The Relationship Between Performance on the Sensory Organization Test and Landing Biomechanics During a Single- and Double-Leg Stop-Jump

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INTRODUCTION
Postural stability and functional joint stability both rely on proper sensorimotor control, including accurateafferent information, efficient central processing, and effective neuromuscular strategies; all resulting in timely activation of dynamic restraints to perturbation. The Sensory Organization Test (SOT) is a common method by which postural stability is assessed. The analysis of landing biomechanics during a stop-jump maneuver can quantify the strategies a person uses to maintain functional joint stability during landing. While there would seem to be significant overlap in the sensorimotor pathways maintaining both postural control and functional joint stability during landing, the relationship between these two has never been assessed.

PURPOSE
The purpose of this study was to assess the correlation between landing biomechanics during a double- and single-legged stop-jump, and performance on the SOT. SOT performance was assessed with the composite score and the sensory analysis scores; preference (PREF), vestibular (VEST), somatosensory (SOM), and visual (VIS). Biomechanics was assessed using lower extremity kinematics, joint moments, ground reaction forces, and shear forces.

METHODS
PROCEDURES
The SOT was performed using a dynamic posturography system that requires an individual to maintain balance throughout a series of conditions, with varying visual and somatosensory challenges, and provides outcome scores to assess balance performance. Two piezoelectric force plates were used to collect all kinetic data during the stop-jump tasks. Three-dimensional motion analysis was employed using infrared cameras and reflective markers. Subjects completed the SOT using the prescribed procedures by the manufacturer followed by three double- and single-leg stop-jump tasks.

DATA REDUCTION
Biomechanical variables were calculated from force plate and motion analysis data using relative Euler rotation angles and inverse dynamics. These variables included: peak and initial contact (IC) angles for the lower extremities (hip, knee, ankle), peak knee abduction moment (KAM), peak vertical (VGRF) and posterior ground reaction forces (PGRF), and peak proximal anterior tibial shear force (PATSF). Variables were analyzed for the dominant leg during the stop-jump tasks.

STATISTICAL ANALYSIS
Pearson’s and Spearman’s Rank correlation coefficients were calculated to assess the correlation between SOT scores and landing characteristics. Significance was set at α=0.05

RESULTS
Some significant correlations were identified and are listed below (Table 1):

Table 1: Pearson’s and Spearman’s Rank coefficients assessing the correlation between stop-jump biomechanics and SOT scores

<table>
<thead>
<tr>
<th></th>
<th>COM Score</th>
<th>PREF Score</th>
<th>VEST Score</th>
<th>SOM Score</th>
<th>VIS Score</th>
<th>PGRF</th>
<th>KAM</th>
<th>VGRF</th>
<th>PATSF</th>
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<tbody>
<tr>
<td>DOUBLE-LEG</td>
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<tr>
<td>Peak PGRF</td>
<td>-0.257</td>
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<td>**</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Peak KAM</td>
<td></td>
<td></td>
<td></td>
<td>-0.237</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td>-0.295</td>
</tr>
<tr>
<td>IC Hip Flexion</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td>-0.297</td>
<td></td>
<td></td>
<td></td>
<td>-0.262</td>
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<tr>
<td>Peak Hip Flexion</td>
<td></td>
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<td>**</td>
<td>-0.249</td>
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</tbody>
</table>

*All Correlations significant at p<.05
**Correlations omitted; not significant at p<.05

CONCLUSIONS
There are several possible explanations for the observed lack of a relationship between SOT performance and landing mechanics. The most likely explanations are that the SOT is either: a) not a challenging enough postural stability for the population studied, or b) not a dynamic enough sensory task to challenge the same feedback pathways as the stop-jump tasks. Regardless of the reason, this general lack of a relationship should cue clinicians to the separate uses of these diagnostic measures in the rehabilitation and treatment of their respective patients.