PERCEPTION OF WEIGHT-BEARING DISTRIBUTION DURING SIT-TO-STAND TASKS IN HEMIPARETIC AND HEALTHY INDIVIDUALS

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INTRODUCTION

Transferring from sitting to the standing position is important to maintain independence in everyday life. Following a stroke, the ability to rise from a chair is characterised by an asymmetry in the weight-bearing (WB). The hemiparetic individuals prefer to place more weight on their non-paretic foot, even though they have the capacity to perform more symmetrically on demand, with visual feedback (Engardt, 1994) or by altering the foot position (Roy et al., 2006). This asymmetrical performance has been associated with paresis and loss of postural control. It is not well known whether the hemiparetic subjects are aware about this asymmetry of WB and if they perceive it adequately. In sit-to-stand (STS), one study reported that the correlation between the strokes individuals' own estimation of WB distribution on a visual analogue scale and the actual WB distribution while rising was low (Engardt and Olsson (1992). The main purpose of this study was to compare the error between the perception of WB and the actual WB distribution of hemiparetic and healthy individuals during the STS task.

METHODS AND PROCEDURES

Eleven individuals with a chronic left hemiparesis (57.0 ± 14.1 yrs), as well as 15 healthy elderly individuals (65.1 ± 3.8 yrs) participated in this study. The hemiparetic group presented a moderate level of motor impairment and, except for one that had a hypoesthesia at the foot; others had good tactile and proprioceptive sensation. Their mean time to complete the Five repetition Sit-to-Stand Test was 16.6 s (±6.6 s) whereas for the healthy participants it was 10.9 s (±1.9 s). The participants were required to rise at natural speed from an instrumented chair equipped with platforms. Forces under each foot were measured by two force plates. Two foot conditions were assessed: spontaneous (SP) and symmetric (S). For the latter, verbal instructions to put equal WB on each foot was given prior to executing the task. After each trial, the participants rated their perceived WB distribution on a visual analogue scale. Two trials were performed for each condition. The WB distribution on the right side (mean of two trials), expressed in percent, was computed using the vertical ground reaction forces (seat and foot), averaged from -0.5 s before the seat-off event to 0.5 s after. For each condition, four errors were computed: 1) raw error (difference between the actual WB distribution and the perception); 2) normalized raw error (raw error/% of actual WB distribution); 3) absolute error (absolute difference between the actual WB distribution and the perception) and 4) normalized absolute error (absolute error/% of actual WB distribution). The results of the two groups were compared using descriptive statistics and independent Student t-tests (p<0.05).

RESULTS

The mean (SD) values of WB distribution and errors of perception for each condition are presented in Table 1. Results revealed a more asymmetrical WB distribution in the hemiparetic group in comparison to the healthy subjects (p<0.001). The patients
presented significantly greater errors of perception than healthy individuals and overestimated systematically the weight under their left (affected) foot.

**DISCUSSION**

Since no other study evaluated the errors of perception of WB during the STS task, comparisons with other results are not possible. For upright stance, a study of Bohannon et al. (1989), in which healthy subjects had to attempt to bear 50% of their weight on one of their lower limb, the mean absolute error of WB perception was of 3.3% (± 3.7%). This is very close to the mean absolute error of 2.8% we obtained for the healthy individuals. In a second study (Bohannon and Tinti-Wald, 1991), they assessed stroke individuals with the same protocol. They found that, although making significantly greater errors (5.2 ± 4.0%) in WB than healthy subjects, the stroke individuals did not systematically bore less weight on their paretic limb. In our study, the hemiparetic individuals, as a group, also made greater errors of perception than the healthy individuals but all, except for two, bore less weight on the paretic foot. The different mechanical demands required between standing and performing a STS might explain these results. Actually, we do not have results to explain the greatest errors found in the stroke group. However, it could be hypothesized that they rated their perceived effort distribution rather than their weight distribution (force) as predicted by the principle of bilateral matching effort proposed by Bertrand et al. (2004) in bilateral matching tasks performed at the upper limbs. Other clinical characteristics, such as the type and localisation of the lesion might also have an influence.

**SUMMARY**

The results of this study revealed greater WB asymmetry and errors of WB perception in hemiparetic compared to healthy individuals during the STS task. However, before assuming that stroke patients can not perform symmetrically, other factors, such as the sense of effort, have to be studied.

**REFERENCES**

Bohannon RW et al. (1989). *Percept Mot Skills, Dec; 69 (3 Pt 1)*: 875-80.

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**Table 1**: WB (right side) and errors of perception (%) for the healthy and hemiparetic groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Conditions</th>
<th>Mean (SD) WB (%)</th>
<th>Types of errors</th>
<th>Raw</th>
<th>Normalized raw</th>
<th>Absolute</th>
<th>Normalized absolute</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Raw</td>
<td>Normalized raw</td>
<td>Absolute</td>
<td>Normalized absolute</td>
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<tr>
<td>Healthy</td>
<td>SP</td>
<td>50.0 (2.7)</td>
<td>1.1 (3.3)</td>
<td>-1.5 (7.6)</td>
<td>7.5 (4.3)</td>
<td>12.2 (6.6)</td>
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<tr>
<td></td>
<td>S</td>
<td>49.7 (3.5)</td>
<td>-0.5 (3.7)</td>
<td>-1.5 (7.6)</td>
<td>7.5 (4.3)</td>
<td>12.2 (6.6)</td>
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<tr>
<td>Hemiparetic</td>
<td>SP</td>
<td>60.1 (7.8)</td>
<td>6.0 (6.4)</td>
<td>9.3 (10.5)</td>
<td>7.5 (4.3)</td>
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<tr>
<td></td>
<td>S</td>
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