

Shift in hippocampal medial position and increased fissure volumes in individuals affected by Developmental Topographical Disorientation

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Developmental topographical disorientation (DTD) refers to the lifelong inability of individuals to orient in familiar surroundings despite the absence of any neurological disorder. Despite reporting no gross volumetric or structural brain abnormalities, studies have reported reduced functional connectivity between the hippocampus and other brain regions in DTDs(1).

Aims: Here, we aim at investigating differences in morphological and morphometric hippocampal features between DTDs and healthy controls(HC).

Method: We measured incomplete hippocampal inversion (IHI) (i.e., a developmental atypical anatomical pattern characterized by the incomplete infolding of the hippocampal subfields(2)) in T1 acquired from DTDs(N=20) and HC(N=390). We rated criterion C1 (roundness and verticality of the hippocampal body), C2 (verticality and depth of the collateral sulcus), C3 (medial positioning of the hippocampus), and C5 (depth of the collateral and the occipitotemporal sulcus), and calculated a total IHI score for each hemisphere. We conducted Mann-Whitney tests between groups for all criteria independently and for the global IHI score. We used FreeSurfer7 to run the automatic segmentation for hippocampal subfields. We compared volumes from (1)CA1, (2)CA2,3,4+DG, (3)fissure, (4)subiculum, (5)tail, (6)head, (7)body, and (8) the whole hippocampus between DTD and HC and used Bonferroni for multiple comparison correction.

Results: IHI prevalence in both DTD and HC was similar to those previously reported in the healthy population. A significant difference was found only for criteria 3 ($p=0.026$). We also found a difference between DTD and HC for the hippocampal fissure bilaterally(both $p<0.001$).

Discussion: Although no differences were found in IHI total score between DTD and HC, in DTDs the hippocampus was more medially positioned with larger hippocampal fissures. These findings are foundational to further investigate their relationship with functional and behavioral characteristics of DTD.

Conclusions: The hippocampus of individuals affected by DTD is more medially positioned with larger hippocampal fissure volumes as compared to healthy individuals.

Keywords: developmental topographical disorientation, hippocampus, incomplete hippocampal inversion

References

1. Iaria G, Arnold AEGF, Burles F, Liu I, Slone E, Barclay S, et al. Developmental topographical disorientation and decreased hippocampal functional connectivity: Dtd and Hippocampal Functional Connectivity. *Hippocampus*. 2014 Nov;24(11):1364–74.
2. Cury C, Toro R, Cohen F, Fischer C, Mhaya A, Samper-González J, et al. Incomplete Hippocampal Inversion: A Comprehensive MRI Study of Over 2000 Subjects. *Front Neuroanat* [Internet]. 2015 Dec 22 [cited 2022 May 16];9. Available from: <http://journal.frontiersin.org/Article/10.3389/fnana.2015.00160/abstract>