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A comparison of mature and immature dentate gyrus granule neuron morphological properties

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Background & Purpose: Hippocampus dentate granule cells (DGCs) have been implicated in memory formation. Unlike in many other regions of the brain, new DGCs are being continuously born throughout adulthood, a process known as neurogenesis. The role of immature DGCs (iDGCs) in hippocampal function, though, is not fully understood. This study will investigate if morphological parameters can differentiate iDGCs from mature DGCs (mDGCs) in the brain slice preparation.

Experimental Approach: Whole-cell patch-clamp recordings were made from DGCs present in 22-28-day old rat brain slices. Cells were filled with neurobiotin and subsequently fixed in paraformaldehyde. Neurobiotin labeling determined the location and morphology of patched neurons. In a subset of slices, immunohistochemistry was performed to identify doublecortin-positive neurons. Confocal microscopy and post-hoc analysis was used to assess the length and branching of projections and soma size of patched neurons as well as the distribution of doublecortin.

Result: Infrapyramidal blade (IB) mDGCs have greater axonal intersections than suprapyramidal blade (SB) mDGCs at distances greater than 140 μ m from the soma. Within the IB, iDGCs were identified by their electrophysiological parameters. These had less dendritic branching than mDGCs at distances of greater than 40 μ m from the somata. Doublecortin antibody labeling, though, suggested that iDGCs were present throughout the DG.

Conclusion & Implication: Morphological differences occur between mDGCs in IB and SB. iDGCs could be in IB using electrophysiological and morphological parameters in brain slices. Positive identification of iDGCs, though, requires doublecortin labeling.

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