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Identification of idiopathic Parkinson disease subgroups using quantitative gait analysis and PET

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Introduction
To investigate gait dysfunction subgroups and identify underlying mechanisms in patients with idiopathic Parkinson disease (IPD).

Methods
This study included 88 patients with IPD who underwent 18F-FP-CIT positron emission tomography (18F-FP-CIT PET) and three-dimensional gait analysis (3DGA) between January 1, 2014 and December 31, 2016. We performed cluster analysis using temporal-spatial gait variables (speed, stride length, cadence, and step width) and divided participants into 4 subtypes. The 18F-FP-CIT PET images were analyzed using 12 striatal subregions (the ventral striatum, anterior caudate, posterior caudate, anterior putamen, posterior putamen, and ventral putamen; all were bilateral). The activity level in each voxel of interest (VOI) was calculated. The specific-to-nonspecific binding ratio (SNBR) was defined as follows: (mean standardized striatal subregional VOI uptake value – mean standardized occipital VOI uptake value)/mean standardized occipital VOI uptake value; occipital uptake was considered to be nonspecific binding. The kinematic and kinetic gait characteristics and SNBR of the12 striatal subregions were compared among the 4 subgroups.

Results
Three subgroups followed typical gait worsening with IPD progression: the comparable gait speed group, cadence-compensated group due to a reduced stride length, and the slowest group due to a lack of cadence compensation. A new group exhibited comparable stride length to other groups, but slow gait speed due to lack of cadence compensation showed a significant decrease in 18F-FP-CIT uptake, especially in the posterior putamen.

Conclusion
Combining 3DGA and 18F-FP-CIT PET reveals the progression of gait dysfunction and helps identify mechanisms of different IPD gait characteristics.

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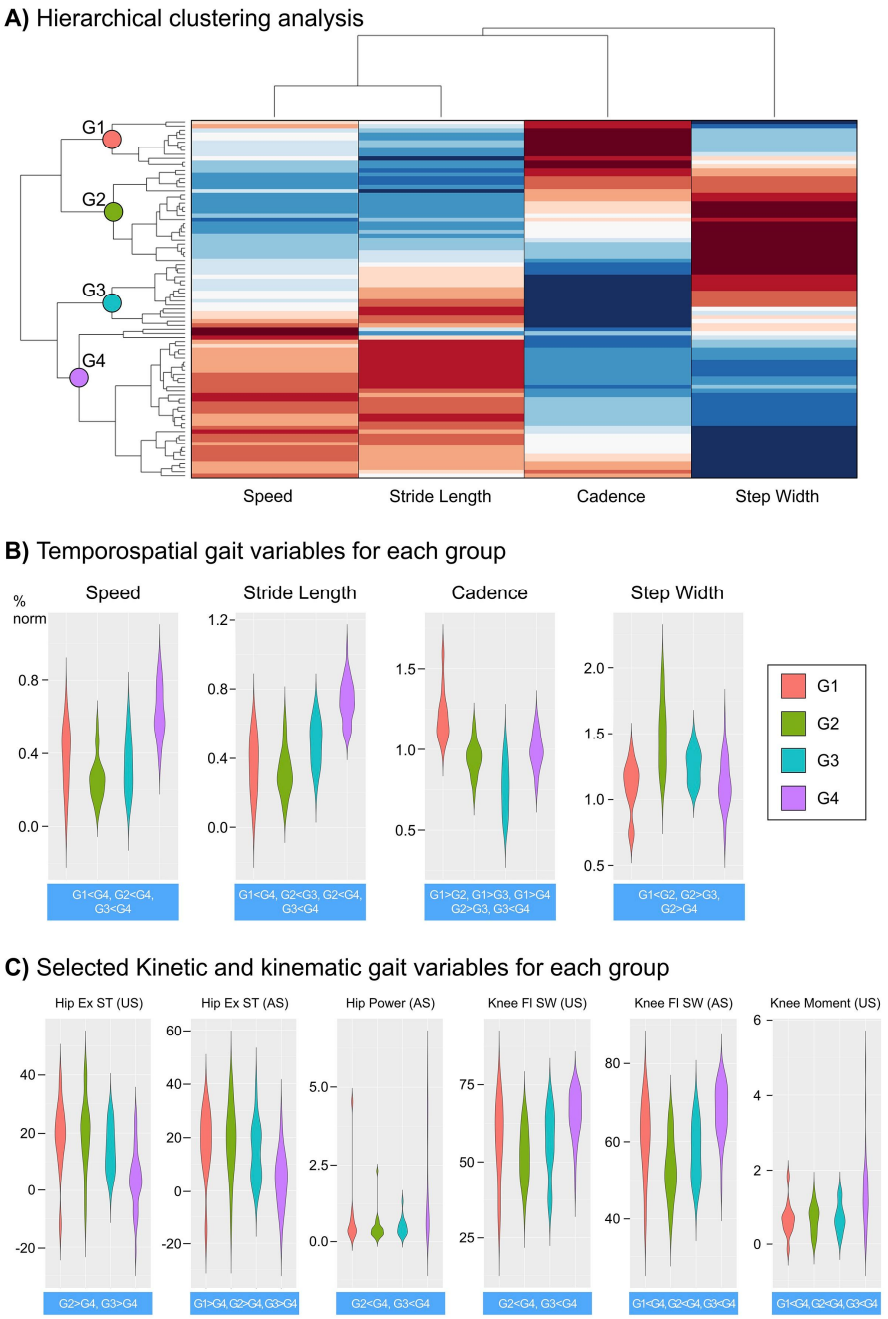

