Supporting Information

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SI Materials and Methods

Validation of Cytochalasin B Experiment. Fig. S1 demonstrates the action of cytochalasin B in disrupting the actin cortex of germinal vesicle-stage oocytes.

Displacements Along the Horizontal Direction. Similarly to the Y-displacement maps in Fig. 2, X displacements over time are illustrated in Fig. S2 for the same excitation by the micropipette. We can see a good agreement between simulation and experiment, with comparable amplitudes and similar wavelength. The displacements are propagating mainly from the vibration pipette through the zona pellucida, because of the cell geometry. The experimental and simulated results nevertheless have some differences, especially at the vibration pipette location, mainly due to two reasons: (*i*) Experimental displacements calculated in the vicinity of the pipette are highly unreliable, whereas the simulation considered accurate displacements, and (*ii*) X displacements are about two times lower in amplitude than Y ones, leading to a lower signal-to-noise ratio.

X-displacement maps were, however, not used to compute elasticity, as the amplitude was smaller, especially in the middle of the cell, which could lead to unreliable results.

Passive Elastography Algorithm Principle. The "passive" elastography algorithm consists of a few steps, as illustrated in Fig. S3. It is based on (*i*) estimating the displacement between each image over time, using the 2D particle image velocimetry algorithm; (*ii*) calculating the temporal cross-correlation between a point (x_0, y_0) and all other points (x, y) of the image; and (*iii*) measuring the focal spot size using the local curvature to obtain the local shear wavelength, so that by multiplying this wavelength with the shear wave frequency one can calculate the shear wave speed, and hence the shear modulus. If the frame rate is under the Nyquist–Shannon limit (i.e., 30,000 frames per second for a 15-kHz vibration), the passive elastography algorithm is able to produce an elasticity map but the results would not be quantitative (12).

Segmentation Illustration. Fig. S4 illustrates the segmentation of the oocyte constituents.

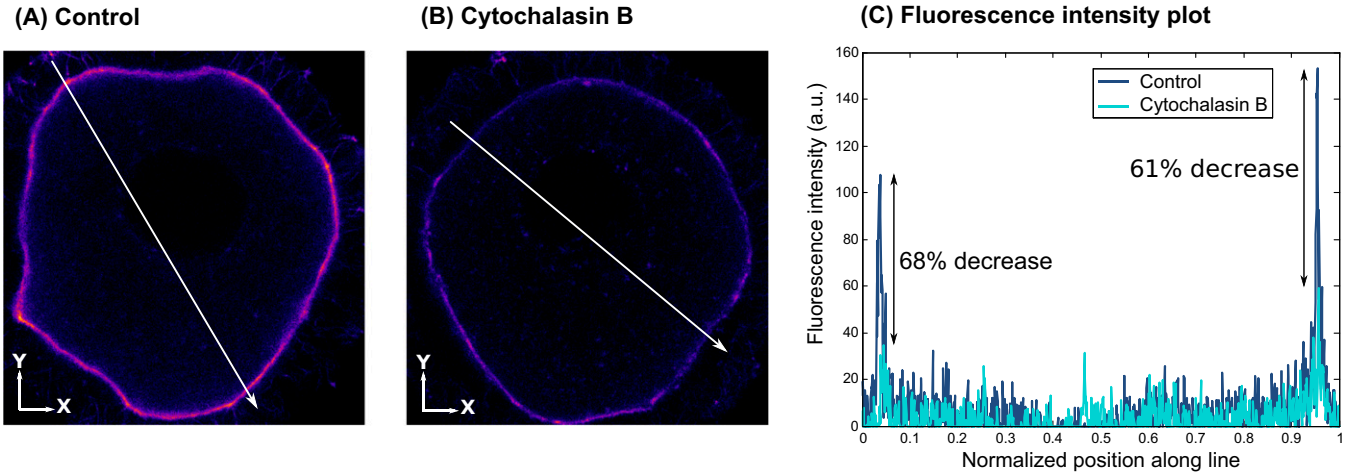

Fig. S1. Demonstration that cytochalasin B disrupts the actin cortex in germinal vesicle-stage oocytes. Images show typical examples of (*A*) control and (*B*) cytochalasin B-treated oocytes that were subsequently fixed and permeabilized, and the actin cortex labeled with Alexa-phalloidin. The actin cortex, concentrated under the plasmalemma, is indicated as a pseudocolor image, warmer colors indicating greater Alexa-phalloidin signal. Note that cytochalasin substantially diminishes but does not completely remove the actin cortex. (*C*) A line intensity plot of fluorescence measured along the white lines, providing a quantitative readout of the loss of cortical actin.

