Identification of specific somatosensation and location to predict postural control outcomes

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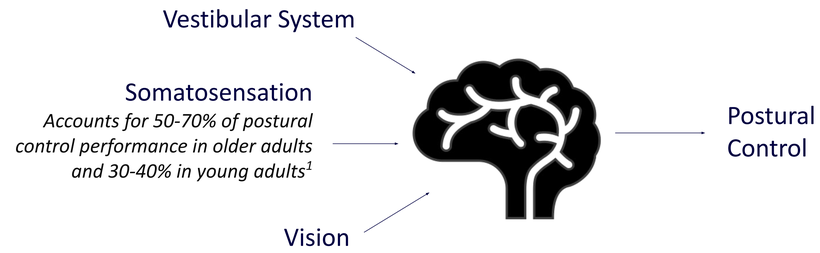
Introduction



Somatosensory integration is paramount to postural control. Clinically viable and easily implemented assessment options for sensory dysfunction related to balance impairment are needed. Touch pressure sensation threshold (PT) and vibration perception threshold (VT) have been used to identify people with somatosensory deficits in the clinic, but postural control relevant sites, testing modalities, and cut-points are unknown.

We aimed to identify the most relevant sites and modalities of somatosensation in the feet for postural control in typical functioning adults

Methods

49 healthy adults (22M, 27F; mean age 42.0 ± 13.8 (SD) y.o.)

SOMATOSENSATION MEASURES

Pressure Sensation Threshold using Semmes Weinstein Graded Monofilaments

Vibration Perception Threshold using handheld Biothesiometer

SITES OF SOMATOSENSATION MEASURES

- Plantar surface great toe
- 1st metatarsal (met)
- 3rd digit
- 3rd met
- 5th digit
- 5th met
- Medial arch
- Lateral arch
- Mid heel
- Medial malleoli
- Lateral malleoli
- Dorsal 5th met
- Dorsal 1st met
- Dorsal 1st/2nd met interspace

POSTURAL CONTROL MEASURES

- Sensory organization test (SOT) **<u>composite equilibrium score</u>** calculated from maximum anterior-posterior center of gravity displacements[2]
- Motor control test (MCT) **<u>composite latency</u>** between onset of support surface translation and the participant's active force response [2]

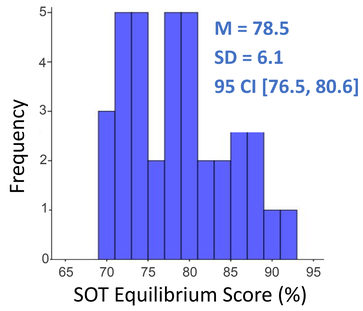
REGRESSION APPROACH

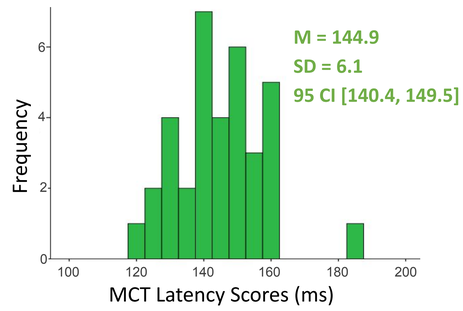
Step 1	Bivariate correlations to identify predictor variables related to postural control (p < .05)
Step 2	Collinearity assessment using the enter method. Variables with VIF >5 removed based on correlation coefficients
Step 3	Non-collinear variables input into a backwards regression procedure
Step 4	Combination of variables to minimize SEE and optimize R^2 identified

Results

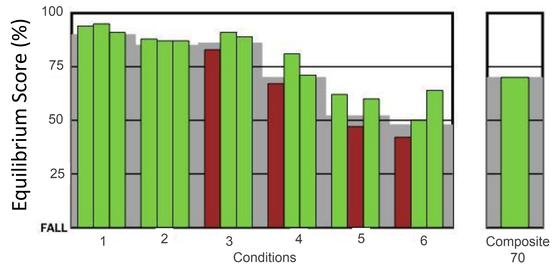
Participant Characteristics

- No fall history, vestibular/orthopedic/neurological disorders, knee/hip replacement, abnormal dizziness, low visual acuity, or using an assistive device for ambulation
- 14 out of 49 were excluded due to abnormal SOT scores

