

Limbic-motor areas interactions as revealed by Constrained Spherical Deconvolution tractography: a mechanism to shape complex motor behaviors?

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Although there are several evidences in animal research on the emotional motor-limbic subcortical system including amygdala, hippocampus, parahippocampal cortex and nucleus accumbens, little is known about its connections to cortical motor-related areas. All these structures are in a position to influence behavior via cortical motor-related areas, which in turn have access, both directly and indirectly, to descending motor pathways. If on the one hand, many animal studies have investigated the neural connectivity of the motor-limbic system using electrophysiological and tracing techniques, on the other hand the use of these methods in the live human brain is limited and elusive due to their invasive nature [1]. By contrast, recent developments in diffusion magnetic resonance imaging and tractography have allowed for non-invasive and in vivo investigation of the human brain. Diffusion-based tractography is a method analyzing the preferential water diffusivity directionality along white matter bundles, thus calculating the highest mathematical probability that water diffuses in a given direction [2]. Using diffusion-weighted magnetic resonance imaging and Constrained Spherical Deconvolution tractography on a population of 15 healthy subjects, we provided tractographic evidence of a structural connection between the amygdala and motor-related areas in humans. These direct limbic-motor pathways may allow for the regulation and modulation of complex motor behaviors and subtle behaviors such as social interactions. The demonstration of these interactions might be fundamental for the comprehension of the pathophysiology of several limbic-sensorimotor diseases, such as autism spectrum disorders and motor conversion disorders.

References

- [1] Ghashghaei et al. (2007) Sequence of information processing for emotions based on the anatomic dialogue between prefrontal cortex and amygdala. *Neuroimage*. 34:905–923.
- [2] Milardi et al. (2016) Extensive Direct Subcortical Cerebellum-Basal Ganglia Connections in Human Brain as Revealed by Constrained Spherical Deconvolution Tractography. *Front Neuroanat*. 10:29.

Keywords

Amygdala; tractography; MRI.