MEASUREMENT OF SIT-TO-STAND TRUNK MOVEMENTS OF YOUNG CONTROLS AND VERY OLD ELDERLY USING A SINGLE SENSOR WITH ACCELEROMETERS AND GYROSCOPES

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BACKGROUND AND AIMS

Much of the knowledge of sit-to-stand (STS) movements comes from force plates or camera based systems. Body fixed sensors are easy to use, cheap, flexible and unobtrusive. We study the feasibility to use a single-sensor for the analysis of STS movements and to compare young and very old subjects.

METHODS

Two sets of 5 repeated STS movements were performed (fig 1 and 2). A single-sensor system with 3 accelerometers and 3 gyroscopes (DynaPort* Hybrid) was fixed around the waist. Data collection and protocol compliance is assisted by special software which communicates with the Hybrid via Bluetooth in order to start and stop and set event markers. A method was developed to automatically identify the start, the flexion and extension phase and the end of the sit-to-stand movement. Temporal and kinematic parameters were extracted. Significant parameters were correlated and redundant parameters removed.

RESULTS

14 elderly subjects (86.4 ± 6.7 years; 165.6 ± 10.2 cm; 65 ± 12.9 kg) and 15 young controls (20.7 ± 1.4 years; 183.2 ± 8.7 cm; 72.9 ± 9.2 kg) were measured. Results are shown in table 1. Elderly stand up slower and with more variable duration over 5 repetitions. Maximum angular velocity, acceleration range and median acceleration during trunk flexion are lower.

Median acceleration during trunk extension was also lower. Correlations between temporal and kinematic parameters were low to medium (data not shown).

CONCLUSIONS

The flexion phase is more distinct than the extension phase. The method is powerful to distinguish the populations, especially during the flexion phase. Low correlations between kinematic and temporal parameters imply kinematic parameters have added value over a stopwatch. Further work will focus on different STS strategies and interventions.

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TABLE 1: Mean (SD) and p-values of the included Sit-To-Stand parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean-Young</th>
<th>Mean-Elderly</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean_Duration (sec)</td>
<td>1.70 ± 0.25</td>
<td>2.37 ± 0.61</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SD_Duration (sec)</td>
<td>0.23 ± 0.12</td>
<td>0.40 ± 0.23</td>
<td>0.02</td>
</tr>
<tr>
<td>Flex_Max_AngVel (deg/sec)</td>
<td>130.46 ± 29.37</td>
<td>91.52 ± 18.69</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Flex_Median_Acc (m/sec 2)</td>
<td>0.14 ± 0.15</td>
<td>-0.06 ± 0.12</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Flex_Range_Acc (m/sec 2)</td>
<td>1.10 ± 0.25</td>
<td>0.87 ± 0.20</td>
<td>0.01</td>
</tr>
<tr>
<td>Ext_Median_Acc (m/sec 2)</td>
<td>-0.14 ± 0.10</td>
<td>-0.31 ± 0.09</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* T-test

Figure 1: Trunk angle and detection of start and end of sit-to-stand (light green) and stand-to-sit (dark green) during 5 repeated movements.

Figure 2: Sit to Stand movement of a 90 year old lady.