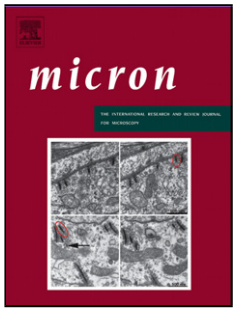

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An engineering insight into the relationship of selective cytoskeletal impairment and biomechanics of HeLa cells

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HIGHLIGHTS

- Confocal and atomic force microscopies study of F-actin and microtubules disruption
- F-actin and microtubules disruption shifts to more fluid- and solid-like behaviours
- F-actin and microtubules strongly affects the cellular adhesion properties
- Stress relaxation data are used to derive storage and loss moduli profiles

ABSTRACT

It is widely accepted that the pathological state of cells is characterized by a modification of mechanical properties, affecting cellular shape and viscoelasticity as well as adhesion behaviour and motility. Thus, assessing these parameters could represent an interesting tool to monitor disease development and progression, but also the effects of drug treatments. Since biomechanical properties of cells are strongly related to cytoskeletal architecture, in this work we extensively studied the effects of selective impairments of actin microfilaments and microtubules on HeLa cells through force-deformation curves and stress relaxation tests with atomic force microscopy. Confocal microscopy was also used to display the effects of the used drugs on the cytoskeletal structure. In synergy with the aforementioned methods, stress relaxation data were used to assess the storage and loss moduli, as a complementary way to describe the influence of cytoskeletal components on cellular viscoelasticity. Our results indicate that F-actin and microtubules play a complementary role in the cell stiffness and viscoelasticity, and both are fundamental for the adhesion properties. Our data support also the application of biomechanics as a tool to study diseases and their treatments.

Keywords: AFM; HeLa; mechanical properties; viscoelasticity; storage modulus; loss modulus