Superior cerebellar peduncle is differently damaged between progressive supranuclear palsy phenotypes

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Introduction

- The superior cerebellar peduncle (SCP) is functionally involved in the cerebello-thalamo-cortical loop in patients with progressive supranuclear palsy (PSP) [1].
- **We investigated SCP integrity in the two disease variants, *i.e.,* Richardson's syndrome (PSP-RS) and PSP-parkinsonism (PSP-P), using an atlas-based, region-of-interest approach.**
- In particular, we assessed SCP volume, mean diffusivity (MD) and fractional anisotropy (FA) in patients with PSP-RS, PSP-P and Parkinson's Disease (PD), and in healthy controls (HC).

Materials&Methods

- Twenty-one patients with PSP-RS (mean age (SD) 71.9 5.9, 57% M), nine with PSP-P (70.1 4.8, all M), twenty with PD (68.9 5.9, 50% M), and thirty HC (69.2 7.2, 47% M) participated in this study.
- MRI protocol included whole-brain 3D T1-weighted and diffusion-weighted images.
- Identification of left and right SCP was carried out by means of a tractography-based probabilistic atlas [2]. Resulting masks were used to calculate volume, average FA and average MD of left and right SCP in all subjects (figure 1).
- Statistical differences in MRI metrics were assessed through analysis of covariance (ANCOVA) with age, sex and brain size as covariates, followed by Tukey's Honest Significant Difference test. Significance threshold $p<0.05$ with false discovery rate correction for multiple comparisons.
- Discriminant analysis with leave-one-out cross-validation was performed to distinguish PSP phenotypes based on MRI.

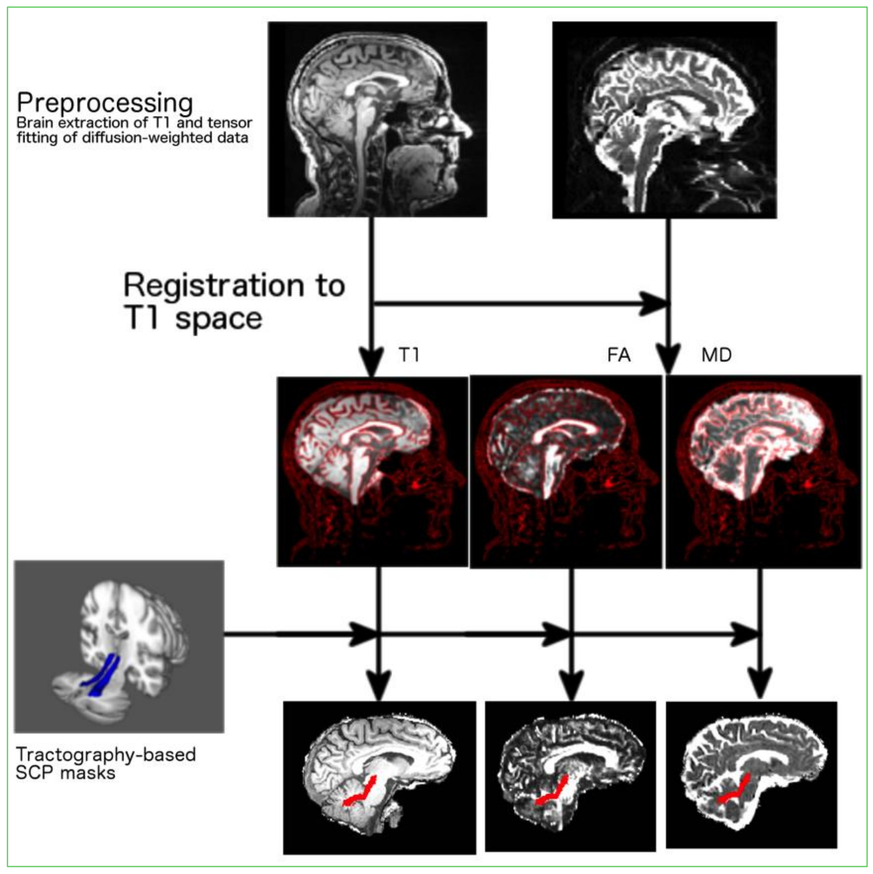

Figure 1. Image processing workflow.

