Still and rotating myosin clusters as determinants for cytokinetic ring constriction

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The cytokinetic ring is a cellular organelle allowing the physical separation of cells. Stresses are generated in the ring by actin filaments and myosin motors leading to constriction in cells ranging from fission yeast possessing a rigid sugar wall to mammalian cells lacking a wall. It remains unclear how the same molecular actors perform constriction in such different mechanical and molecular conditions. Using micro-cavities to orient rings in single focal planes [1-3], we show that internal dynamics of rings are distinct in different cell types. At the onset of constriction in mammalian cells, we observe a transition from homogeneous distribution to stationary periodic pattern of myosin clusters. In contrast, in fission yeast, myosin clusters rotate prior and during constriction. Our theoretical analysis reveals the origin for the two behaviours from common sets of interaction rules. It also suggests that patterns in mammalian cells increase the stress generated in the ring, whereas in fission yeast they could serve to transport the wall machinery. These ideas are supported by experiments using drugs, mutants and laser ablation. Such self-organisations of myosin clusters may be generic in morphogenesis.

[1] Riveline, D. and Buguin, A. Devices and methods for observing the cell division. WO/2010/092116. *Patent* (2009).
[2] Riveline, D. and Wollrab, V. Devices and methods for observing eukaryotic cells without cell wall. WO/2013/135809. *Patent* (2012).
[3] Riveline, D. Methods for observing cells with cell wall or invertebrate embryos with oblong eggshell. WO/2013/144302. *Patent* (2012).