INTRODUCTION

Transitioning from shod to barefoot running is becoming increasingly popular among recreational and competitive distance runners. Thus, we believe the merits of barefoot running should be evaluated based on the changes it induces in habitually shod distance runners. To date, however, there is inconclusive scientific evidence of this activity’s benefits and/or risks. Available data on overground barefoot running is constrained by speed [1] or limited to a comparison in the sagittal plane between different subject groups [2]. The purpose of this preliminary study was to expand on previous findings by examining sagittal and frontal plane kinematic and kinetic differences in ankle dynamics between shod and barefoot conditions in habitually shod individuals running overground at self-selected speeds.

METHODS

In this investigation, two female and one male habitually shod runners (Ages 40, 34, 26 years and BMI 20.4, 22.4, 23.1 kg/m² respectively) performed overground running at their self-selected speeds; shod and then barefoot. Each subject completed 6-8 trials in each condition. All subjects had a history of running a minimum of 12 km per week and reported no significant injuries over the preceding 12 months. Kinematic data were recorded using an 8-camera Qualisys motion capture system (Gothenburg, Sweden) at 250 Hz. The foot was modeled as a rigid segment and tracked using a dorsal marker cluster plate. Kinematic data were low pass filtered at 6 Hz and averaged over the available number of trials (6-8). Three-dimensional kinetics were recorded from AMTI force platforms (Watertown, MA) at 1500 Hz. Data is reported for the dominant lower limb of each subject. Standard inverse dynamics methods were used in the moment calculations. Foot contact was defined at a minimum of 20 N vertical ground reaction force and stance phase is reported after normalizing to 100 data points.

RESULTS AND DISCUSSION

Foot/ankle kinematics

The average speeds for shod and barefoot running were 4.26 ms⁻¹ and 4.23 ms⁻¹ respectively. In the sagittal plane, all three subjects demonstrated a shift from a rear-foot strike to a forefoot strike in the barefoot condition (change in angle at footstrike 115-340%, effect size (ES): 7.8) (Fig. 1).

In the frontal plane, there was a relative increase in the inversion angle at footstrike in the barefoot condition (change in angle at footstrike 115-340%, effect size (ES): 7.8) (Fig. 2). However, the peak eversion angle was similar between the two conditions, and thus the change in the total range of motion was not as large (-1 to 25%, ES: 0.4).
Foot/ankle kinetics

In the sagittal plane, barefoot running eliminated the initial dorsiflexor moment observed in the shod condition (Fig. 3). The total impulse demonstrated an increase of 20-23% (ES: 8.0).

Frontal plane kinetics demonstrated an increase in the peak invertor moment in the barefoot condition (Fig. 4). This translated to a 9-92% increase in the impulse (ES: 1.4).

CONCLUSIONS

These results demonstrate immediate differences between shod and barefoot overground running in both sagittal and frontal plane foot/ankle dynamics when running at self-selected speeds in habitually shod distance runners. The changes that occur when switching from shod to barefoot running will dictate the new demands that are placed on the foot and ankle musculoskeletal and tendinous structures. These new demands may lead to beneficial effects such as strengthening of muscles and/or detrimental effects through repetitive overloading of muscles, tendons and bones. These preliminary data should inform the design of expanded studies and ultimately the prescription of safe and effective training protocols for persons transitioning from shod to barefoot running.

REFERENCES


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