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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 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),
  - SomVisVest (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

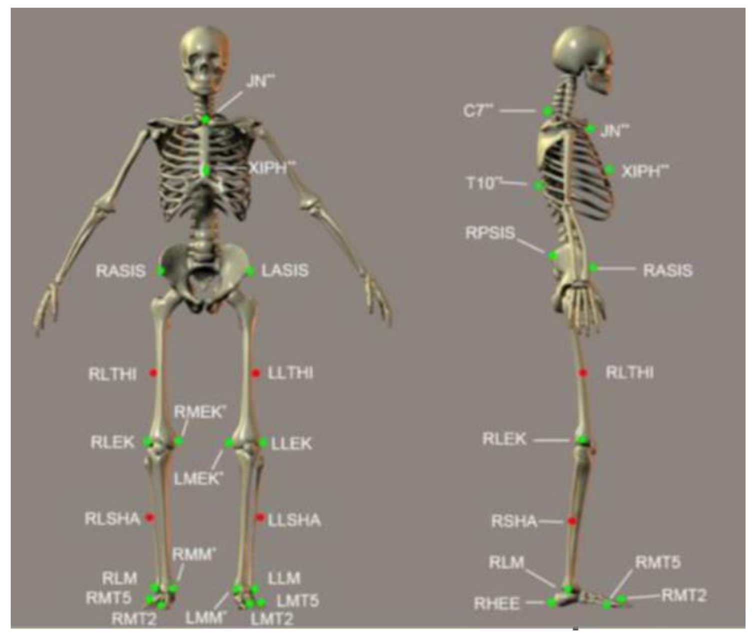

Figure 1: Infra red reflective markers at various bony landmarks

Figure 2: Elderly Participant Walking on Treadmill

Table 1: Anthropometric Table for Participants

	Age	Height (cm)	Weight (kg)
Mean	76.83	161.27	67.83
Standard Deviation	7.67	3.83	12.73

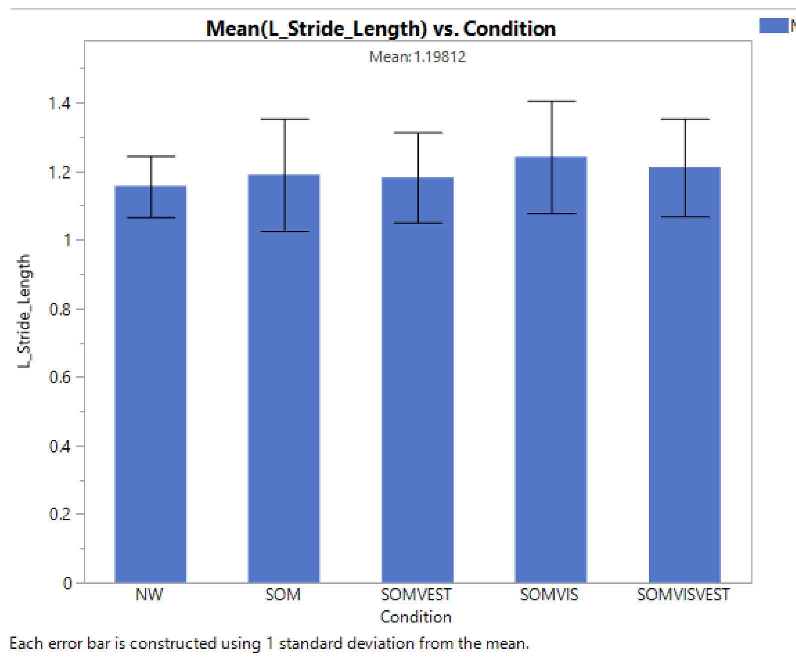

Figure 4: Stride Length variability during sensory perturbation conditions

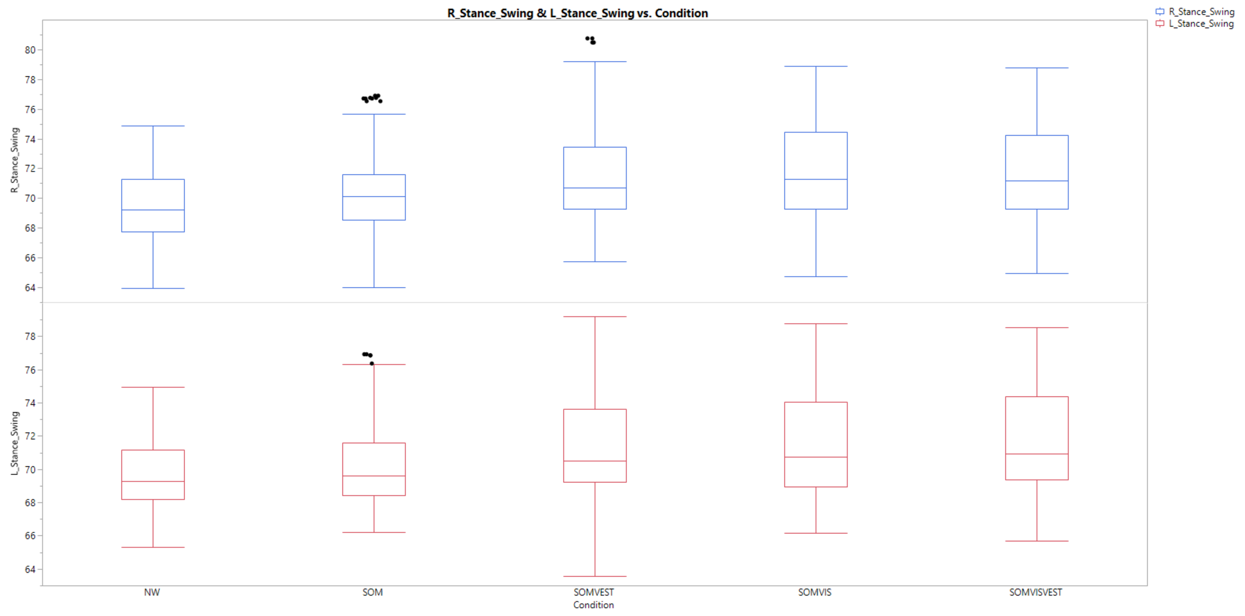

Figure 3: Stance to Swing time ratio during gait cycle

Figure 5: Elderly Participant and immersed in VR of GRAIL

Table 2: variability in gait parameters

		Condition				
		NW	SOM	SOMVEST	SOMVIS	SOMVISVEST
Stance_Swing	Mean	69.61	70.28	71.40	71.53	71.70
	CV	3.031	3.587	4.077	4.274	4.016
Stance_Time	Mean	0.803	0.841	0.846	0.894	0.873
	CV	8.120	16.30	13.33	15.64	13.48
Step_Length	Mean	0.567	0.581	0.587	0.615	0.599
	CV	9.408	14.50	12.58	15.23	14.11
Step_Width	Mean	0.157	0.159	0.155	0.154	0.157
	CV	35.10	35.41	30.08	33.91	30.82
Stride_Length	Mean	1.156	1.189	1.182	1.242	1.211
	CV	7.724	13.81	11.14	13.19	11.75
Stride_Time	Mean	1.153	1.193	1.181	1.246	1.214
	CV	7.446	13.43	10.37	12.31	10.57
Swing_Time	Mean	0.350	0.352	0.336	0.352	0.341
	CV	10.16	10.05	9.707	9.341	9.001

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

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References

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