ACCELEROMETER-BASED ANALYSIS OF THE SIT-TO-WALK MOVEMENT

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Introduction

The reduction of the base of support during the Sit-to-Walk (STW) movement is assumed to threat balance [Åberg et al, 2010] thus predisposing to falling. The STW analysis presents particular interest for subjects with defective mobility who are considered to have a high risk of falling [Frykberg et al, 2009]. Accelerometerers provide a cost and time effective 3D data and are used in monitoring the risk of falling [Culhane et al, 2005] as well as in gait analysis [Takeda et al, 2009]. However, there is lack of studies using an accelerometer-based analysis of the STW movement. The aim of this study was to apply an accelerometer-based analysis of the STW movement under two velocity conditions.

Methods

Nineteen (19) young healthy men (age 21.4 ± 2.7 yrs) performed 2 trials in the preferred (PV-STW) and fast velocity (FV-STW) conditions, respectively. Subjects were seated on a backless and armless stool placed at the beginning of a 2m long corridor and initiated the STW movement on the vocal command 'GO'. For the FV-STW they were instructed to react as if they were hurried to answer the phone, or to stop an activated alarm. 3D MTx inertial sensors (Xsens Technologies) were attached at the center of mass the trunk, thigh, shank and foot segments [Takeda et al, 2009]. Data was collected at 50 Hz and underwent fusion algorithm calculations by the Matlab component of MT manager 1.6 (Xsens Technologies). The parameters calculated were: a) the total STW duration (t_{total}), b) the relative to t_{total} durations of flexion, transition, extension and swing STW phases [Dehail et al, 2007] expressed as a percentage of t_{total}, c) the Euler angles (roll, pitch and yaw) for each segment and d) the peak angular velocity and the peak linear acceleration for each segment. Student's t-test was used to compare the the PV-STW and FV-STW conditions ($p<0.05$, SPSS 19.0).

Results

The duration of t_{total} presented a 25% decrease in the FV-STW compared to the PV-STW ($p<.05$). With the exception of the decreased relative duration of the extension phase in the FV-STW ($p<.05$), the other phases (flexion, transition and swing) presented an increased percentage of t_{total}, however the differences did not yield statistical significance ($p>0.05$). The Euler angles significantly changed in the FV-STW ($p<.05$) were those of the thigh roll (decreased), the shank roll (increased) and the shank yaw (increased). In FV-STW a significant increase ($p<.001$) was found for the angular velocities (23, 20, 30 & 32%) and the linear accelerations (13, 30, 33 & 36%) of the trunk, thigh, shank and foot, respectively.

Discussion

The duration of total STW movement as well as the durations of the STW phases were all in line with previous studies. Overall, the motor strategy was not significantly changed in the FV-STW. The significant increase of angular velocities and linear accelerations in the FV-STW condition is of critical interested for subjects who sustain a high risk of falling [Åberg et al, 2010]. Our results show than an accelerometer-based analysis of the STW differences due to velocity increase may reveal critical parameters with regard to falling prevention. Thus, the study provides further support in the use of accelerometers in rehabilitation medicine **[**Culhane *et al*, 2005].

References

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