

Author's Accepted Manuscript

On the correct interpretation of measured force and calculation of material stress in biaxial tests

D.R. Nolan, J.P. McGarry



www.elsevier.com/locate/jmbbm

PII: S1751-6161(15)00290-8
DOI: <http://dx.doi.org/10.1016/j.jmbbm.2015.08.019>
Reference: JMBBM1579

To appear in: *Journal of the Mechanical Behavior of Biomedical Materials*

Received date: 27 May 2015
Revised date: 23 July 2015
Accepted date:
10 August 2015

Cite this article as: D.R. Nolan, J.P. McGarry, On the correct interpretation of measured force and calculation of material stress in biaxial tests, *Journal of the Mechanical Behavior of Biomedical Materials*, <http://dx.doi.org/10.1016/j.jmbbm.2015.08.019>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

On the correct interpretation of measured force and calculation of material stress in biaxial tests

D.R. Nolan^a, J.P. McGarry^{a,*}

^a*Biomedical Engineering, National University of Ireland, Galway, Galway, Ireland*

Abstract

Biaxial tests are commonly used to investigate the mechanical behaviour of soft biological tissues and polymers. In the current paper we uncover a fundamental problem associated with the calculation of material stress from measured force in standard biaxial tests. In addition to measured forces, localized unmeasured shear forces also occur at the clamps and the inability to quantify such forces has significant implications for the calculation of material stress from simplified force-equilibrium relationships. Unmeasured shear forces are shown to arise due to two distinct competing contributions: (1) negative shear force due to stretching of the orthogonal clamp, and (2) positive shear force as a result of material Poisson-effect. The clamp shear force is highly dependent on the specimen geometry and the clamp displacement ratio, as consequently, is the measured force-stress relationship. Additionally in this study we demonstrate that commonly accepted formulae for the estimation of material stress in the central region of a cruciform specimen are highly inaccurate. A reliable empirical correction factor for the general case of isotropic materials must be a function of specimen geometry and the biaxial clamp displacement ratio. Finally we demonstrate that a correction factor for the general case of non-linear anisotropic materials is not feasible and we suggest the use of inverse finite element analysis as a practical means of interpreting experimental data for such complex materials.

*Corresponding Author

Email address: patrick.mcgarry@nuigalway.ie (J.P. McGarry)

Download English Version:

<https://daneshyari.com/en/article/7208324>

Download Persian Version:

<https://daneshyari.com/article/7208324>

[Daneshyari.com](https://daneshyari.com)