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Multiscale biomechanics of brain tumours favours cancer invasion by cell softening and tissue stiffening. JOSEF KAS, ANATOL FRITSCH, STEFFEN GROSSER, SABRINA FRIEBE, MARTIN REISS-ZIMMERMANN, WOLF MLLER, KARL-TITUS HOFFMANN, Leipzig University, INGOLF SACK, Charite Berlin — Cancer progression needs two contradictory mechanical prerequisites. For metastasis individual cancer cells or small clusters have to flow through the microenvironment by overcoming the yield stress exerted by the surrounding. On the other hand a tumour has to behave as a solid to permit cell proliferation and spreading of the tumour mass against its surrounding. We determine that the high mechanical adaptability of cancer cells and the scale controlled viscoelastic properties of tissues reconcile both conflicting properties, fluid and solid, simultaneously in brain tumours. We resolve why different techniques that assess cell and tissue mechanics have produced apparently conflicting results by our finding that tumours generate different viscoelastic behaviours on different length scales, which are in concert optimal for tumour spreading and metastasis. Single cancer cells become very soft in their elastic behavior which promotes cell unjamming. On the level of direct cell-to-cell interactions cells feel their micro-environment as rigid elastic substrate that stimulates cancer on the molecular level. All over a tumour has predominately a stiff elastic character in terms of viscoelastic behaviour caused by a solid backbone. Simultaneously, the tumour mass is characterized by a large local variability in the storage and loss modulus that is caused by areas of a more fluid nature.

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