

PATH OF CENTRE OF PRESSURE IN NORMAL POPULATION: ASYMMETRIES AND RATIOS

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INTRODUCTION

The centre of pressure (COP) trajectory is a measurement commonly used in clinical assessment, gait analysis and patient treatment strategies [1]. Whilst a number of studies have examined the effects of shoe design and inserts on the COP trajectory, there is a clear paucity of information on the underlying asymmetries between the left and the right foot, which will not only affect the product design but also clinical assessment and intervention. Therefore, the purpose of this pilot study was to examine the possible asymmetries of COP trajectories and ratios in a normal population.

METHODS

A total of 73 subjects (21.03 years, 173 cm, 71.39 kg) took part in this study. Subjects were asked to walk barefoot on a 0.5m long pressure platform (RSScan, Olen, Belgium) using the 2-step gait initiation protocol as described by Meyers-Rice et al. in 1994 [2]. Data was randomly recorded to collect three trials for both the left and the right foot at 500Hz. A trial was deemed good if the subject's foot was located within the confines of the platform and no signs of targeting were apparent.

The maximum anteroposterior (AP) and mediolateral (ML) displacement were calculated for each trial, and then averaged for each subject. The symmetry index (SI) was subsequently calculated to compare left and right asymmetries using:

$$SI = \frac{R - L}{0.5(R + L)}$$

Where R and L are the left and right displacements respectively (either AP or ML). An $|ML|/|AP|$ displacement ratio was also calculated using the average displacement for each subject.

RESULTS AND DISCUSSION

Table 1 indicates calculated SI. While male subjects appear to have higher symmetry indices, suggesting larger asymmetry between both feet, when compared to the female subjects, no significant differences were found. It

was however observed that the ML COP displacement has a higher variability than the AP COP displacement. This may be attributed to the inherent structural characteristics of one's foot. While every care was taken to exclude subjects with either pes planus (flat foot) or pes cavus (high arched foot), individual differences could still be observed in arch height, which could have an influence of the ML COP displacement.

In addition, the right foot ML and AP COP displacements as well as the ML/AP ratios were significantly higher when compared with the left foot ($p < 0.05$). This is reflected in the general trend where most SI values were positive. It also supports previous findings from Sadeghi et al. [3] that during gait each foot and lower limb has a different function where one is used for propulsion while the other for control and stability, which can also be related to leg dominance.

CONCLUSIONS

This pilot study focused on the asymmetries and ratios of path of the COP between left and right foot in normal population during barefoot walking. A general trend of higher ML and AP displacements were recorded on the right foot. Higher ML/AP ratios were also observed for the right foot, suggesting different functions are attributed to each foot during gait. While these findings could be useful for footwear last design, shoe manufacture and clinical intervention, more research is needed to draw additional conclusions.

REFERENCES

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Table 1: Comparison of AP and ML symmetry index and left and right displacement ratio for males and females.

Gender	Symmetry Index* (mm)		Displacement Ratio	
	Anteroposterior	Mediolateral	Left	Right
Males (34)	1.77 (±6.49)	16.16 (±25.22)	17.10 (±4.56)	20.24 (±4.52)†
Females (29)	1.55 (±4.70)	8.49 (±15.82)	17.22 (±3.48)	19.18 (±3.88)†
Total	1.69 (±5.82)	13.31 (±22.25)	17.15 (±4.13)	19.84 (±4.26)†

* A negative value would indicate a higher value for the left displacement compared to the right.

† Indicate significant differences between left and right values ($p < 0.05$).