# **Sensorimotor Control of Balance After Stroke**



**Sampada Chaudhari<sup>\*,1</sup>, Neha Mehta<sup>\*,1</sup>, Hiba Rabieh<sup>\*,1</sup>**, Nishant Rao<sup>1</sup>, Michelle Gale<sup>2</sup>, Eric Todd<sup>2</sup>, Jose L. Contreras-Vidal<sup>2</sup>, and Pranav J. Parikh<sup>1</sup>

\*Equal contribution

<sup>1</sup>Center for Neuromotor and Biomechanics Research, Department of Health and Human Performance, University of Houston.

<sup>2</sup>Department Electrical and Computer Engineering, University of Houston, Houston, TX.

# Do we know enough to reduce falls among stroke survivors?



- Stroke survivors have a high fall risk; impaired balance control is an important factor contributing to falls among patients [1,2].
- Current interventions are less effective as we do not understand all the factors contributing to poor balance control [2].
- Does brain reorganization after stroke affect balance control?

#### Hypothesis:

The altered communication between the brain areas after stroke is associated with patients' impaired balance control.

#### **Approach: Multi-modal and Multi-system [3]**

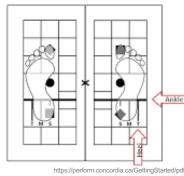
- Brain activity: electroencephalography (EEG).
- Muscle activity: electromyography (EMG).
- Balance performance: lab-based and clinical assessment.

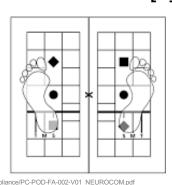
# How did we design and perform the study?

Stroke survivors (n = 3) and healthy control subjects (n = 1) provided informed written consent to participate in this study.

#### Lab-based balance assessment: NeuroCom Platform [3]

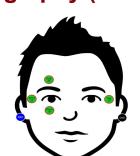


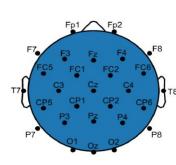




# Electroencephalography (EEG): 64-channel [3]







# **Electromyography (EMG)** [3]





10 EMG sensors - Biceps Femoris, Rectus Femoris, Tibialis Anterior, Soleus, Gastrocnemius medialis

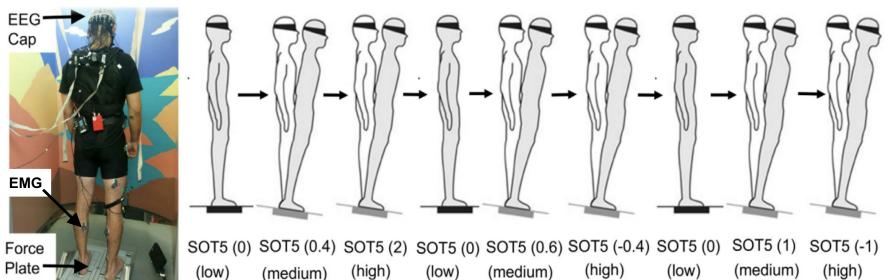
#### **Clinical tests**

Berg Balance Scale (BBS) Timed Up and Go (TUG)

Montreal Cognitive Assessment (MoCA)

# Do stroke survivors exhibit impaired balance control?

# Experimental task and design



The continuous balance task with varying difficulty levels: low, medium, and high (figure adopted from *Goel et al 2019* [3]).

Baseline	Continuous	Baseline
(B1)	Balance Task	(B2)
***		***
<b></b>	<b></b>	<b></b>
EEG	EEG	EEG

**Group 1**: Stroke patients with mild-to-moderate stroke (severity >5 and <14 on NIH stroke scale).

**Group 2**: healthy age- and gender-matched control subjects with no neurological or musculoskeletal disorder.

### Participants' characteristics and their clinical test scores

Patients	Age	Gender	Lesion site	Stroke since	MoCA	BB score	TUG
#1	61 years	Male	Right MCA	27 months	26	44#	60 sec#
#2	66 years	Male	Right MCA	54 months	26	44	20 sec
#3	66 years	Female	Right MCA	24 months	26	46	25 sec

# indicates subjects clinical test scores with ankle foot orthotics

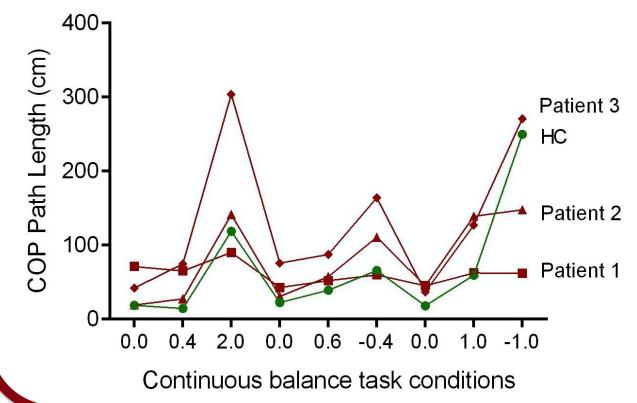
Healthy adult	Age (years)	Gender	MoCA	BB score	TUG
#1	60 years	Female	26	56	9 sec

Stroke patients had reduced clinical balance test scores when compared with a healthy control.

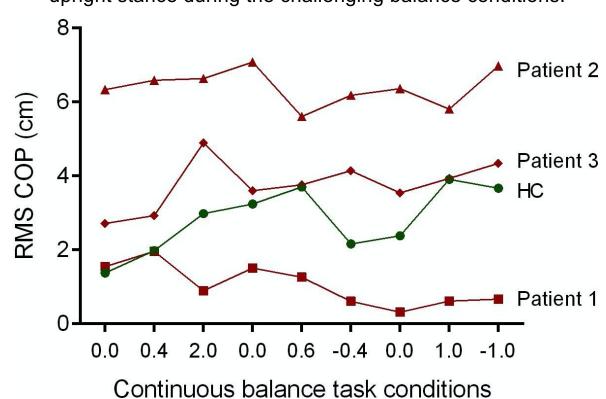
Clinical gait performance was also impaired in stroke patients when compared with a healthy control.

#### Balance performance on the continuous balance task

Increased postural sway in stroke patients compared to a healthy control during the challenging balance conditions.



2 of 3 patients showed an impaired ability to maintain upright stance during the challenging balance conditions.



### Take-home message and implications for future studies

The balance control is affected after stroke, but the degree of impairment varies from person to person.

Ongoing work involves EMG and EEG data analysis and recruitment of more participants.

**Long-term goal**: to assess and design neuromodulation strategies to influence balance control in stroke survivors, using MRI- guided Transcranial Magnetic Stimulation (TMS).

# **ACKNOWLEDGEMENTS**

This project was supported by the National Institute of Health National Center for Neuromodulation grant to PJP

# References

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#### CONTACT

PJP : pjparikh2@uh.edu NR: <u>nrao3@uh.edu</u>