Contribution ID : **22** Type : **Poster**

Uncovering the physical constraints on cell shape for a functional actomyosin ring during cytokinesis

Cytokinesis is a fundamental cellular process, which consists in the physical division of a cell into two, once the genetic material has been replicated. In animal cells, this is achieved by constriction of an actomyosin ring assembled to the equatorial cell cortex. For cytokinesis to take place, the shape of the cell during cell division might be essential. Indeed, most eukaryotic cells round up when entering mitosis in a process called mitotic cell rounding, which seems to be a general feature of cell division. Mitotic cell rounding is believed to play a role in satisfying the geometric requirements of the mitotic spindle during cell division. However, the mechanism by which cytokinesis is dependent on mitotic rounding is still obscure. We observe that mechanically constricted C. elegans embryos at one-cell stage, which are squeezed to approx. 1/3 of their height, fail to undergo cytokinesis. We find that physically limiting mitotic cell height leads to an inhomogeneous non-muscle myosin distribution along the cytokinetic ring. This finding help to disclose the mechanical requirements on cell shape for a functional cytokinetic ring during cytokinesis.

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Session Classification : Poster Session