

# WITHIN-SUBJECT VARIABILITY OF PLANTAR PRESSURE PATTERNS IN BAREFOOT RUNNING.

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## INTRODUCTION

Dynamic plantar pressure measurements offer a unique opportunity to assess foot functioning during stance phase in running. However a biomechanical or clinical interpretation has to take within-subject, or between-trial variability into account. Only Cornwall and McPoil (2000) studied within-subject variability for LMFI (Lateral-Medial Force Index) and LMAI (Lateral-Medial Area Index) obtained during 3 trials of barefoot walking. Intraclass Correlation Coefficient (ICC) values were .386 and .374 respectively.

The purpose of this study was first to investigate the between-trial variability for a large number of variables deduced from plantar pressure measurements. Second, difference was studied between left foot and right foot pressure data.

## METHOD

Plantar pressure data were collected from 80 healthy undergraduate physical education students without lower extremity abnormalities. A footscan pressure plate (RsScan nv., 2m x 0.4m, 16384 sensors, 480 Hz, dynamic calibration with AMTI) was mounted in the middle of a 16.5m long wooden running track. The subjects were asked to run barefoot at a speed of 3.3m/s (+/- 0.17m/s). Prior to the measurements, all subjects performed habituation trials. Three valid left and three valid right stance phases were measured. After testing one observer placed 8 regions (medial heel, lateral heel, metatarsal heads I to V and hallux) on the footprints for all trials. Temporal data (i.e. time to peak pressure, instants on which the regions make contact and instants on which the regions end footcontact) peak pressure data and relative and absolute impulses were calculated for all 8 regions. Eight medio-lateral ratio's were calculated at four instants of the footcontact, namely initial contact (IC), midstance (Mst) – i.e. contact of one of the metatarsal heads –, foot flat (FF) – i.e. contact of all metatarsal heads – and heel off (HO). Excursion ranges of these ratio's were calculated over three intervals (IC-Mst, Mst-FF and FF-HO) and also medio-lateral displacements of center of pressure. Between-trial variability was investigated by using ICC (SPSS 10.0). Differences between left foot trials and right foot trials was studied by using a paired sample T-test.

## RESULTS AND DISCUSSION

The ICC values are summarized for 5 categories of plantar pressure variables in table 1. ICC values for total contact time are .843 for the left foot and .789 for the right foot, and therefore temporal variables are absolute reported.

In general, peak pressure variables and impulses, show rather high ICC values (mostly above 0.7). The temporal variables show very different ICC values with between-trial variability becoming lower during forefoot contact. This is also true for the medio-lateral ratio's. Also the impulses showed high ICC values for the regions in the forefoot, but lower ones for the heel regions. On the other hand, peak pressure variables showed an overall low between-trial variability. Medio-lateral COP displacements showed low ICC values. Two factors may play a role here. First, these variables are calculated on time instants and over time intervals and therefore timing dependent (with rather large variability). Second, in each footprint the observer had to define a foot axis (metatarsal II – middle of the heel) as a reference for COP location. A minor shift of this axis in the three trials may induce between trial variability. Most variables deduced from plantar pressure measurements during barefoot running display good ICC (26% > 0.7) to satisfactory ICC (68% > 0.5) with mid-forefoot contact period in favour. Higher variability is assumed present due to the transient nature of initial heel contact. In the second part of the study, differences between left foot contacts and right foot contacts were found, especially in the calculated values of the medio-lateral ratio's. Also peak pressure variables showed differences between left and right foot.

In conclusion, for interpreting purposes it is important both (1) to measure a sufficient number of trials, and (2) to analyse left and right foot trials separately.

## REFERENCE

Cornwall, MW, McPOil, TG (2000). Analysis of the center of pressure gait line and its relationship to rearfoot motion, *emed Scientific Meeting, 2-6 August 2000*

## ACKNOWLEDGEMENTS

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**Table 1:** ICC values for between trial variability and the significant differences between left foot and right foot trials

	ICC values for the left trials between	ICC values for the right trials Between	Left-right variability Significant difference
<b>Temporal variables:</b>			
- time to peak pressure	.424 and .735	.326 and .670	3 of 8
- time to first contact	.607 and .698	.578 and .715	1 of 8
- time to end contact	.755 and .827	.427 and .776	1 of 8
<b>Peak pressure variables</b>	.539 and .831	.579 and .865	4 of 8
<b>Medio-lateral COP displacements</b>	.090 and .729	.099 and .594	0 of 7
<b>Impulses</b>			
- absolute	.572 and .818	.448 and .839	3 of 8
- relative	.585 and .854	.361 and .820	3 of 8
<b>Medio-lateral ratio's</b>	.144 and .769	.187 and .712	24 of 44

