

# FOOT STRUCTURE IS RELATED TO FOOT FUNCTION

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## INTRODUCTION

It has been suggested that foot structure may influence foot function (Song et al., 1996). The aim of this study is to investigate the relationship between foot structure and function as a predictive tool that could be used to plan more effective conservative and surgical treatments of pedal pathologies. We hypothesize that measures of foot structure (hindfoot alignment and arch height) are associated with biomechanical measures of foot function in asymptomatic healthy individuals.

## METHODS

Foot structure was characterized by computing: (1) the maleolar valgus index (MVI) while standing, (2) arch height index (AHI) while sitting, and (3) AHI standing. MVI is a measure of static hindfoot alignment (Song et al, 1996). The subject's plantar foot is scanned while standing on a plexiglass platform over a flatbed scanner with a custom-made jig to register the lateral and medial malleolus. The deviation from the midpoint of the transmalleolar axis to the midpoint of the hindfoot, normalized to the foot width in this region, comprised the MVI. Note that AHI is the arch height at one-half of foot length normalized by the truncated foot length (Zifchock et al, 2006).

Foot function was characterized by calculating: (1) The center of pressure excursion index (CPEI - a measure of dynamic foot function), which is the lateral displacement of center of the pressure curve from the line constructed between the initial and the final center of pressure values, normalized by the foot width at the anterior one third of foot. (Song et al., 1996) The emed X system (Novel gmbh, Germany) and custom software, developed in C++, were employed to calculate the CPEI. Peak pressure (PP) and maximum force (MF) were calculated for the total plantar foot and each masked anatomical region using Novel software. Temporal-distance foot-fall parameters (e.g. step length, stride length, velocity, etc) were obtained with the GaitMatII (EQ systems, Glenside, PA). Each of 61 asymptomatic healthy adult test subjects walked at their comfortable self-selected speed across both the Emed-X and the GaitmatII systems to obtain the foot function data. Each subject also was structurally evaluated with MVI and AHI (sitting and standing).

## RESULTS

Pearson correlation coefficients were calculated for each combination of structural and functional parameter for the entire cohort. The results are summarized in Table 1. MVI was significantly correlated with PP and MF at the hallux and negatively correlated with MF at the 1<sup>st</sup> MTPJ. AHI standing was correlated with PP and MF at the 1<sup>st</sup> MTPJ and negatively correlated with the PP at the 2<sup>nd</sup> MTPJ. AHI sitting was correlated with double support time and velocity. Step

and stride lengths were negatively correlated with AHI sitting. AHI sitting was correlated with MF at the 5<sup>th</sup> MTPJ and negatively correlated with 2<sup>nd</sup> MTPJ PP and MF at the 1<sup>st</sup> MTPJ.

## DISCUSSION

MVI was correlated with hallucial loading and negatively correlated with 1<sup>st</sup> MTPJ loading. This finding is consistent with the overpronation that accompanies valgus hindfeet and a hypermobile first ray. AHI was correlated with medial column loading as well as temporal-distance footfall parameters. Foot structure is correlated with foot function and one's basic gait pattern.

Table 1: correlation between foot structure & function

|                        | AHI sit           | AHI stand         | MVI (%)           |
|------------------------|-------------------|-------------------|-------------------|
| CPEI (%)               |                   |                   |                   |
| Double support time    | R=0.316, p=0.017  |                   |                   |
| Step Length            | R=-0.354, p=0.007 |                   |                   |
| Stride Length          | R=-0.340, p=0.010 |                   |                   |
| Velocity               | R=0.339, p=0.010  |                   |                   |
| Peak Pressure-Hallux   |                   |                   | R=0.380, p=0.004  |
| Peak Pressure-1st MTPJ |                   | R=0.320, p=0.015  |                   |
| Peak Pressure-2nd MTPJ | R=-0.375, p=0.004 | R=-0.316, p=0.017 |                   |
| Maximum force Hallux   |                   |                   | R=0.354, p=0.007  |
| Maximum force 1st MTPJ | R=-0.344, p=0.009 | R=0.265, p=0.046  | R=-0.294, p=0.026 |
| Maximum force 5th MTPJ | R=0.266, p=0.045  |                   |                   |

## REFERENCES

Song et al., JAPMA 86(1):16-23, 1996.  
Zifchock et al., Foot Ankle Int, 27(5):367-72, 2006

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