Myosin reins in neurites

Myosin II pulls growth cones in the right direction, as shown by Stephen Turney and Paul Bridgman (Washington University, St. Louis, MO). Growing neurons in the developing embryo are directed by guidance cues such as laminin-1 (LN1), which steer the extension of neurite growth cones. Bridgman had previously noticed that neuronal growth cones contain high levels of myosin II. As this motor generates force on the cytoskeleton, he figured it might be involved in turning neurites in response to guidance cues.

Such was the case for LN1, as shown by the growth of neurites at borders between LN1 and polyornithine substrates. Normally, growing neurites rapidly retreat from polyornithine and turn back into the laminin surface. But when myosin II activity was inhibited, the neurites ignored the change in substrate and grew over polyornithine.

Turning depended on the activation of integrins—the LN1 receptors. The subsequent activation of focal adhesion kinases might activate or recruit myosin II. On polyornithine, both myosin II and focal complexes are randomly distributed. On LN1, however, myosin IIB concentrated in the transitional domain of the growth cone—intermingled with or just behind the new front of focal complexes. Myosin placement in relation to adhesion sites might pull neurites toward more LN1 and away from unwanted substrates.

Reference: Turney, S.G., and P.C. Bridgman. 2005. Nat. Neurosci. doi:10.1038/nn1466.

Inequality made equal

Forces generating asymmetry give rise to left–right (LR) differences in internal organs such as the lungs and liver. Now, Yasuhiko Kawakami, Juan Carlos Izpisua Belmonte, and colleagues (Salk Institute, La Jolla, CA), and Julien Vermot and Olivier Pourquié (Stowers Institute for Medical Research, Kansas City, MO) show that these forces are buffered by the action of retinoic acid (RA) to ensure symmetry in vertebrae and muscle formation.

Vertebrae and muscle are derived from the somites, which form as symmetric segmentations along the anterior–posterior axis. These segments form near the node, a mass of cells that provides positional information to organize the body plan. In mice and chicks, the node contains ciliated cells that generate fluid movement to produce LR asymmetry.

The Salk group shows that this ciliated system is conserved in zebrafish. They also find that loss of the system causes asymmetric somite formation. As RA gradients help to time somitogenesis, the authors investigated whether it coordinates the LR system with somite formation. Indeed, blocking RA production led to more somites on the left side, and this asymmetry depended on the LR information flow.

A similar RA buffer also operates in chicks and mice, according to the Missouri group. The details regarding how RA influences LR patterning are not clear. RA down-regulates FGF activity, and this antagonism is known to help time somite formation via oscillations in gene expression. In the absence of RA, these oscillations were faster on the left side than they were on the right.

The loss of Zip1 is known not to impair homologue pairing. But Roeder hypothesizes that it may become more important when other mechanisms that contribute to pairing are impaired.

References: Kawakami, Y., et al. 2005. Nature. 435:165–171.
Vermot, J., and O. Pourquié. 2005. Nature. 435:215–220.