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Atomic Force Micro-rheology And Brillouin-raman Micro-spectroscopy As New Tools for the Investigation of Adld Pathology

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The nucleus architecture and mechanics are governed by nuclear lamina. Gene duplication and overexpression of lamin B1 have been identified in families affected by autosomal dominant leukodystrophy (ADLD), with increased nuclear stiffness observed in correlation with this overexpression [1]. The primary method for characterizing cell mechanics is nanoindentation by atomic force microscopy (AFM). However, determining nuclear elasticity through indentation approaches is a challenging task, as the nucleus is an internal organelle not directly accessible to the AFM probe.

To overcome this, we applied a poroelastic model combined with stress-relaxation technique [2] to calculate the poroelastic diffusion coefficient (Dp) in living cells. This investigation revealed a significant difference in poroelastic behavior between ADLD and healthy cells, which was more pronounced than changes in stiffness alone. Moreover, the modifications in nuclear mechanics are characterized by Brillouin-Raman Micro-Spectroscopy [3], a contact-free elastography method achieving sub-cellular spatial resolution. The proposed correlative approach sets a new standard for studying pathological nuclear conditions.

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