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Towards *in vivo* tissue mechanics

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Mechanical tissue properties are increasingly recognized as phenotypic characteristics that may change during development, or as pathological conditions occur and progress. The quantification of such material properties often relies on physical contact between a load-applying probe and a processed sample surface. In case of inhomogeneous, enclosed tissues, especially those of the central nervous system, such measurement requirements can only be met if the tissue is excised, possibly sectioned and the targeted region exposed. Recently, Brillouin microscopy has emerged as a contact-free and non-destructive technique that facilitates an all-optical interrogation of mechanical tissue properties without the need of animal sacrifice and further tissue processing. However, the interpretation of Brillouin microscopy measurements and their relation to other contact-based techniques remains elusive. To address this aspect, we performed mechanical measurements across multiple spatio-temporal scales using both indentation measurements and Brillouin microscopy on the same sample types *ex vivo*. Those measurements were complemented by *in vivo* Brillouin microscopy measurements. Our results show that *ex vivo* tissues, tested with both indentation measurements and Brillouin microscopy, reveal a distinct mechanical signature that allows to distinguish regions of interest within the tissue. For some tissues, this mechanical signature appears to be less prominent or absent in *in vivo* measurements using Brillouin microscopy. Moreover, some types of tissue show a correlative relationship between the two types of mechanical testing, while others do not. The presented work not only constitutes an important link between testing methods with different spatio-temporal scales, but provides first systematic insights to the factors to which Brillouin microscopy is sensitive in complex biological tissues. Ultimately this will further our understanding of *in vivo* mechanical properties and path the way for predictive computational approaches that aim at treating human conditions.