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CYTOSKELETON

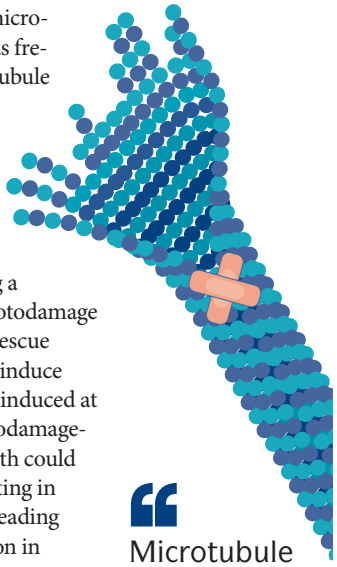
Patching up microtubule growth

Microtubules are constantly remodelled, undergoing cycles of growth and shrinkage. Microtubule growth is supported by rescue events, during which microtubule depolymerization is arrested, allowing for their subsequent elongation. Aumeier, Schaedel *et al.* now show that the occurrence of local damage at the microtubule lattice, followed by concomitant self-repair through the incorporation of new tubulin dimers, can promote these rescue events.

Microtubule self-repair has been previously demonstrated to occur *in vitro*. To show that microtubules can also self-repair *in vivo*, the authors showed that, in mammalian cells, free tubulin could indeed incorporate into patches along the microtubule lattice. These events were mostly concentrated at regions where microtubules curved, crossed each other or bundled — sites that are associated with high rates of mechanical strain and damage. Importantly, microtubule depolymerization was frequently arrested and microtubule regrowth was stimulated at these sites.

To investigate whether microtubule damage is able to promote rescue events, microtubules were locally photodamaged using a focused laser beam. The photodamage increased the frequency of rescue events and was sufficient to induce microtubule growth. When induced at the cell boundary, this photodamage-mediated microtubule growth could influence cell motility, resulting in the establishment of a new leading edge and favouring migration in this direction.

Further *in vitro* experiments revealed that no accessory proteins were necessary to rescue microtubule growth, but that rescue was dependent on the presence of free tubulin.



Vicky Sumersby/NPG

> Microtubule damage is able to promote rescue events

Furthermore, rescue events were increased in the presence of a tubulin analogue that is unable to hydrolyse GTP. This collectively indicated that microtubule rescue events are induced specifically at sites of lattice self-repair and that this is an inherent property of microtubules, which is dictated by structural changes associated with the incorporation of GTP-bound tubulin dimers to the lattice.

The study uncovered a mechanism of regulating microtubule length, which may contribute to maintaining microtubule networks in regions where microtubules are particularly subjected to mechanical strain, such as the leading edge of migrating cells. It would be interesting to explore to what extent microtubule dynamics *in vivo* are influenced by this mechanism and how it is fine-tuned, for example, by several cellular microtubule-associated proteins.

Paulina Strzyz

ORIGINAL ARTICLE Aumeier, C., Schaedel L. *et al.* Self-repair promotes microtubule rescue. *Nat. Cell Biol.* http://dx.doi.org/10.1038/ncb3406 (2016)