MEASUREMENT OF THE FORCE EXERTED BY NEURITES DURING NEURONAL DIFFERENTIATION

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During neuronal differentiation, neurites are guided towards their final target by molecular cues that are sensed by filopodia and lamellipodia, highly motile structures extruding from the tip of the growing neurite, i.e. the growth cone. Filopodia explore the environment by rapidly moving in all directions, searching for the correct pathway and lamellipodia follow, opening the way to the growing neurite. Cell motility is primarily powered by motor proteins, able to convert chemical energy into cytoskeleton movement and force generation. The kinetics of filopodia and lamellipodia motion has been analyzed but little is known about the force that these neuronal structures exert on their environment. Indeed, the analysis of this force has been limited to theoretical considerations and an experimental analysis has been restricted to samples of isolated filaments.

A quantitative characterization of forces exerted by neurons during neuronal differentiation is necessary for understanding their motility and the precise role of molecular motors. Therefore, we used optical tweezers to measure the force exerted by Rat Dorsal Root Ganglion cells during neuronal differentiation. Results show that force exerted by filopodia is in the order of 1 to 2 pN while lamellipodia being more complex and relatively larger structures exerts force more than 11 pN. Force exerted by Filopodia during its lateral motion and protrusion were also measured.