Journal Club

SUPER-DUPER RESOLUTION IMAGING OF MITOTIC MICROTUBULES

There is a lot of excitement about super-resolution imaging in cell biology and how we can integrate image analysis and computer modelling to quantify our data. The papers I am highlighting describe nanometre-scale imaging of microtubules within the mitotic spindle in three dimensions. They used computer processing and spatial statistics to model the organization of these microtubules; cutting-edge stuff, but the papers are more than 20 years old!

The McIntosh group used electron microscopy and computational image processing to analyse serial sections of mitotic rat-kangaroo kidney epithelial cells. Spindles at different mitotic stages were reconstructed, enabling the investigators to trace the course of individual microtubules. This was not the first time microtubule reconstructions had been attempted, but there were conflicting views on microtubule organization in the spindle that needed resolving.

> “definitive evidence for the first time that the kinetochore fibre is a bundle of parallel microtubules”

The power of these papers lies in the digitization of electron micrograph negatives and the resulting computer model. This enabled the analysis of the spatial organization of microtubules in the spindle and provided definitive evidence for the first time that the kinetochore fibre is a bundle of parallel microtubules, with some extending from the kinetochore to the pole and a few interpolar microtubules that invade the bundle.

A few years later, the computer programs described in these studies were packaged by Mastronarde *et al.* into IMOD. This free software suite of modelling, display and image processing that can be used for three-dimensional reconstruction, is being actively developed and is a ‘must have’ for electron microscopists.

Since these papers were published, many things have changed: faster computing, digital capture of images, tomography, improved fixation methods and even automated sectioning are now all available. Even so, a similar analysis today would still be regarded as a tour de force.

Despite the advances in super-resolution imaging, electron microscopy is still the only game in town for visualizing individual microtubules within a complex subcellular array. These studies, and others like it, continue to teach us much about cell biology.

Stephen J. Royle
Division of Biomedical Cell Biology, Warwick Medical School
Gibbet Hill Road, Coventry, CV4 7AL, UK
e-mail: s.j.royle@warwick.ac.uk

The author declares no competing financial interests

ORIGINAL RESEARCH PAPERS McDonald, K. L.. *et al.* Kinetochore microtubules in PTK cells. *J. Cell Biol.* **118**, 369–383 (1992) | Mastronarde, D. N. *et al.* Interpolar spindle microtubules in PTK cells. *J. Cell Biol.* **123**, 1475–1489 (1993)
FURTHER READING McEwen, B. F., Dong, Y. & VandenBeldt, K. J. Using electron microscopy to understand functional mechanisms of chromosome alignment on the mitotic spindle. *Methods Cell Biol.* **79**, 259–293 (2007)