

# Constrained spherical deconvolution provides evidence of extensive subcortical direct cerebellum-basal ganglia connections in human brain

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Traditionally, the basal ganglia (BG) are thought to play a major role in the selection and inhibition of motor commands, while the cerebellum plays a role in tuning and reshaping on-going movement. In the past, the connections between the cerebellum and the cerebral cortex have been considered to be anatomically and functionally distinct from those linking the BG with the cerebral cortex. Evidences from recent anatomical experiments, using retrograde transneuronal transport of rabies virus in macaques, have challenged this old perspective demonstrating disynaptic subcortical pathways that directly link the cerebellum with the BG. Since the application of these techniques to the human brain remains elusive, due to the invasive nature of such methods, whether and to what extent these specific connections between the BG and cerebellum exist in the human brain remains unclear. However, recent developments in Diffusion Magnetic Resonance Imaging (dMRI) and diffusion tractography may allow for non-invasive and in vivo studies of the anatomical substrate of basal ganglia systems. Indeed, in our previous paper we studied the basal ganglia connectome providing strong evidences of a direct connection from cortex to Globus Pallidum (GPe and GPi) [1]. Thirteen normal subjects with no history of any overt neurological and/or psychiatric disorders were examined to test the hypotheses that substantial interactions, at least on the level shown in animal studies, also exist in the human brain. We demonstrated that it is feasible to disclose these cerebellar-subcortical connections by using constrained spherical deconvolution (CSD), an innovative approach which allows a reliable reconstruction of small- and long-fiber pathways, with subvoxel resolution in brain regions with multiple fiber orientations [2]. In particular we found evidences of subthalamic-cerebellar, dentate-thalamo-striatal, dentate-rubral-thalamic, dentate-rubral-pallidal and dentate-nigral connections. In addition to these connections, we found a direct cerebellar-dentate-pallidal connection never reported in literature to our knowledge; we identified and isolated two well-distinct tracts presenting an ipsilateral and contralateral component, converging mainly on the antero-medial part of the globus pallidus.

## References

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## Keywords

Basal ganglia; cerebellum; CSD; dento-pallidal.