# HEMODYNAMIC LONGITUDINAL ANALYSIS OF THE EFFICACY OF THE CONTOUR NEUROVASCULAR SYSTEM BASED ON IN VIVO DATA

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## Introduction

Intracranial aneurysms (IAs) are dilatations of the neurovascular system which occur in 3% of the western population [1]. IAs carry the risk of rupture, which can lead to fatal consequences like stroke. Different shapes of IAs exist, which can be differently treated to prevent IA rupture. For example, side wall aneurysms can be treated with flow diverting stents [2]. Wide necked bifurcation aneurysms (WNBA) can be treated with the novel Contour Neurovascular System (Contour) [3]. In this study, the effect of the Contour is analyzed numerically using computational fluid dynamics (CFD). CFD simulations are based on patient specific in vivo data of WBNAs and the placed Contour. Post treatment data exists in different temporal ranges after placement, which allows for the longitudinal analysis of the effectiveness.

## Methods

Thirteen WBNA cases, all treated with a Contour, were considered in this study. In vivo data was captured with digital subtraction angiography and computed tomography in varying quantity and temporal ranges (ranging from 1 month to 3 years and 2 to 5 post-images per case) after placement for each case. Medical images were segmented and prepared for simulations, respectively. The exact shape and placement of the Contour could be captured, nevertheless artifacts led to non-usable data. Thus, original Contour computer-aided design files were placed and shaped as seen in the in vivo data [3]. Moreover, due to low flow of contrast agent into the IA head, post-treatment data did not reveal the IA head shape. The pre-treatment IA head was hence stitched onto the post treatment vessel. For each case, pre- and post-treatment CFD simulations were performed using the solver Star CCM+ with laminar flow conditions. Blood was modeled with the Carreau-Yasuda Model and a constant density of 1055kg/m³. Morphological changes of the IA ostium were analyzed in an associated study and compared with the hemodynamic effects of the Contour onto intra-aneurysmal flow.

## Results

Hemodynamic flow parameters like velocity and kinetic energy show reduction after placement of the Contour, when compared to the pre-treatment state for each case. Additionally, wall shear stress and oscillatory shear index were reduced after treatment. Looking at the longitudinal change, parameters stay low over time.

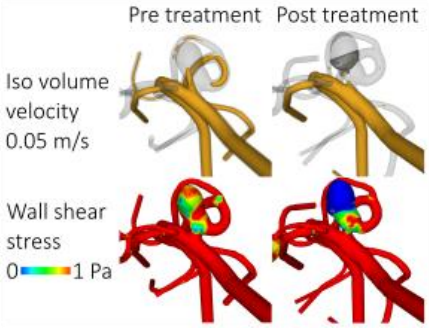


*Figure 1: Exemplarily visualization of the velocity iso volume and wall shear stress pre- and post-treatment for one case.*

## Discussion

The reduction of hemodynamic parameters shows the efficacy of the Contour in long term and based on in vivo data. Hemodynamic reduction was up to now only demonstrated in vitro [3, 4]. Compared to other devices like flow diverting stents, the Contour gives the advantage of not occluding small vessels close to the IA [2]. The longitudinal analysis is important to analyze the long-term effect, which was not evaluated in recent research yet due to the novelty of the device. Morphological and hemodynamic results show that there is no reverse effect of the Contour in the long term and that its efficacy can be demonstrated. Limitation of this study are the non-visible and thus stitched IA head of the post-treatment data as well as the manual adjustment of the Contour placement, which can lead to differences from the real placement.

## References

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## Acknowledgements

This work was supported by the German Research Foundation within the SPP 2311 (grant no. 465189657) and the German Federal Ministry of Education and Research within the Research Campus STIMULATE (grant no. 13GW0473A).