Rupture limit evaluation of human cerebral aneurysms wall: experimental study

H. Brunel, D. Ambard, H. Dufour, P.H. Roche, V. Costalat, F. Jourdan

PII: S0021-9290(18)30447-0
DOI: https://doi.org/10.1016/j.jbiomech.2018.06.016
Reference: BM 8754

To appear in: *Journal of Biomechanics*

Accepted Date: 19 June 2018

Please cite this article as: H. Brunel, D. Ambard, H. Dufour, P.H. Roche, V. Costalat, F. Jourdan, Rupture limit evaluation of human cerebral aneurysms wall: experimental study, *Journal of Biomechanics* (2018), doi: https://doi.org/10.1016/j.jbiomech.2018.06.016

Rupture limit evaluation of human cerebral aneurysms wall: experimental study

H. Brunel[a,b], D. Ambard[a], H. Dufour [b], P.H. Roche [b], V. Costalat [c], and F. Jourdan[a]*

[a] *LMGC, Univ. Montpellier, CNRS, France;* [b]*CHU-AMU Marseille, France;* [c]*CHU Montpellier, France*

Abstract

Background and purpose

Rupture risk of intracranial aneurysms is a major issue for public healthcare. A way to obtain an individual rupture risk assessment is a main objective of many research teams in the world. For many years, we have investigated the relationship between the mechanical properties of aneurysm wall tissues and the rupture risk. In this work, we try to go further and investigate rupture limit values.

Methods

Following surgical clipping, a specific conservation protocol was applied to aneurysmal tissues in order to preserve their mechanical properties. Thirty-nine intracranial aneurysms (27 females, 12 males) were tested using a uniaxial tensile test machine under physiological conditions, temperature, and saline isotonic solution. These represented 24 unruptured and 15 ruptured aneurysms. Stress/strain curves were then obtained for each sample, and a fitting algorithm was applied following a Yeoh hyperelastic model with 2 parameters. Moreover, uniaxial tensile tests were conducted until rupture of samples to obtain values of stress and strain rupture limit.

Results

The significant parameter a C_2 of the hyperelastic Yeoh model, allowed us to classify samples' rigidity following the terminology we adopted in previous papers (Costalat 2011, Sanchez 2013): Soft, Stiff and Intermediate. Moreover, strain/stress rupture limit values were gathered and analyzed thanks to the tissue rigidity, the status of the aneurysm (initially ruptured or unruptured) and the gender of the patient.