# SUPPLEMENTARY MATERIAL

## Detailed Methods

### Participants and study design

We reviewed the medical records of three university hospitals (Wonju Severance Christian Hospital, Mar 2013–Apr 2023; Dongtan Sacred Heart Hospital, Nov 2012–Mar 2023; and Severance Hospital, Dec 2016–Feb 2018) and collected patients with Parkinson's disease (PD) who were treated with antiparkinsonian drugs at least for one visit interval. Diagnosis of PD was performed according to the clinical criteria of UK PD brain bank,[1] and patients who took dopamine receptor blocking agents were excluded from the study. Among them, patients who took anticholinergics (benztropine, procyclidine, or trihexyphenidyl) during their medical therapy were selected and classified according to presence or absence of an oral-buccal-lingual dyskinesia. The dyskinesia group was defined as patients with dyskinesia that occurred after the initiation of anticholinergic therapy and disappeared after the discontinuation of anticholinergics. Dyskinesia should be involuntary and not distractible and persist all waking day without fluctuation.[2] Patients who did not withdraw from anticholinergics to confirm recovery from dyskinesia or did not fully recover from dyskinesia after withdrawal were excluded from the study population. For the control group, we reviewed and collected data of patients who took anticholinergics for more than 12 months without dyskinesia. As the dyskinesia occurred within 9 months in all cases except for 1 (14.9 months), we adopted 12 months to define control group. In both groups with and without dyskinesia, patients who took amantadine during anticholinergic therapy were excluded from this study.

The severity of motor symptoms was assessed by data of OFF-time Unified PD Rating Scale (UPDRS) motor score (part III) and Hoehn & Yahr stage which were measured within 3 months prior to the initiation of anti-parkinsonian drugs. The calculation of UPDRS motor subscores and the classification of motor subtype were performed according to the previously described methods.[3,4]

### Statistical analyses

An independent *t* test was used to identify continuous variables associated with developing dyskinesia. Chi-square test was used to compare the proportions of the categorical variable data, while Fisher's exact test was used when at least one expected value of the cells in the contingency table was less than 5. To compare paired categorical variables between time points, a McNemar test was conducted. Factors showing $p$ values < 0.1 in univariate analyses were included in a logistic regression analysis, and the variables were selected with the backward elimination method (condition; $p < 0.5$). According to these criteria, age at onset of PD, time from PD onset to initiation of anticholinergics, UPDRS motor score, and difference in levodopa dose and levodopa-equivalent daily dose (LEDD) between two time points were included in the logistic regression model, while age at initiation of anticholinergics, UPDRS motor subscores for bradykinesia and rigidity, and LEDD at follow-up were excluded from model because of potential multicollinearity. All analyses were performed with SPSS Statistics 27 (Armonk, NY, USA) and $p$ values < 0.05 were regarded as significant.

## REFERENCES


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4. Lee Y, Ko J, Choi YE, Oh JS, Kim JS, Sunwoo MK, et al. Areas of white matter hyperintensities and motor symptoms of Parkinson disease. Neurology 2020;95:e291-e298.