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1. Right versus left foot pressure dynamics in running

1.1 Introduction:

Since the 1960's there has been an impressive number of studies looking at the left-right dominance of the upper and lower extremities in relation to both environmental and genetic factors. From a clinical perspective it is well known that left-right assymmetries in the human limbs may explain certain overuse injuries in sports or ergonomic situations such as running. The aim of this study was therefore to gather accurate pressure data and describe the normal left-right differences in a healthy young population.

1.2 Methods:

Fifthy two male and 30 female subjects (age 18-40 yrs.) were asked to run twice barefooted with a constant controlled running speed over a footscan® pressure plate with a length of 50-200 cm and a resolution of 3.0 sensors /cm2. Pressure data were sampledwith a sample frequency of at least 300Hz and stored on a disk. Both force and pressure (-time) distribution underneath both feet were analysed using the footscan® analysis software. With this software the angle between the rearfoot and forefoot alignement an the relative abduction-adduction angle was determined. Moreover, a pronation ratio (ProRat) was calculated at 5 and 55% and at maximum push off of the stance phase.

The ProRat for for the rear- and midfoot is defined as:

$$\frac{\sum \text{Pressure}\,(\text{Heel}_{\text{medial}} + \text{MTH-1} + \text{MTH-2} + \text{Hallux})}{\sum \text{Pressure}\,(\text{Heel}_{\text{lateral}} + \text{MTH-3} + \text{MTH-4})}$$

The ProRat at maximum push off is defined as:

$$\frac{\sum \text{Pressure}\,(\text{MTH-1} + \text{MTH-2})}{\sum \text{Pressure}\,(\text{MTH-1} + \text{MTH-2} + \text{MTH-3} + \text{MTH-4} + \text{MTH-5})}.$$

1.3 Results:

On average no significant left-right differences were found for either the angle between rear and forefoot or the relative abduction-adduction angle. The ProRat's at respectively 5 and 55% of the stance phase and at maximum push-off were on average 52, 74 and 23% (t-test, $p<0.001$) higher for the right foot than for the left one. This means that for the whole stance phase the medial side of the right foot bears significantly more load than the corresponding side of the left foot.

1.4 Discussion:

Our results indicate that in a healthy young population the right and left foot are not symmetrically loaded. Since we did not measure kinematics we do not know wether a high ProRat also correlates with an excessive pronation movement of the feet. Since most people are right footed the relative higher ProRat on the right side might be an expression of a dominance of the right lower limb.

1.5 Conclusion:

High sample frequencies in pressure measurements can reveal significant differences between the right and the left foot. Future research should therefore be directed towards studying these differences in relation to the kinematics and injuries of the lower limb, both in sports and exercise.