Figure. 1 The gait pattern-based subgrouping analysis results. (A) The hierarchical clustering analysis was conducted using 4 temporospatial gait variables (speed, stride length, cadence, and step width), where the red, blue, cyan, and violet circles represent each of the 4 groups. The boxplots of gait variables for each group are shown (B) and the post-hoc comparison results are described in the blue box at the bottom of each boxplot. (C) Boxplots for the selected kinematic and kinetic gait variables are also shown. Abbreviations: AS, more affected side; Ex, extension; Fl, flexion; US, less affected side.

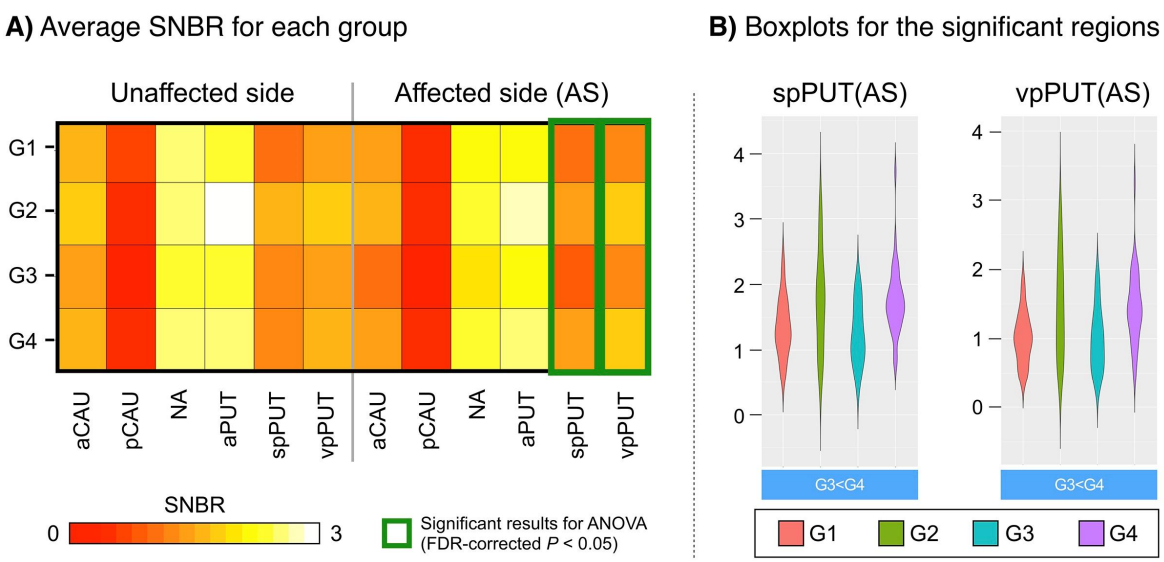

Figure. 2 The average SNBR for each group (A), where brain regions with significant ANOVA results were checked using a solid green line. The boxplots for the significant brain regions are shown (B) and the post-hoc comparison results are described in the blue box at the bottom of each boxplot. Abbreviations: ANOVA, analysis of variance; SNBR, specific-to-nonspecific binding ratio.