

Thalamic parcellation based on probabilistic neocortical connections in a neonatal population

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Recently, many research studies have given significant attention to the thalamus. This paired deep gray matter nucleus has important role in integrating motor and somatosensory systems as well as increasingly recognized importance in cognition.¹ Therefore, knowledge about the normal development of thalamic nuclei in the infant population could have a significant impact on our comprehension of the thalamic physiology and how it is affected in pathological states.

The aim of this preliminary study is to provide a parcellation of the thalamus in clusters that have an anatomical and functional correspondence to known thalamic nuclei in a neonatal population. The clusters are derived from thalamic connections to predefined neocortical targets observed using probabilistic diffusion tractography. Previous studies have demonstrated that this approach can be successfully (and meaningfully) implemented for the adult population.^{2,3,4}

We retrospectively selected five term neonates imaged at a 3 Tesla system, whose study included volumetric T1 weighted acquisitions as well as good quality DTI images. All images were interpreted as normal by a radiologist. Probabilistic diffusion tractography analysis using tools from the FSL library was run using the thalamus as a seed region and pre-defined cortical areas as target regions. These comprised pre-frontal cortex, pre-motor and primary motor areas, somatosensory area, posterior parietal cortex, occipital and temporal lobes. The seed and target areas were manually segmented using *Freeview* (<http://surfer.nmr.mgh.harvard.edu/FreeviewGuide>).

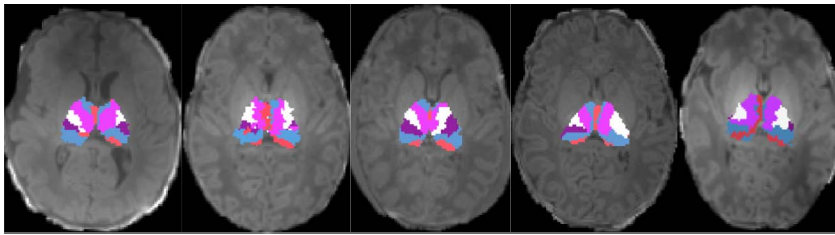


Fig 1: Demonstration of thalamic parcellation on a selected co-registered axial slice for the 5 studied subjects.

We were able to consistently identify 7 main clusters, which appear to have anatomical and functional correspondence to the thalamic ventral anterior, ventral lateral, ventral posterior and medial nuclei, pulvinar, medial and lateral geniculate

bodies. Thus, this preliminary study was able to prove the feasibility of thalamic parcellation in neonates based on cortical connections using probabilistic tractography.

Our goal is to include new subjects in this study, extending the age range in order to catch developmental changes over time, as well as describe how this thalamic nuclear groups behave on age matched diseased populations. Moreover, a quantitative measure of success rate of the thalamic nuclear parcellation and its consistency within and across subjects are desired.

References:

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