GENDER-DEPENDENT DIFFERENCES IN LEVEL AND DOWNHILL RUNNING

Klaus Peikenkamp¹, Michael Meyer¹, and Lothar Thorwesten²
¹Institute for Sport Science, University of Münster, Münster, Germany, klaus.peikenkamp@uni-muenster.de
²Institute for Sport Medicine, University of Münster, Münster, Germany

INTRODUCTION

Despite the high number of studies dealing with running there is still a lack of information about gender differences in level and downhill running. Therefore, the purpose of this study was to analyze kinematic and dynamic differences between level and downhill running for female and male runners, respectively.

METHODS

9 females (32 y., 1.73 m, 60 kg) and 7 males (33 y., 1.79 m, 70 kg) took part in the study. At the time of the investigation they perform running activities between 3 and 6 hours per week.

During testing, the subjects performed 2 running sequences of 5 minutes each on a treadmill (Woodway Ergo XELG 90 Spezial): level running and downhill running (5%) at a speed of 2.78 m/s.

An ultrasound measuring system (Zebris CMS HS) was used to obtain 3-dimensional kinematic data at the left knee joint. Active marker were placed on the malleolus lateralis, epicondylus femoris lateralis, and the trochanter major. In the shoe of the same leg a pressure distribution insole (Novel München, I8) consisting of 99 capacitive sensors was placed. All data were synchronized and recorded with a measuring frequency of 90 Hz. At least 5 steps were included in the data analysis. The following parameters were analyzed (during foot contact):

- knee extension at initial ground contact
- maximum knee flexion
- time of maximum knee flexion
- maximum knee flexion velocity
- time of maximum knee flexion velocity
- active maximum of normal force
- average normal force
- normal momentum, calculated by the normal force-time-integral

A 2-factor (gender and running level) repeated ANOVA was used to detect significant differences (p < .05).

RESULTS AND DISCUSSION

Only significant results are provided.

Kinematics

Main effect: The maximum extension velocity was larger for the females (320°/s) than for the males (260°/s).

Interaction effects: For the male subjects the knee extension at initial ground contact increased by 4° when downhill running. This difference of 4° was also measured by Hamill et al (1984) for slightly higher running velocities (3.8 m/s) and grade (4%). Additionally, the time of maximum knee flexion (38% CT vs. 43% CT) and the time of the maximum flexion velocity (28% CT vs. 33% CT) occurred later in downhill running. The kinematic results do not support the findings of Malinzak et al (2001) who reported a reduced knee flexion for female compared to male runners.

Dynamics

Main effects: none

Interaction effects: For the female subjects the 3 analyzed dynamic parameters were slightly lower during downhill running (normal momentum: 0.30 BW*s vs. 0.28 BW*s; average normal force: 1.41 BW vs. 1.38 BW; active maximum of normal force: 2.29 BW vs. 2.23 BW). For the male runners these parameters increased during downhill running (normal momentum: 0.32 BW*s vs. 0.34 BW*s; average normal force: 1.44 BW vs. 1.57 BW; active maximum of normal force: 2.31 BW vs. 2.44 BW). The active maximum of normal force is similar to the data reported by Munro et al (1987) who measured 2.8 BW during level running with 3 m/s.

The results indicate a gender-dependent strategy to compensate a change in the running ground’s grade. The female runners try to retain the dynamic load during foot contact by changing the knee kinematics. In contrast to that the male runners favor a relatively constant knee kinematics which results in higher forces and momentum when downhill running. In a next step the influence of fatigue should also be included.

SUMMARY

Knee kinematics and pressure distribution were recorded during level and downhill running on a treadmill for 9 female and 7 male runners. While the females change the knee kinematics to retain the dynamic load independent of the grade the males show different dynamic loads and similar kinematics on both grades.

REFERENCES