The Role of Local, Nanoscale Fluctuations in Cellular Mechanosensing

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Key Research Aims and Goals

To characterize local, small-scale, cellular fluctuations

Research Highlights and Results

- We quantified substrate deformation by 3T3-L1 cells by embedding fluorescent particles in polyacrylamide(PA) substrates and tracking their displacements. Using fluorescence imaging and a frame rate of 10 frames per second, we established sub-10nm precision.
- Cells apply small scale forces which result in periodic nanoscale deformations of the underlying substrate in the direction parallel to the axis of cell polarization (a, b). This direction of deformation aligns with the expected orientation of the actin and microtubule cytoskeleton.
- On either side of the horizontal axis of the cell, the sinusoidal pattern of the fluctuations is reversed, but has the same amplitude (c). This suggests that symmetry plays a role in how cells feel their surroundings.

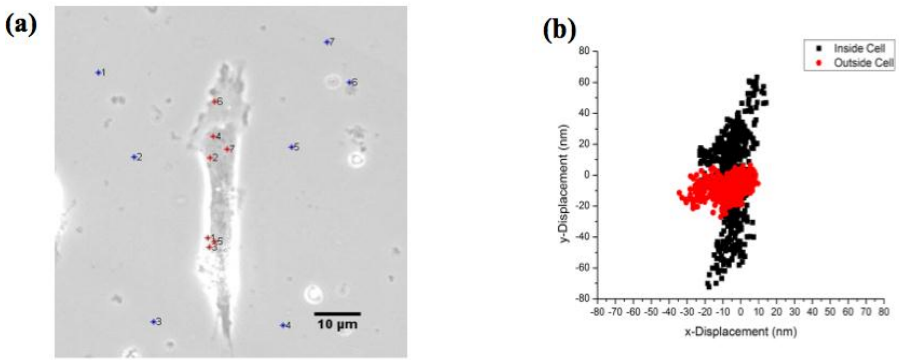
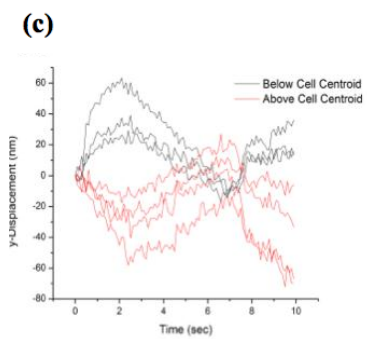


Figure 1. (a) Phase contrast image of cell with microsphere (MS) overlay. Numbers correspond to locations of MSs embedded in the gel. (b) Y vs. X displacement of MSs inside and outside the area covered by the cell. (c) Periodic motion of MSs below (1, 3, 5) and above (2, 4, 6) the cell centroid.



Future Research Plans

- Explore how small-scale fluctuations vary by cell type by measuring fluctuations for mutated, cancerous, and stem cells
- Investigate how cells respond differently in a 3D environment using long time-lapse imaging and 3D hydrogels
- Study the effect of substrate stiffness on local fluctuations using a unique substrate fabrication technique to make PA gels with a stiffness gradient