

Supporting Information

Kikuchi et al. 10.1073/pnas.09004511106

SI Text

The interplay of anchoring and contractility discussed in our paper may find realization in the stable alignment and guidance of microtubules towards filopodia (1) in the neuronal growth cone, which contains both parallel and normal alignment of F-actin to microtubules (MT). As seen in Fig. S1, MT that do not extend in a nearly parallel direction to filopodia are strongly buckled. Yet 95% of MT target existing filopodia (1). Because we have shown in the paper that actin–MT interaction in a purely equilibrium setting in general leads to buckling, we suggest the following active mechanism for the stable alignment of MT reaching filopodia. When an extending MT enters the lamella, it meets the contractile actomyosin network, with actin filaments in a variety of directions and movements. The typical angle between a MT and an actin filament will be substantial, and our analysis in the paper predicts that such

an encounter leads to buckling as observed. Near the entrance to a filopodium, the actin-gel should be substantially parallel to the filopodium, and hence to any MT growing on-axis toward it. From our theory, the parallel, contractile actin-gel should stiffen the MT, leading to less buckling and greater extension, thus helping it reach the filopodia. Whether the specific targeting of microtubules to filopodia is entirely driven by the mechanism proposed here or if other mechanical gel effects or specialized proteins fulfill an essential role is an open question. An unambiguous test of our predictions would require a system of precisely known components with independent control of anchoring and activity, such as a recombinant purified system with variable cross-linkers and motors.

1. Schaefer AW, Kabir N, Forscher P (2002) Filopodia and actin arcs guide the assembly and transport of two populations of microtubules with unique dynamic parameters in neuronal growth cones. *J. Cell Biol.* 158: 139–152.

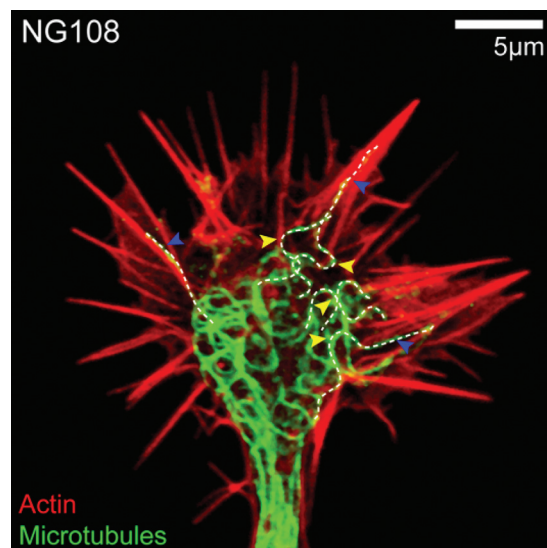


Fig. S1. Cytoskeletal polymers in a fixed and fluorescently stained growth cone of an NG108-15 neuronal cell. In the peripheral domain actin filaments (red) form dense networks in the veil-like lamellipodium and bundles in the spike-like filopodia. Microtubules (green) emerge from the central domain into the periphery where they are buckled (yellow arrowheads) in the lamellipodium by the actin network or stabilized in the filopodial region (blue arrowheads). For illustration, some microtubules are traced by a dotted white line.