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The Role of Dynein in Microtubule Mechanics TONY LADD, University of Florida, GAURAV MISRA, Stanford University, JUN WU, ROBERT RUSSELL, TANMAY LELE, RICHARD DICKINSON, University of Florida — Experiments in Lele's group have shown that microtubules severed by laser ablation do not straighten, as would be expected from the large bending moments along their lengths. Instead, segments near newly created minus ends typically increased in curvature following severing, while segments near new microtubule plus ends depolymerize before any observable change in shape. However, in dynein-inhibited cells, segments near the cut straightened rapidly following severing. These observations suggest that microtubules are subject to significant tangential forces, and that lateral motion of the microtubule is primarily opposed by frictional rather than elastic forces. To interpret the experimental results, we have developed a numerical model for intracellular microtubule mechanics, accounting for dynein-generated forces on the microtubules. We have supplemented the Kirchoff model for an elastic filament with the stochastic growth and collapse of microtubules, and by a model for dynein generated forces. I will present simulations of the dynamics of individual microtubules that show how motor forces result in the localization of short-wavelength buckles near the cell periphery. Our results suggest that microtubule shapes in vivo reflect a dynamic force balance, where bending moments are opposed by dynein-motor forces that include a large effective friction from the stochastic binding and unbinding of the motors. Simulations of the motion of the centrosome are consistent with a mechanism for centrosome centering driven by pulling forces exerted by dynein motors. I will explain how tension on the centrosome can be reconciled with buckled filaments near the cell periphery.

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