EVALUATION OF STABILITY IN SELF-PACED WALKING ON THE DUAL-BELT TREADMILL BY MEANS OF 3D GROUND REACTION FORCES

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Introduction

In spite of long history of human gait research, not so much evidence on kinetic analysis during walking has accumulated. One of the main reasons is that gait analysis was strictly limited to analysis based on artificially targeted single step on the force plate as well as time consuming, complex and thus expensive procedures. Development of new technology as instrumented dual-belt treadmill enables to analyze continuous recordings of each step during gait. This study was designed to describe the variability of 3D ground reaction forces (GRF) during self-paced normal walking at different constant speeds.

Methods

Subjects walked on dual-belt treadmill instrumented with respective force platform (GRAIL; Gait Real-time Analysis Interactive Lab, Motek Medical, The Netherlands). Self-paced target walking speeds (60-140 m/min) were set by synchronizing with motion capture system. 3D GRFs (Fa-p: anterior-posterior, Fm-l; medio-lateral and Fvert: vertical) during each step were continuously recorded and stable 15-20 steps in each walking speed were used for analysis. Each GRF was synchronized and superimposed at onset of foot contact, and average GRF curve as well as coefficient of variance was calculated.

Results

As walking speed increased, foot contact time became to decrease, which was accompanied by the increases in first peak GRFs at foot contact (from 60 to 140 m/min, Fa-p increased 0.15 to 0.4 N/BW, Fm-l increased 0.1 to 0.15 N/BW, Fvert increased 1 to 1.5 N/BW).

Discussion

In first peak in GRF immediately after foot contact during fast walking such as 140 m/min, large variability especially in both Fa-p and Fm-l were observed. Inter-individual and intra-individual (right and left foot) differences in GRF frustration were also stressed. It was suggested that unstable dynamic balance was indicated especially at the early phase in double support during normal fast walking.

References

GRAIL-Gait-Real-time-Analysis-Interactive-Lab;
http://www.motekmedical.com/products/grail-gait-real-time-analysis-interactive-lab/