THE MECHANICS BEHIND FILOPODIAL RETRACTION

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Filopodia are very dynamic, tentacle like cell protrusions that play important mechanical and sensory roles for different cell processes. They are involved in cell migration, wound healing and in the dorsal closure during the embryonic development. We recently observed filopodia while actively pulling the invasive bacteria Shigella towards the host cell before infection occurred. In all these examples mechanical forces are involved but the exact mechanics behind the filopodial retraction are far from being understood. We use an optical trap to place differently coated beads close to the tip of a preexisting filopodia. Directly after binding to the bead we observe filopodial retraction. In parallel we use confocal microscopy to visualize the filopodial actin structure. Single filopodia retract with constant velocity over their whole length against a force that we can keep constant. We observed filopodial retraction velocities ranging from 5 to 100 nm/s against applied forces ranging between 0 and 40 pN. The pulling velocity of a single filopodia does not depend on the applied force. However applying high forces above 40 pN leads to a disruption of the filopodia internal structure close to the tip. This leads to a membrane tube that is pulled from the filopodial tip. Local addition of Cytochalasin D to the actively pulling filopodia leads to a similar breakage of the structure. Our experiments show that the high retraction forces observed in our experiment are transmitted by the filopodial actin core and not generated by membrane tension.