Neural stem cells and early-born neurons collaborate three-dimensionally for neocortical histogenesis

Takaki Miyata, MD., Ph.D.
Nagoya University

We are asking how neural stem cells’ morphology is regulated three-dimensionally and how this regulation contributes to continuous cell production and the overall brain formation. Stem cells in the mammalian brain primordia originally take a neuroepithelial structure in which their nuclei diffusely occupy the entire wall (about ten nuclei thick) of the neural tube or brain vesicle. This diffuse nuclear distribution is due to the cell cycle-dependent, to-and-fro nuclear movement (called interkinetic nuclear migration) exhibited by each neuroepithelial cell (80 µm long), which spans from the apical (inner) surface to the basal (outer) surface of the wall. When the first neuronal group comes out as a result of divisions within the initial neuroepithelium, neurons accumulate in an outer zone (1-2 cell thick) just beneath the basal lamina and stem cells become longer (90-100 µm). The elongated stem cells keep their apicobasal attachment as well as nuclear migration trajectory in a range of 80 µm (ten nuclei thick) with a basal process (~20 µm) extended. Stem cells’ elongation coupled with maintenance/renewal of basal processes further continues as the wall thickens. How this elongation occurs is unknown and it is important to understand whether and if so how this phenomenon might affect stem cells’ cytogenetic behavior. Through in vivo RNAi experiments and live imaging in slice culture, we found that the earliest cohort of neurons in the developing mouse neocortex may play an important role in extrinsically shaping the neural stem cells.

