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Sommario/riassunto

Understanding the underlying mechanisms of how axons and dendrites develop is a fundamental problem in neuroscience and a main goal of research on nervous system development and regeneration. Previous studies have provided a tremendous amount of information on signaling and cytoskeletal proteins regulating axonal and dendritic growth and guidance. However, relatively little is known about the relative contribution and role of cytoskeletal dynamics, transport of organelles and cytoskeletal components, and force generation to axonal elongation. Advancing the knowledge of these biomechanical processes is critical to better understand the development of the nervous system, the pathological progression of neurodegenerative diseases, acute traumatic injury, and for designing novel approaches to promote neuronal regeneration following disease, stroke, or trauma. Mechanical properties and forces shape the development of the nervous system from the cellular up to the organ level. Recent advances in quantitative live cell imaging, biophysical, and nanotechnological methods such as traction force microscopy, optical tweezers, and atomic force microscopy have enabled researchers to gain better insights into how cytoskeletal dynamics and motor-driven transport, membrane-dynamics, adhesion, and substrate rigidity influence axonal elongation. Given the complexity and mechanical nature of this problem, mathematical modeling contributes significantly to our understanding of neuronal mechanics. Nonetheless, there has been

limited direct interaction and discussions between experimentalists and theoreticians in this research area. The purpose of this Frontiers Research Topic is to highlight exciting and important work that is currently developing in the fields of neuronal cell biology, neuronal mechanics, intracellular transport, and mathematical modeling in the form of primary research articles, reviews, perspectives, and commentaries.