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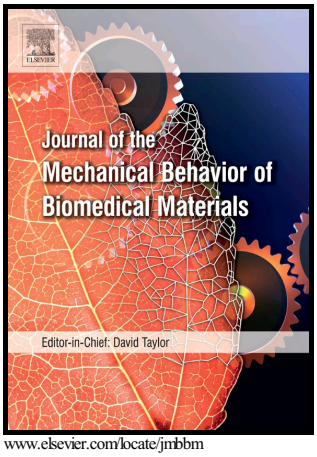

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Tensile rupture of medial arterial tissue studied by X-ray micro-tomography on stained samples

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Abstract

Detailed characterization of damage and rupture mechanics of arteries is one the current challenges in vascular biomechanics, which requires developing suitable experimental approaches. This paper introduces an approach using *in situ* tensile tests in an X-ray micro-tomography setup to observe mechanisms of damage initiation and progression in medial layers of porcine aortic samples. The technique requires the use of sodium polytungstate as a contrast agent, of which the conditions for use are detailed in this paper. Immersion of the samples during 24 hours in a 15 $g.L^{-1}$ concentrated solution provided the best compromise for viewing musculo-elastic units in this tissue. The process of damage initiation, delamination and rupture of medial tissue under tensile loading was observed and can be described as an elementary process repeating several times until complete failure. This elementary process initiates with a sudden mode I fracture of a group of musculo-elastic units, followed by an elastic recoil of these units, causing mode II separation of these, hence a delamination plane. The presented experimental approach constitutes a basis for observation of other constituents, or for investigations on other tissues and damage mechanisms.

Keywords: Aorta ; dissection ; rupture mechanism ; X-ray tomography ; *in situ* tensile test

1. Introduction

Detailed characterization of damage and rupture properties of arteries is one the current challenges in vascular biomechanics. Several approaches to characterize rupture and/or dissection properties of vascular tissues have been addressed (see, for instance, the review (Tong et al., 2016) and references