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Force Regulation in Tissue Mechanics¹

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We have investigated tissue mechanics in live fly embryos perturbed by a UV microbeam and imaged with confocal microscopy. The actin cytoskeletons of these transgenic flies are labeled with green fluorescent protein to provide contrast without compromising biological function. We concentrate on dorsal closure, a model system for development and wound healing, to identify connections between forces, genetics, and morphogenesis. Dorsal closure is proving to be an attractive system for research in biological physics since key cell boundaries lie in a plane and exhibit multiple symmetries, which facilitates modeling. We find that four spatially and temporally coordinated processes are responsible for the dynamics of dorsal closure. The bulk of progress is driven by contractility in supracellular “purse strings” and in the amnioserosa, whereas adhesion-mediated zipping coordinates the forces produced by the purse strings. When the UV microbeam was used to block adhesion mediated zipping, altered dynamics preserve closure, attributed to an upregulation of the force produced by the remaining amnioserosa. In addition, the modeling of wild type and mutant phenotypes is predictive; although closure in myospheroid mutants ultimately fails when the cell sheets rip themselves apart, our analysis indicates that β_{ps} -integrin has an earlier, important role in zipping.

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