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Force generation within tissues during development

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During embryonic development, multicellular tissues physically change shape, move, and grow. Changes in epithelial tissue organization are often accomplished by local movements of cells that are driven largely by forces generated by the motor protein myosin II. These forces are patterned to orient cell movements, resulting in changes in tissue shape and organization to build functional tissues and organs. To investigate the mechanisms of force generation *in vivo*, we use the fruit fly embryo as a model system. Spatial patterns of forces orient cell movements to drive rapid tissue elongation along the head-to-tail axis of the embryo. I will describe how studying embryos generated with engineered myosin variants provides insight into where, when, and how forces are generated to efficiently reorganize tissues. We found that a myosin variant that is locked-in to the active or "on" state accelerates cell movements, while two mutant myosin variants associated with human disease produce slowed cell movement. These myosin variants all disrupt tissue elongation, but live imaging and biophysical measurements reveal distinct effects on myosin organization and dynamics within cells and uncover mechanisms that control the spatial and temporal patterns of force generation. These studies shed light not only on how defects in force generation contribute to disease but also on physical principles at work in active, living materials.