www.elsevier.com/locate/jbiomech

Dynamic mechanical properties of murine brain tissue using micro-indentation

D.B. MacManus, B. Pierrat, J.G. Murphy, M.D. Gilchrist

PII: S0021-9290(15)00370-X
DOI: http://dx.doi.org/10.1016/j.jbiomech.2015.06.028
Reference: BM7229

To appear in: *Journal of Biomechanics*

Received date: 3 March 2015
Revised date: 27 June 2015
Accepted date: 30 June 2015

Cite this article as: D.B. MacManus, B. Pierrat, J.G. Murphy and M.D. Gilchrist, Dynamic mechanical properties of murine brain tissue using micro-indentation, *Journal of Biomechanics,* http://dx.doi.org/10.1016/j.jbiomech.2015.06.028

Dynamic mechanical properties of murine brain tissue using micro-indentation

D.B. MacManus [a], B. Pierrat[a], J.G. Murphy[b], M.D. Gilchrist[a]*

[a] *School of Mechanical & Materials Engineering, University College Dublin, Dublin, Ireland*

[b] *Department of Mechanical & Manufacturing Engineering, Dublin City University, Dublin, Ireland*

**Corresponding Author*

Tel: +353 1 716 1890, +353 1 716 1991

Email: david.mac-manus@ucdconnect.ie (D.B. MacManus), baptiste.pierrat@ucd.ie (B. Pierrat), jeremiah.murphy@dcu.ie (J. G. Murphy), michael.gilchrist@ucd.ie (M. D. Gilchrist)*

Abstract

In the past 50 years significant advances have been made in determining the macro-scale properties of brain tissue in compression, tension, shear and indentation. There has also been significant work done at the nanoscale using the AFM method to characterise the properties of individual neurons. However, there has been little published work on the micro-scale properties of brain tissue using an appropriate indentation methodology to characterise the regional differences at dynamic strain rates. This paper presents the development and use of a novel micro-indentation device to measure the dynamic mechanical properties of brain tissue. The device is capable of applying up to 30/s strain rates with a maximum indentation area of 2500 μm^2. Indentation tests were carried out to determine the shear modulus of the cerebellum (2.11±1.26 kPa, 3.15±1.66 kPa, 3.71±1.23 kPa) and cortex (4.06±1.69 kPa, 6.14±3.03 kPa, 7.05±3.92 kPa) of murine brain tissue at 5, 15, and 30/s up to 14% strain. Numerical simulations were carried out to verify the experimentally measured force-displacement results.