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A Stochastic Model for Calcium Regulation in Spines

The study of calcium signals in dendritic spines is of great interest, as these by either action potential or by synaptic activity play a crucial role in the synaptic plasticity within an individual spine. Because of the small size of spine and the indicators commonly used to measure spine calcium activity, calcium function can be severely disrupted. Therefore, it is very difficult to explain the exact relationship between spine geometry and spine calcium dynamics. Recently, it has been suggested that the medium range of calcium which induces long term potentiation leads to the structural stability stage of spines, while very low or very high amount of calcium leads to the long term depression stage which results in shortening and eventually pruning of spines. We discuss a stochastic model to examine the role of calcium and the mechanisms that govern its regulation in the spine morphology.