Characterizing viscoelastic properties of the cortex in mitotic cells

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Abstract

Cell stiffness is a key parameter for our understanding of cell shape, cell migration and tissue organization. However, as the cell consists of several components, it is challenging to extract the force contribution and the elastic modulus of a specific component upon cell deformation. Here, we probe the stiffness of round, mitotic HeLa cells in a parallel plate compression setup, where we measure the force necessary to compress cells in between plates. An earlier study showed that in steady state, this force is due to cell surface tension. Here, we apply step strains and sinusoidal modulation of the plate distance at various frequencies allowing us to probe differential cell stiffness. We find strong indications that cell stiffness in mitosis is dominated by actomyosin and therefore by the mitotic cortex. This interpretation allows to extract an associated frequency-dependent area extension modulus. We show that myosin activity at the same time fluidizes and stiffens cells, where differential cell stiffness increases linearly in dependence of active prestress. On the other hand, the passive cross-linker α-actinin solidifies and stiffens mitotic cells. Our study shows how active and passive cross-linkers influence rheological properties of the cortical actin-network *in vivo*.