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GRAIL Based Sensory Perturbations - A New Tool to Assess Sensory Organization and Fall Risk During Walking in the Elderly

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Fall Risk Assessment in the Elderly using GRAIL based Sensory Perturbations

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Introduction

• Falls are a well-recognized risk factor for unintentional injuries among all older adults, accounting for a large proportion of fractures, emergency department visits, and urgent hospitalizations [1]
• According to the CDC’s Web-based Injury Statistics Query and Reporting (WISQARS)[1-2], in 2010 about 3.7 million people, over the age of 50, reported non-fatal fall-related injuries and 24,000 people in this age bracket died from falling or from their injuries.
• GRAIL (Gait Realtime Assessment & Interactive Lab) was used for sensory perturbations
• A system with a treadmill integrated with Virtual Reality environment
• 5 sensory perturbation conditions tested:
  - Normal Walking
  - Somatosensory (Som).
  - Som and Visual optic flow disturbance (Vis),
  - Som and Vestibular sensory perturbation (vest),
  - Som Vis Vest (som+vis+vest)

Purpose:

• To assess fall risk in elderly

Hypothesis:

• We hypothesize that the difficulty in sensory organization during walking would influence variability in walking and decrease in walking stability

Method

• Written Consent form signed
• 29 infrared markers placed on bony markings that were picked up by infrared cameras
• Preferred velocity was obtained
• 5 conditions were tested
• Somatosensory- treadmill swayed changing 0.01 cm, pitch angle changed by 0.5 cm
• Vestibular senses- participant followed ball on screen
• Visual optic flow- velocity increased by 3 times, VR environment displayed a scenery moving with walking
• Protocol was approved by Chapman university IRB #1718HO20

Table 1: Anthropometric Table for Participants

<table>
<thead>
<tr>
<th>Condition</th>
<th>Age (Mean)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>76.83</td>
<td>161.27</td>
<td>87.83</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>7.67</td>
<td>3.33</td>
<td>12.73</td>
</tr>
</tbody>
</table>

Table 2: variability in gait parameters

<table>
<thead>
<tr>
<th>Condition</th>
<th>Variability in gait parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stance_Swing</td>
<td>CV 3.511 7.7834 11.471 18.4271 4.028</td>
</tr>
<tr>
<td>Stance_time</td>
<td>CV 3.511 7.7834 11.471 18.4271 4.028</td>
</tr>
<tr>
<td>Step_length</td>
<td>CV 3.511 7.7834 11.471 18.4271 4.028</td>
</tr>
<tr>
<td>Step_width</td>
<td>CV 3.511 7.7834 11.471 18.4271 4.028</td>
</tr>
<tr>
<td>Swing_length</td>
<td>CV 3.511 7.7834 11.471 18.4271 4.028</td>
</tr>
<tr>
<td>Swing_time</td>
<td>CV 3.511 7.7834 11.471 18.4271 4.028</td>
</tr>
</tbody>
</table>

Conclusion

• Gait variability was influenced
• Greater difficulty task with sensory lead to more variability
• Also lead to decrease in balance and stability
• More trials need to take place

Limitations

• Limited on number of participants
• Learning effect was present
• Adaptations occurred

Acknowledgements

We are thankful to Department of Physical Therapy and Department of Kinesiology for all facilities to conduct this research. We are also thankful to Dr. Lynn Tierney for help in recruitment in older subjects.

References