

# Pisa Syndrome in Parkinson's Disease: Pathogenic Roles of Verticality Perception Deficits

Young Eun Huh<sup>1</sup>, Kunhyun Kim<sup>2</sup>, Won-Ho Chung<sup>3</sup>, Jinyoung Youn<sup>2</sup>, Seonwoo Kim<sup>4</sup>, Jin Whan Cho<sup>2,\*</sup>

<sup>1</sup>Department of Neurology, CHA Bundang Medical Center, CHA University, Seongnam, 13496, Korea

<sup>2</sup>Department of Neurology, Sungkyunkwan University School of Medicine, Samsung Medical Center, Seoul, 06351, Korea

<sup>3</sup>Department of Otolaryngology, Head and Neck Surgery, Sungkyunkwan University School of Medicine, Samsung Medical Center, Seoul, 06351, Korea

<sup>4</sup>Statistics and Data Center, Samsung Medical Center, Seoul, 06351, Korea

\* email: [jinwhan.cho@samsung.com](mailto:jinwhan.cho@samsung.com)

*Supplementary information:* Supplementary Table

		<b>PD-PS with unilateral CP (n=8)</b>
<b>Age (years)</b>		66.0 (53.8-78.3)
<b>Male gender (%)</b>		3 (37.5)
<b>Disease duration (years)</b>		14.0 (4.8-23.3)
<b>Hoehn and Yahr stage</b>		2.5 (2-3)
<b>UPDRS-III</b>		24.5 (12.0-37.0)
<b>PD motor subtype (PIGD/TD)</b>		4/4
<b>Degree of PS (°)</b>		14.0 (10-18)
<b>Direction of PS (R/L)</b>		4 (50.0)
<b>Abnormal SVV (%)</b>		6 (75.0)
	<b>Direction of SVV (R/L)</b>	1/5
	<b>Ipsiversive SVV</b>	4
<b>Asymmetry of motor symptoms</b>		4.0 (0.2-7.8)
<b>PS tilting to the less affected hemibody (%)</b>		2 (25.0)
<b>Dominant side of motor symptoms (R/L)</b>		4/4
<b>CP (%)</b>		8 (100.0)
	<b>Side of CP (R/L)</b>	4/4
	<b>Ipsilateral CP</b>	8
<b>EMG patterns of paraspinal muscles (%)</b>		
	<b>Contralateral hyperactivity</b>	3 (37.5)
	<b>Bilateral hyperactivity</b>	5 (62.5)
<b>Back pain (%)</b>		3 (37.5)
<b>BBS</b>		47.0 (45.2-48.8)
<b>LEDD (mg)</b>		688.0 (499.2-876.8)
<b>Treatment regimen (%)</b>		
	<b>Levodopa + dopamine agonist</b>	7 (87.5)
	<b>Levodopa</b>	0
	<b>Dopamine agonist</b>	1 (12.5)
<b>BMI (kg/m<sup>2</sup>)</b>		24.8 (20.3-29.3)
<b>MMSE</b>		27.5 (25.5-29.5)
<b>Education (years)</b>		16.0 (7.5-24.5)

**Supplementary table.** Demographic and clinical measurements in PD-PS with unilateral CP. Data are presented as median (interquartile range) unless otherwise noted. BBS: Berg Balance Scale, BMI: body mass index, CP: canal paresis, LEDD: levodopa equivalent daily dose, MMSE: Mini-Mental State Examination, PIGD: postural instability and gait disturbance, SVV: subjective visual vertical, TD: tremor dominant, UPDRS-III: Unified Parkinson's Disease Rating Scale motor score.