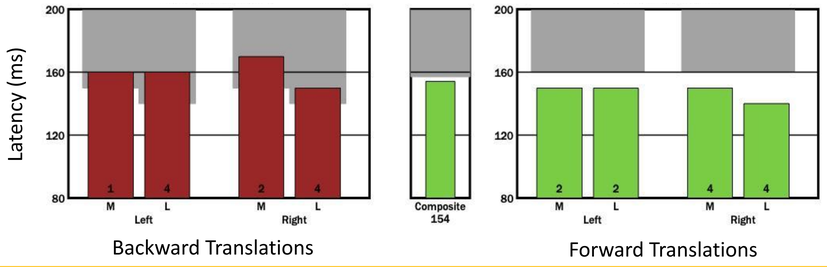




Sample Postural Outcomes



$$Equilibrium\ Score = ((12.5° - (\theta max - \theta min)) \div 12.5°) \cdot 100$$

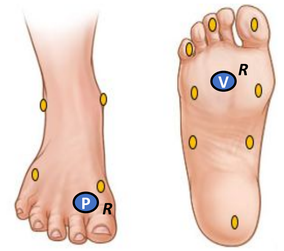


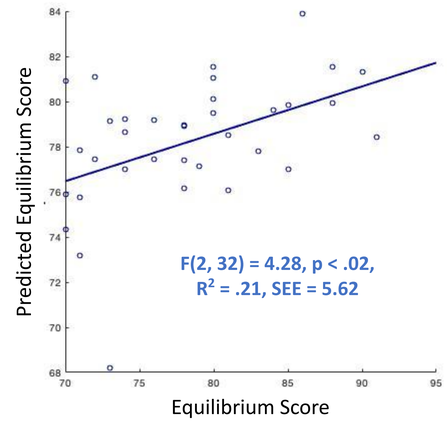
Composite Equilibrium Score (SOT)

Model inputs (p<.05)

- 1 PT variable (r=.37)
- 3 VT variables (r = -.34-.37)

Final Model Predictors





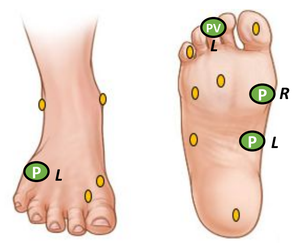
Somatosensory thresholds from only a few sites (vibration > pressure) were mildly correlated with equilibrium in 6 sensory conditions for healthy adults

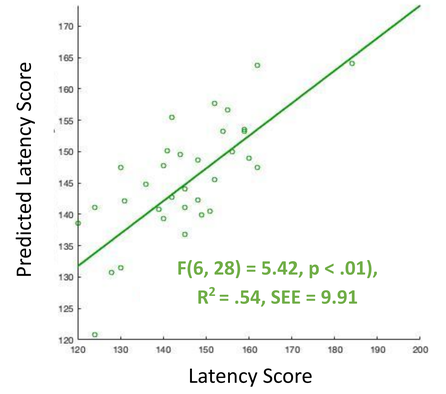
Composite Latency Score (MCT)

Model inputs (p<.05)

- 14 PT variables (r = .34 - .60)
- 9 VT variables (r = .33 - .38)

Final Model Predictors





Somatosensory thresholds from multiple sites (pressure > vibration) were moderately correlated with response to surface translations in healthy adults

Discussion & Significance

- Somatosensation is one component of postural control expected to explain only a portion of variance in postural control performance.
- Preliminary baseline somatosensation data in healthy adults offers insight to postural control relevant somatosensory inputs.

Image Credit: cdc.org

References

[1] Simoneau G. et al. (1995). *Gait Posture*, **3**: 115-122.
[2] Vanicek N. et al. (1990). *J. Vis. Exp.*, **82**.