Age-related differences in support leg joint kinetics during sprinting in boys

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Summary

This study examined age-related differences in support leg joint kinetics of sprinting for a broad range of chronological age of boys. The support leg joint kinetic variables were obtained using force platforms and a high-speed camera. The current results demonstrate that smaller mean knee extension and hip flexion torques during the support phase in older boys could result in temporal slower development of sprint ability.

Introduction

It has been reported that, for boys, there is a temporal slower development of sprinting ability from 8.8 to 12.1 y [1]. However, age-related differences in leg joint kinetics of sprinting for a broad range of chronological age have never been investigated. Therefore, the purpose of this study was to clarify age-related differences in support leg joint kinetics during sprinting for a broad range of chronological age of boys.

Methods

One hundred and thirty-seven healthy boys (mean ± SD: age 11.9 ± 2.5 y, stature 1.48 ± 0.17 m, body mass 41.6 ± 13.7 kg) performed 50-m sprint during which ground reaction forces (GRFs) and running motion were recorded using a long force platform system (TF-90100, Tec Gihan, Kyoto, Japan; 1000 Hz) and a high-speed camera (DC-GH6, Panasonic, Tokyo, Japan; 240 Hz), respectively. The camera was located at the 30-m mark from the start line and 30 m from the left side of the runway.

Running speed was calculated using GRF data in accordance with a previous study [1]. The instants of foot strike and toe-off were determined by the vertical GRF with the threshold of 10 N. Nine anatomical landmarks (head, ears, suprasternal, and greater trochanter, knee, ankle, heel, first metatarsal bone and toe for the left leg) of the participant from 15 frames before to 15 frames after the one stride cycle starting from the left foot strike were manually digitized using a Frame-DIAS system (Dkh, Tokyo, Japan). From the digitized endpoints, a 5-segment linked model comprising the head, trunk, left thigh, left shank and left foot was developed. The coordinates of the segment endpoints were smoothed using a Butterworth low-pass digital filter with a cut-off frequency of 12 Hz. The GRFs during the left support phase at the motion analyzed step were extracted. The GRF was resampled down to 240 Hz and filtered using a Butterworth low-pass digital filter with a cut-off frequency of 12 Hz.

Linear and angular kinematics of the joints and segments were calculated from the smoothed coordinate data. The location of the center of gravity of the segments and the inertia properties of each segment were estimated from body segment parameters for Japanese boys [2]. The joint moment of the hip was then calculated from the GRF, kinematic variables, location of center of mass and inertia properties.

To allocate the participants into three age groups as is the case with a previous study [1], breakpoint ages were set at 8.8 and 12.1 y. Linear regression analysis was adopted to evaluate age-related differences in variables for each age group.

Results and Discussion

In line with a previous study [1], a trend of smaller age-related differences in maximal running speed in the middle age group was found, indicating the temporal slower development of sprint ability. In the middle age group, moreover, trends of smaller mean knee extension and hip flexion torques during the support phase in older boys were found in the middle age group (Figure 1). These age-related differences could lead to longer support phase and slower recovery of the swing leg during sprinting which in turn may result in the temporal slower development of sprint ability.

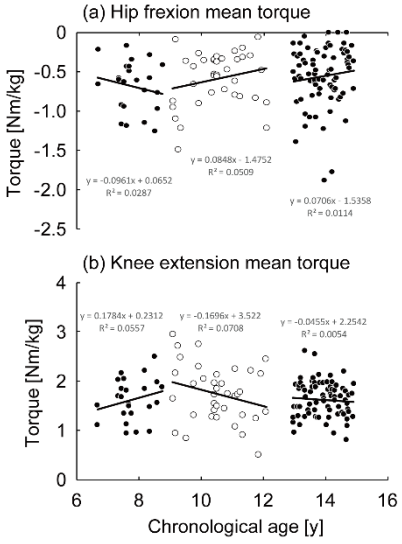

Figure 1: Mean hip flexion and knee extension torques during the support phase plotted against chronological age.

Conclusions

The current results demonstrate that smaller mean knee extension and hip flexion torques during the support phase in older boys may result in temporal slower development of sprint ability.

References

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