation of FPI-R (Neutral) with HOP-R



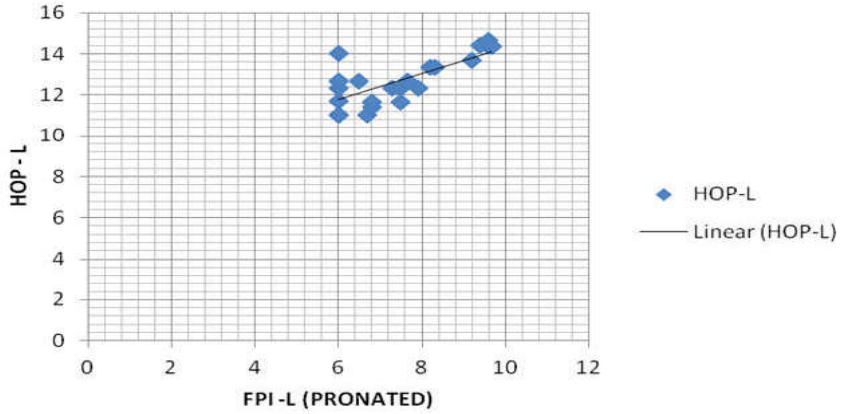
Graph 3: Correlation of FPI-R (Pronated) with HOP-R



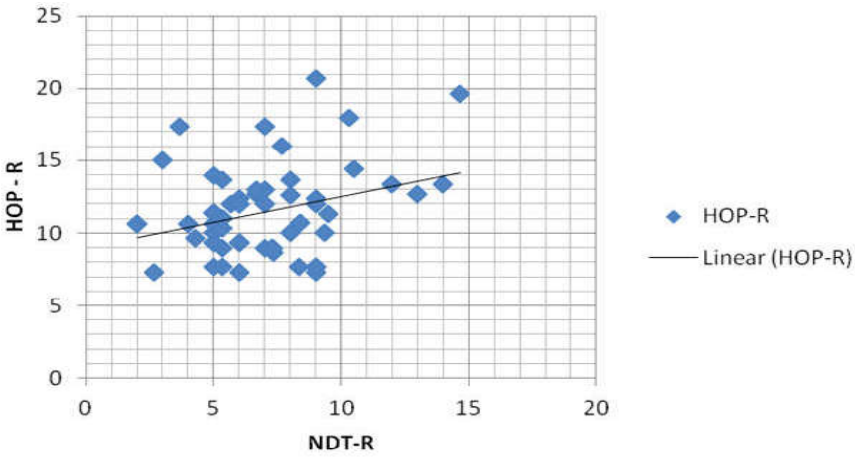
Graph 4: Correlation of FPI-L (Supinated) with HOP-L



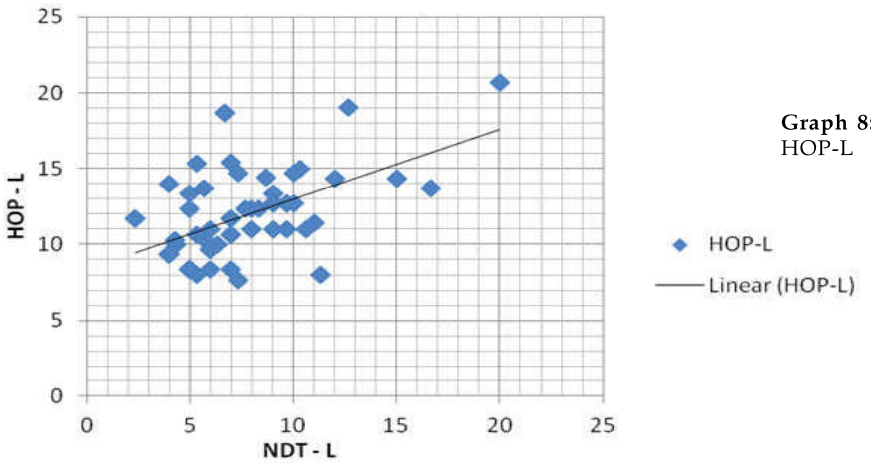
Graph 5: Correlation of FPI-L (Neutral) with HOP-L



Graph 6: Correlation of FPI-L (Pronated) with Hop-L



Graph 7: Correlation of NDT-R with HOP-R



Graph 8: Correlation of NDT-L with HOP-L

Discussion

Novice runners face a challenge when taking up running because of the high risk of sustaining a running-related injury (RRI) when compared with experienced recreational runners [2]. Of all the non-modifiable risk factors, foot posture and knee alignment have been of special interest among clinicians because mal-alignment of the foot and knee are believed to be associated with development of RRI [13].

60 male running athletes were included in the study with mean age 16.13 ± 1.09 years, Height 64.4 ± 5.05 inches and weight 54.7 ± 10.4.

For the purpose of statistical analysis the FPI-6 scores of 60 subjects were divided into three groups i.e. less than 0 (supinated), between 0-5(neutral), more then 5 (pronated). The data of FPI-6 of above groups was then correlated with corresponding values of Side hop test. There was found to be significant correlation between the scores of FPI-6 & Hop test for supinated and pronated foot types [Supinated (R) r= 0.876, $p<0.05$, Supinated (L) r= 0.297, $p<0.05$ Pronated (R) r= 0.262 $p<0.05$, Pronated (L) r= 0.736,$p<0.05$] while for the normal foot there was found to be moderately weak correlation [neutral (R) r= 0.145, $p<0.05$, Neutral (L) r= 0.175, $p<0.05$). Similarly there was significant correlation between the scores of NDT and Side Hop Test [Right= 0.306,$p<0.05$, Left = 0.518, $p<0.05$]

A more pronated foot type as measured by the FPI was associated with greater peak forefoot abduction and earlier peak rearfoot eversion in the PFPS group, and greater rearfoot eversion range of motionin the control group. In both individuals with and without PFPS, there was fair to moderate association between the FPI and some parameters of dynamic foot function [14].

The Foot Posture Index, normalized Navicular Drop, and calcaneal angle relative to subtalar joint neutral are all reliable and sensitive to group differences when used in a population with PFPS. Individuals with PFPS possess a more pronated foot posture and increased foot mobility compared to controls [15].

Chuter et al in his study stated that there are several limitations to this study that should be considered. This study was restricted to normal and pronated foot types as determined by FPI score. A supinated foot type, classified by a score -5 to 0 on the FPI scale, was not included. Due to the nature of the ordinal scale used in the FPI, i.e. evenly distributed categories and directional, it suggests that the predictive capacity of the FPI may extend to a negatively scored supinated foot type however this is currently an assumption [16]. However the current study takes into consideration all the three components of FPI-6.

Hop test scores should be evaluated as *both* a comparison with known distance and time standards based on sex and level of competition and relative to an individual athlete's limb symmetry index. Based on the results of this study, hop test scores should be evaluated based on normative data that are specific to the individual's sex and level of competition as well as the individual's limb symmetry index [17].

Therefore from the present study it can be interpreted that the hypothesis " There is significant correlation between Navicular Drop Test with Functional Ankle Stability in Running Male Athletes." And "There is significant correlation between Foot Posture Index-6 and Functional Ankle Stability in Running Male Athletes" are accepted.

Conclusion

Results show that There is low correlation between Navicular Drop Test with Functional Ankle Stability in Running Male Athletes. And there is low correlation between Foot Posture Index-6 and Functional Ankle Stability in Running Male Athletes.

Ethical Clearance: Taken from ethical committee

Source of Funding: Self

Conflict of Interest: nil

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