Neuromechanics

The human brain is the continuous subject of extensive investigation aimed at understanding its behavior and function. Despite a clear evidence that mechanical factors play an important role in regulating brain activity, current research efforts focus mainly on the biochemical or electrophysiological activity of the brain. Here, we show that classical mechanical concepts including deformations, stretch, strain, strain rate, pressure, and stress play a crucial role in modulating both brain form and brain function. This opinion piece synthesizes expertise in applied mathematics, solid and fluid mechanics, biomechanics, experimentation, material sciences, neuropathology, and neurosurgery to address today's open questions at the forefront of neuromechanics. We critically review the current literature and discuss challenges related to neurodevelopment, cerebral edema, lissencephaly, polymicrogyria, hydrocephaly, craniectomy, spinal cord injury, tumor growth, traumatic brain injury, and shaken baby syndrome. The multi-disciplinary analysis of these various phenomena and pathologies presents new opportunities and suggests that mechanical modeling is a central tool to bridge the scales by synthesizing information from the molecular via the cellular and tissue all the way to the organ level [1)].

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Goriely A, Geers MG, Holzapfel GA, Jayamohan J, Jérusalem A, Sivaloganathan S, Squier W, van Dommelen JA, Waters S, Kuhl E. Mechanics of the brain: perspectives, challenges, and opportunities. Biomech Model Mechanobiol. 2015 Feb 26. [Epub ahead of print] PubMed PMID: 25716305.