we have elucidated the molecular mechanisms underlying dendritic spine initiation (Saarikangas et al., Dev. Cell 2015), dendritic filopodia elongation (Hotulainen et al., JCB 2009), spine head growth (Hotulainen et al., JCB 2009) and spine head maintenance (Koskinen et al., MCN 2014). Our current working model is presented in Figure.

Figure. Working model.

Current Projects: In our current projects, we are revealing the roles of actin regulating proteins Rif and gelsolin in neurons. In addition, we study novel mechanisms to regulate the neuronal actin cytoskeleton (actin tyrosine phosphorylation and pH-dependent actin regulation). Furthermore, we elucidate the effects of genetic mutations linked to schizophrenia and autism spectrum disorder on dendritic spine density and morphology. Finally, we are clarifying the special actin regulation underlying the structure of the axon initial segment.

- Role of Rif in the brain.
- Function of gelsolin in dendritic spines.
- Phosphorylation of actin in dendritic spines.
- pH-dependent regulation of the actin cytoskeleton in dendritic spines.
- Synaptic pathology in schizophrenia and autism spectrum disorder – focus on the actin cytoskeleton.
- Regulation of the axon initial segment actin cytoskeleton.

Methods: We are taking a bottom-up approach, where molecular mechanisms learnt in simpler in vitro systems, such as test tubes, fibroblasts or dissociated hippocampal neurons, are taken to more complex systems, such as acute brain slices and the in vivo brain. At all levels, advanced microscopy techniques play a major role.

Impact: Dendritic spine density and morphology are altered in various neurological diseases. The actin cytoskeleton is a structural component regulating dendritic spine density and morphology. Manipulation of the dendritic spine actin cytoskeleton provides a means to change dendritic spine morphology and density. Thus, manipulating the actin cytoskeleton could be used to rescue the altered dendritic spine density and morphology in neurological diseases.

See also lab home page: www.helsinki.fi/neurosci/hotulainenlab/

Selected publications


Koskinen, M. and Hotulainen, P. (2014) Measuring F-
actin properties in dendritic spines. Front. Neuroanat. 8, 74.


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