Results

- Significant alteration of all SCP metrics (decreased volume and FA, increased MD) was present in patients with PSP-RS bilaterally.
- PSP-P compared to HC showed bilateral MD increase and right SCP volume decrease (and a trend towards significance for left SCP volume ($p=0.07$)). Compared to PD, PSP-P had decreased SCP volume bilaterally and decreased FA in the right SCP (with a trend towards significance in the left SCP ($p=0.08$)).
- In the comparison between PSP subtypes, PSP-RS patients had significantly decreased FA values ($p=0.02$) and significantly increased MD values ($p=0.01$) in the left SCP.
- Finally, we found a significant increase in FA in PD patients when compared to controls bilaterally.
- Discriminant analysis performed using left SCP average values of MD and FA separated the two PSP phenotypes with an accuracy of 70%. When using all MRI metrics extracted from the SCP, the accuracy raised to 73%.

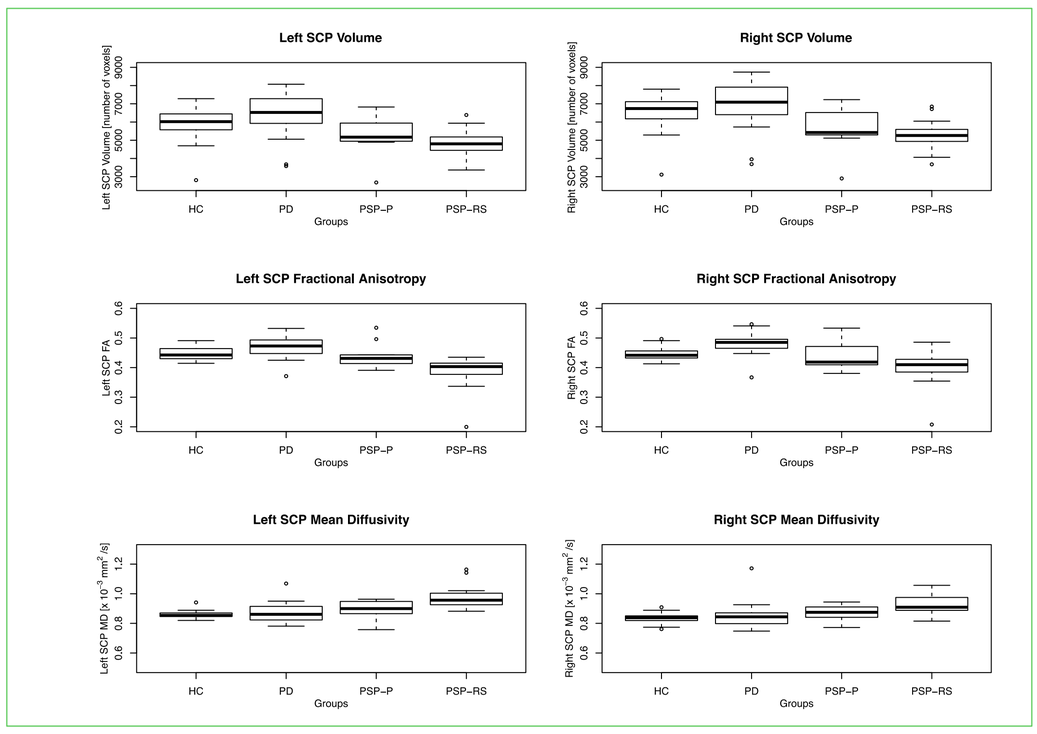

Figure 2. Box-and-whisker plots of volumes, FA and MD of the right and left SCP in patients and controls.

Conclusions

SCP abnormalities are present in both PSP subtypes, albeit their entity is different across phenotypes: in fact, damage is more severe in PSP-RS than in PSP-P, despite significantly longer disease duration and higher severity of disease in the latter form. Diffusion metrics of the left SCP could separate PSP phenotypes with 70% accuracy.

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References

1. Tsuboi Y, Slowinski J, Josephs KA, et al. Atrophy of superior cerebellar peduncle in progressive supranuclear palsy. Neurology 2003;60:1766–1769.
2. de Schotten, Michel Thiebaut, Alberto Bizzi, Flavio Dell'Acqua, Matthew Allin, Muriel Walshe, Robin Murray, Steven C. Williams, Declan GM Murphy, and Marco Catani. "Atlasing location, asymmetry and inter-subject variability of white matter tracts in the human brain with MR diffusion tractography." Neuroimage 54, no. 1 (2011): 49-59

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