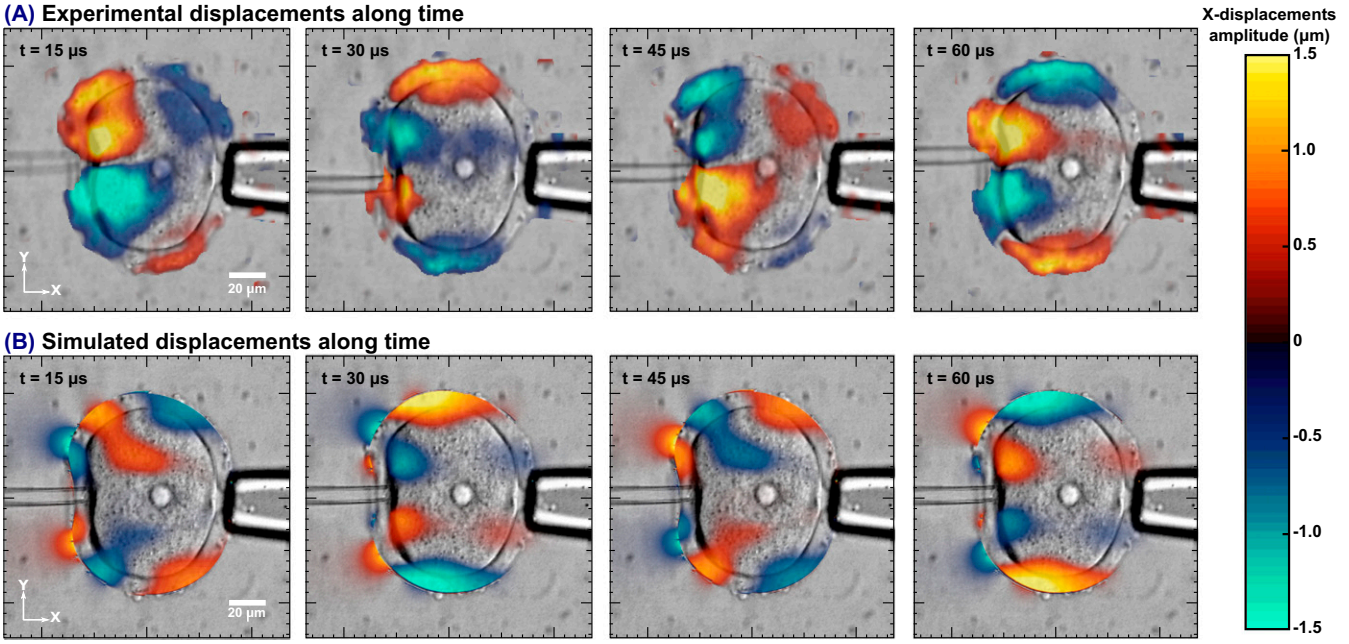

Fig. S2. Experimental (*A*) and simulated (*B*) X-displacement maps, at t = 15, 30, 45, and 60 µs, superimposed on the optical images of the cell. We can see displacements with an amplitude approximately from −1.5 to 1.5 µm, propagating from the vibrating pipette through the external layer of the cell. (Scale bars, 20 µm.)

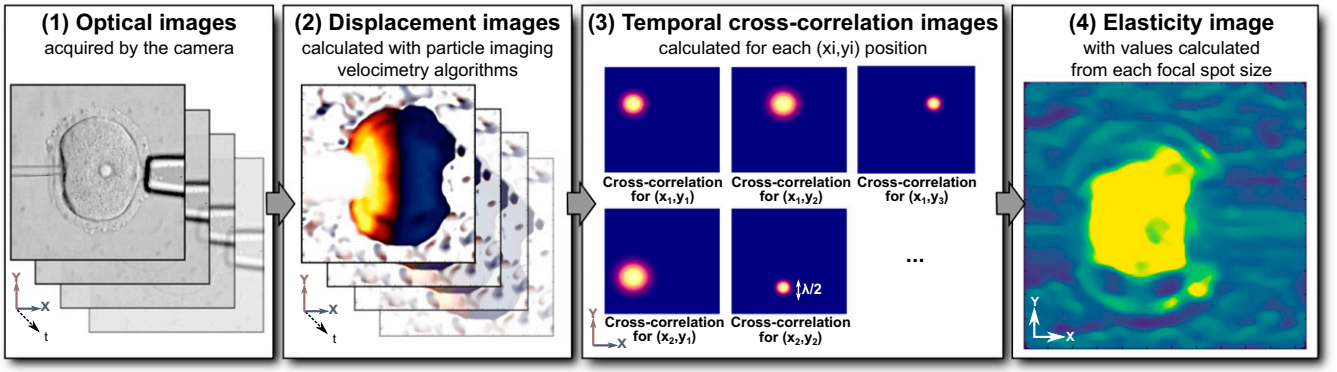

Fig. S3. Illustration of the passive elastography algorithm applied on cells. The elasticity estimation consists of four steps: (1) acquisition of the optical images, (2) estimation of the displacements between images, (3) computation of the temporal cross-correlation of each image, and (4) estimation of the elasticity from the focal spot size.

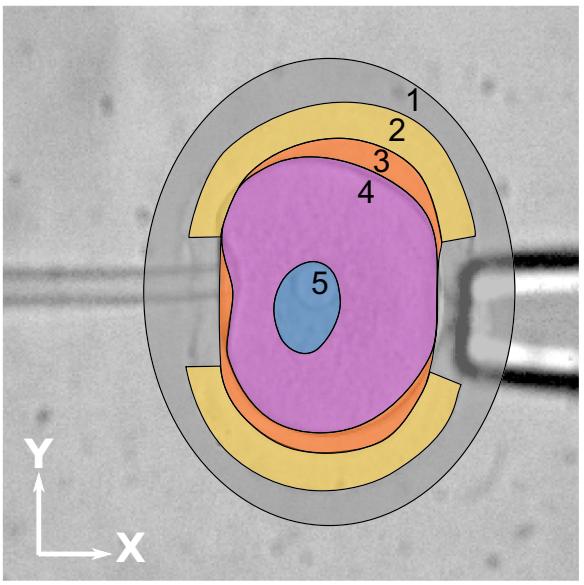

Fig. S4. Illustration of the segmentation. 1: extracellular fluid; 2: zona pellucida; 3: perivitelline space; 4: cytoplasm; 5: nucleus; 2 + 3 + 4 + 5: whole cell.