Elucidating optimal biological tissue shape during growth

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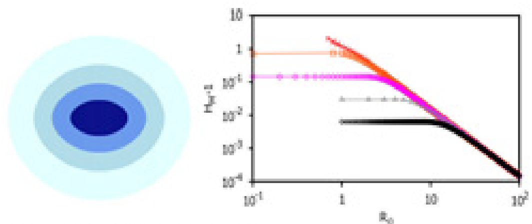

Friction-dominated growth.

A team of European scientists has now extended a previous biophysical model to investigate elongated growth within biological tissues by describing the evolution over time of the shape of a fruit fly's wing. They found the aspect ratio of the typical biological shapes may exhibit a maximum at finite time and then decrease. For sufficiently large tissues, the shape is expected to approach that of a disk or sphere. These findings have been reported by Carles Blanch-Mercader from the University of Barcelona, Spain, and colleagues, in a paper published in the *European Physical Journal E.* They provide a more general classification than previously available of the different types of morphologies a tissue can be expected to attain, depending on its initial size and its physical properties.

In this study, the authors consider a model of the biological tissue represented as a so-called active nematic fluid. It consists of self-aligned cells that have long-range directional order, with their long axes roughly parallel. The authors also integrated the dynamics of the tissue shape related to cell division—by focusing on time scales much longer than the cell cycle—using so-called conformal mapping techniques.

The model takes into account the previously identified local force that a cell produces when it starts dividing to replicate, which is distributed in a way that is dependent on the direction of growth. It also accounts for two other realistic forces typically found in biological tissues: friction with the environment and capillary tension caused by cell aggregates.

This study's hypothesis is that if the cells that constitute a tissue are organised and aligned collectively in the same direction, the force produced by each individual cell division event builds up. The authors show that the accumulation of forces may be sufficient to shape the biological tissue by elongating it.

More information: C. Blanch-Mercader, J. Casademunt, and J. F. Joanny (2014), Morphology and growth of polarized tissues, *European Physical Journal E* 37: 41, DOI: 10.1140/epje/i2014-14041-2

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