Mechanotransduction of axonal growth: novel perspectives in mechanobiology field

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Axonal growth has always been considered an interesting and enigmatic phenomenon. Historically, the scientific community has considered fundamental the role played by the growth cone, which provides an axonal guidance mechanism, influencing the direction and orientation of the movement, in response to chemical signals [1]. However, recent discoveries have shown that mechanical signalling is just as critical as biochemical signalling for axonal growth [2]. Currently, it is widely accepted that neurites elongate, when mechanical tension is applied, the process being referred as "stretch-growth" [3]. Recently, we developed a methodology to stretch axons by applying extremely low mechanical forces, similar to those generated endogenously [4]. Specifically, magnetic nanoparticles (MNPs) have been used to label axons and to stretch them by using the dragging force generated by a permanent magnet. MNP-mediated stretching has been found to strongly increase the spontaneous elongation rate and the sprouting of primary neurons in culture. Experimental data suggest that local mechanisms, including local translation and local transports, may be involved. These novel perspectives open new horizons in the understanding of the mechanisms that govern axonal growth and, more generally, in the knowledge of what is behind cell response to external mechanical forces.

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