Linking tensional force dynamics with actin architecture

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The cellular tensional homeostasis relates to the regulation of dynamical forces that maintain the mechanic equilibrium in cells and cellular networks. It is these force dynamics and it's relation with actin organization what we are interested in exploring. A key limiting element in the understanding of the integration of force regulation in the cell mechanical sensing is the difficulty of coupling a deviation from an internal "tensional cellular homeostasis", with the active force measurement of its returning to equilibrium.
Using optogenetics combined with time resolved TFM on micropatterns as a strategy; we probed the time scales at which the mechanical homeostasis works by measuring the dynamics of cellular forces while submitting cells to different geometrical boundaries. This analysis could be done within the same cell thus preventing intercellular variability. Among the great strengths of optogenetics we find the possibility of performing precise transient and spatially signaling disruptions (1). This technique allowed us then to disturb the cellular mechanical equilibrium of cells constrained to different micropattern arrangements, thus affecting their actin organization, in a temporally controlled way. As a result, the force cellular profile showed a clear response to the light perturbations which enabled the analysis of the force time scales. Most importantly, it allowed us to tackle the question whether the cell architecture and actin orientation is affecting the cell force dynamics and its efficiency of pulling.

(1) Karunarathne, W. K et al, 2015. Subcellular optogenetics—controlling signaling and single-cell behavior. J. Cell Sci. 128:15–25.