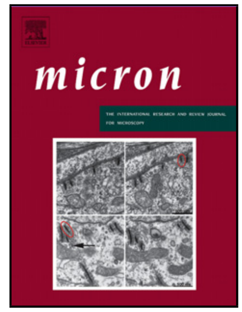

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Nanoscale mechanics of brain abscess: an Atomic Force Microscopy study

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Highlights

- We study the nanoscale mechanics of surgically removed brain abscess tissues, by atomic force microscopy
- According to previous histological findings, the brain abscess is modelled as three-layers system.
- Mechanical properties of each layer are characterized by using the Young's modulus E, and the AFM indentation cycle hysteresys.
- This results have the potential to improve our understanding of the mechanical cues regulating the brain in its physiological and pathological state.

Abstract

Mechanical stimuli are a fundamental player in the pathophysiology of the brain influencing its physiological development and contributing to the onset and progression of many diseases. In some pathological states, the involvement of mechanical and physical stimuli might be extremely subtle; in others it is more evident and particularly relevant. Among the latter pathologies, one of the most serious life-threatening condition is the brain abscess (BA), a focal infection localized in the brain parenchyma, which causes large brain mechanical deformations, giving rise to a wide range of neurological impairments. In this paper, we present the first nano-mechanical characterization of surgically removed human brain abscess tissues by means of atomic force microscopy (AFM) in the spectroscopy mode. Consistently with previous histological findings, we modeled the brain abscess as a multilayered structure, composed of three main layers: the cerebritis layer, the collagen capsule, and the internal inflammatory border. We probed the viscoelastic behavior of each layer separately through the measure of the apparent Young's *modulus (E), that gives information about the sample stiffness, and the AFM hysteresis (H), that estimates the contribution of viscous and dissipative forces. Our experimental findings provide a full mechanical characterization of the abscess, showing an average E of (94 ± 5) kPa and H of 0.37 ± 0.01 for the cerebritis layer, an average E = (1.04 ± 0.05) MPa and H = 0.10 ± 0.01 for the collagen capsule and an average E = (9.8 ± 0.4) kPa and H = 0.57 ± 0.01 for the internal border. The results here presented have the potential to contribute to the development of novel surgical instruments dedicated to the treatment of the pathology and to stimulate the implementation of novel constitutive mechanical models for the estimation of brain compression and damage during BA progression.*