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PROGRAM & ABSTRACT BOOK プログラムとアブストラクトの本



INFLUENCE OF NEGLECTING FREE MOMENT AND TRANSVERSE GROUND REACTION FORCES IN THE DETECTION OF THE INSTABILITY OF GAIT

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INTRODUCTION

Monitoring the instability of gait is of great interest to detect and prevent falling risks. State of the art parameters such as the MMA-BCOM index, already evaluated in at risk population [1], basically requires the six components of ground reaction forces and moments or equivalently the position of the center of pressure and four components (i.e. the three components of the force and the vertical free moment). Unfortunately, it is currently not possible to accurately estimate the free moment from embedded sensors as well as the antero-posterior and mediolateral component of the force. The aim of the study was to compare the estimation of the MMA-BCOM index when neglecting the free moment and/or the transverse components of the ground reaction forces with the estimation of the same index including all the components of the ground reaction forces and moments.

METHODS

Two groups of subjects (four with transfemoral amputation (TF) and eight non-amputee (NA)) performed a quantified gait analysis combining full body kinematics capture (200 Hz) with synchronised ground reaction forces and moments recording (1000 Hz). Three force plates were used to measure all the components during at least one entire gait cycle. Position of the center of mass was computed from a geometrical inertial model [2] and forces and moments components were filtered at 10 Hz prior to the computation of the MMA-COM index. This index is the distance between the Minimal Moment Axis and the Center Of Mass of the body and is obtained at each instant of time using:

$$\text{MMA - COM index} = \frac{\|\mathbf{F} \times \mathbf{M}_{BCoM}\|}{\|\mathbf{F}\|^2}$$

where $\mathbf{F} \times \mathbf{M}_{BCoM}$ is the cross product between the external forces and the external moment computed at the BCoM, \mathbf{M}_{BCoM} [1]. The amplitude of the index was then retrieved and averaged over the gait cycle. Values were compared for the two groups and the three conditions: C1/ complete ground reaction forces and moments; C2/ neglecting the vertical free moment at the center of pressure; C3/ neglecting the free moment and the transverse components of the force.

RESULTS AND DISCUSSION

Average patterns of the MMA-BCOM index for both studied populations show that condition C3 differs from the reference condition C1 contrary to condition C2 which gives very close evolution compared to the reference.

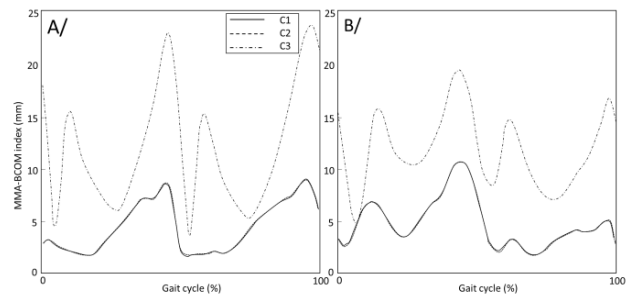


Figure 1 Average patterns of MMA-COM index for A/ NA group, B/ TF group and three conditions

The difference of amplitude of the index between condition C2 and condition C1 is 2 mm (+/-1.2 mm) on average for all the subjects. On the contrary this difference reaches 171 mm (+/-17 mm) between condition C3 and condition C1. In comparison, the difference of amplitude of the index is of in average 36 mm between NA and TF groups. Thus, contrary to condition C1 and C2, condition C3 is not accurate enough to differentiate the groups.

CONCLUSIONS

The results of this study show that the vertical free moment at the center of pressure can be neglected without hindering the capacity of the MMA-BCOM to discriminate the two populations. This conclusion makes realistic the quantification of the parameter by combining transverse forces estimated from inertial measurement units and location of the center of pressure estimated from pressure insoles.

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