The relation between dendritic geometry, electrical excitability, and axonal projections of L2/3 interneurons in rat barrel cortex.

Abstract:
Interneurons in layer 2/3 (L2/3) of the somatosensory cortex show 4 types of axonal projection patterns with reference to the laminae and borders of columns in rat barrel cortex (Helmstaedter et al. 2008a). Here, we analyzed the dendritic geometry and electrical excitability of these interneurons. First, dendritic polarity, measured based on the insertion points of primary dendrites on the soma surface, yielded a continuous one-dimensional measure without a clustering of dendritic polarity types. Secondly, we analyzed polar and vertical distributions of dendritic length. A cluster analysis allowed the definition of 7 types of dendritic arborization. Thirdly, when dendritic polarity was related to the intrinsic electrical excitability we found that the ratio of frequency adaptation in trains of action potentials (APs) evoked by current injection was correlated with the number of primary dendrites. Numerical simulations of spiking patterns in L2/3 interneurons suggested that the number of primary dendrites could account for up to 50% of this correlation. Fourthly, dendritic arborization was not correlated with axonal projection, and axonal projection types could not be predicted by electrical excitability parameters. We conclude that 1) dendritic polarity is correlated to intrinsic electrical excitability, and 2) the axonal projection pattern represents an independent classifier of interneurons.