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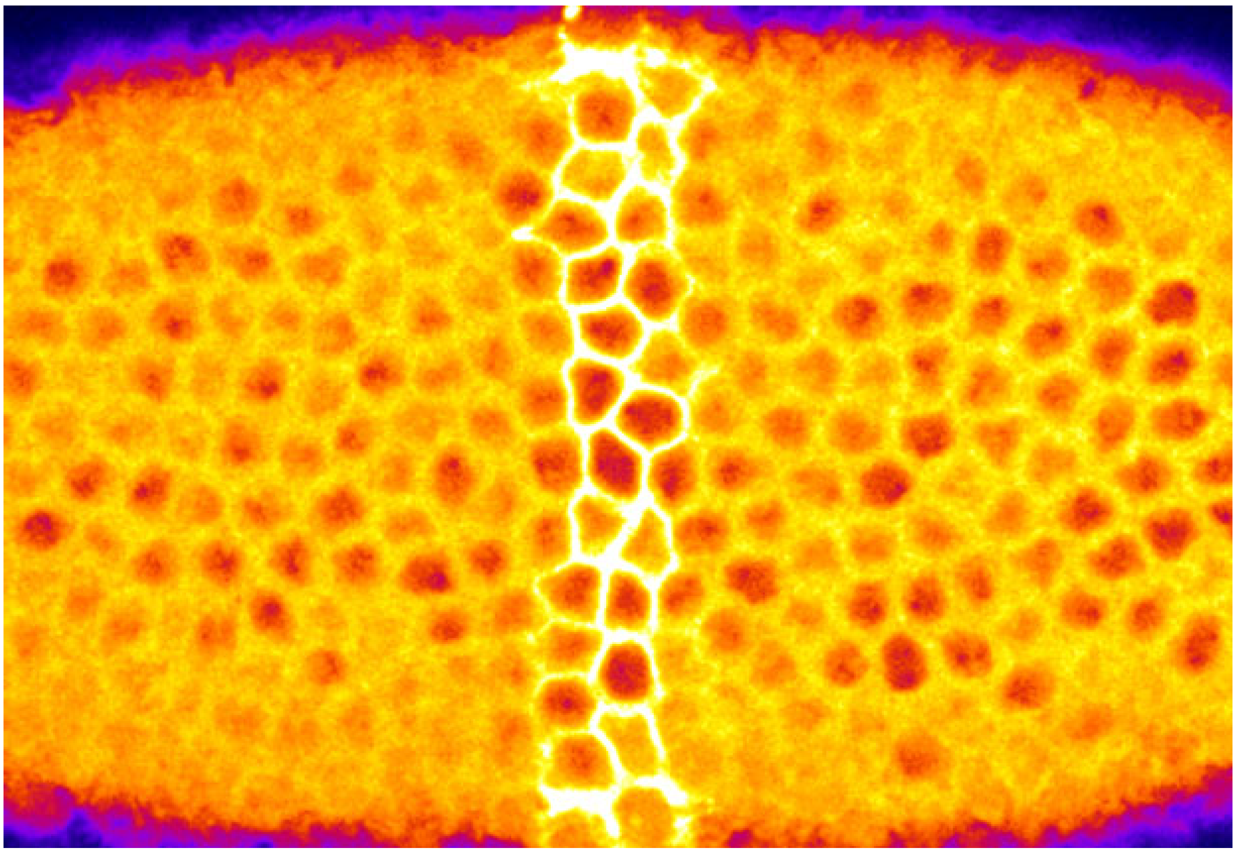
Shaping contraction

November 20 2015



Credit: EMBL/Giorgia Guglielmi

You were once a hollow shell. To sculpt that hollow ball into an organism with layers of internal organs, muscle and skin, portions of that embryonic 'shell' folded inwards. The same happens to fruit fly embryos, and researchers at the European Molecular Biology Laboratory (EMBL) in Heidelberg, Germany, have now identified a particular group of cells which are crucial for the first such fold. They also showed for the first time that the shape in which cells are arranged determines the direction in which they contract. Published today in *Developmental Cell*, the findings were obtained thanks to a new technique in which the scientists use a laser as a remote control.

When a fruit fly embryo is around 4 hours old, cells on its underside start contracting, making the tissue fold inwards to form what is known as the ventral furrow. Inside each cell, a network of actin fibres pulls the membrane inwards, taking it from a roughly round shape to a rectangle that gets thinner and thinner, and pulls its neighbours into the embryo as it contracts.

The EMBL scientists developed a new technique in which they use a laser to remove anchor points for the actin fibres, preventing individual cells from contracting. By applying the technique to different parts of the embryo, they were able to pinpoint a cluster of cells that have to contract for the ventral furrow to form. The same approach enabled them to outline an area in the embryo and prevent cells outside that region from contracting. By changing the shape of the 'contracting' area, they discovered that cells only contract like they do in normal embryos if they are arranged in a rectangle. This implies that the 'squashing' from circular to rectangular shape is not directed by some internal programming but rather is dictated by the overall shape of the tissue.

The new approach overcomes one of the main challenges scientists have so far faced when studying development: it enables them to view effects immediately. By contrast, the standard methods to date, which relied on turning genes on or off, required hours or even days before the effects of that manipulation could be seen.

"The methods we had available so far made it a bit like arriving at the scene of a car crash after the fact: you know something went wrong at some point, but you were not there when it happened, so you cannot tell what exactly caused the accident," says Stefano De Renzis, who led the work. "Our new optogenetic method is more like a remote control: you turn on the laser, and see the effect within seconds."

Next, De Renzis plans to use this new method to look at how cells in the developing fruit fly embryo communicate with each other.

The technique has already raised considerable interest. The EMBL scientists have received requests from colleagues looking to apply to studies of stem cells and neural tube development in mice, as well as others investigating fruit fly development, interactions between cells, and more.

More information: Giorgia Guglielmi et al. An Optogenetic Method to Modulate Cell Contractility during Tissue Morphogenesis, *Developmental Cell* (2015). DOI: 10.1016/j.devcel.2015.10.020

Provided by European Molecular Biology Laboratory