

# Author's Accepted Manuscript

A study of wall shear stress in 12 aneurysms with respect to different viscosity models and flow conditions

Øyvind Evju, Kristian Valen-Sendstad, Kent-Andre Mardal



PII: S0021-9290(13)00413-2  
DOI: <http://dx.doi.org/10.1016/j.jbiomech.2013.09.004>  
Reference: BM6280

To appear in: *Journal of Biomechanics*

Accepted date: 1 September 2013

Cite this article as: Øyvind Evju, Kristian Valen-Sendstad, Kent-Andre Mardal, A study of wall shear stress in 12 aneurysms with respect to different viscosity models and flow conditions, *Journal of Biomechanics*, <http://dx.doi.org/10.1016/j.jbiomech.2013.09.004>

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.

1 A study of wall shear stress in 12 aneurysms with respect to different  
2 viscosity models and flow conditions<sup>☆</sup>

3 Øyvind Evju<sup>a</sup>, Kristian Valen-Sendstad<sup>a,b</sup>, Kent-Andre Mardal<sup>a,\*</sup>

4 <sup>a</sup>Center for Biomedical Computing, Simula Research Laboratory, Martin Linges vei 17, Fornebu, Norway

5 <sup>b</sup>Biomedical Simulation Laboratory, Department of Mechanical & Industrial Engineering; and Institute of Biomaterials and  
6 Biomedical Engineering, University of Toronto, 5 Kings College Road, Toronto, ON, Canada

---

7 **Abstract**

8 Recent computational fluid dynamics (CFD) studies relate abnormal blood flow to rupture of cerebral  
9 aneurysms. However, it is still debated how to model blood flow with sufficient accuracy. Common as-  
10 sumptions made include Newtonian behavior of blood, traction free outlet boundary conditions and inlet  
11 boundary conditions based on available literature. These assumptions are often required since the available  
12 patient specific data is usually restricted to the geometry of the aneurysm and the surrounding vasculature.  
13 However, the consequences of these assumptions have so far been inadequately addressed.

14 This study investigates the effects of 4 different viscosity models, 2 different inflow conditions and 2  
15 different outflow conditions in 12 middle cerebral artery aneurysms. The differences are quantified in terms  
16 of 3 different wall shear stress (WSS) metrics, involving maximal WSS, average WSS, and proportion of  
17 aneurysm sac area with low WSS. The results were compared with common geometrical metrics such as  
18 volume, aspect ratio, size ratio and parent vessel diameter and classifications in terms of sex and aneurysm  
19 type.

20 The results demonstrate strong correlations between the different viscosity models and boundary condi-  
21 tions. The correlation between the different WSS metrics range from weak to medium. No strong correlations  
22 were found between the different WSS metrics and the geometrical metrics or classifications.

23 *Keywords:* Cerebral aneurysms, computational fluid dynamics, wall shear stress, non-Newtonian fluid,  
24 boundary conditions.

---

<sup>☆</sup>Word count: 2765 (Introduction through Conclusion)

\*Corresponding author at: Center for Biomedical Computing, Simula Research Laboratory, P. O. Box 134, N-1325 Lysaker, Norway

*Email address:* kent-and@simula.no (Kent-Andre Mardal)

Download English Version:

<https://daneshyari.com/en/article/10431694>

Download Persian Version:

<https://daneshyari.com/article/10431694>

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