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Electronic poster abstracts

E-061 Towards the Pre-Surgical Treatment Planning of Cerebral Aneurysms Using High Fidelity Simulations

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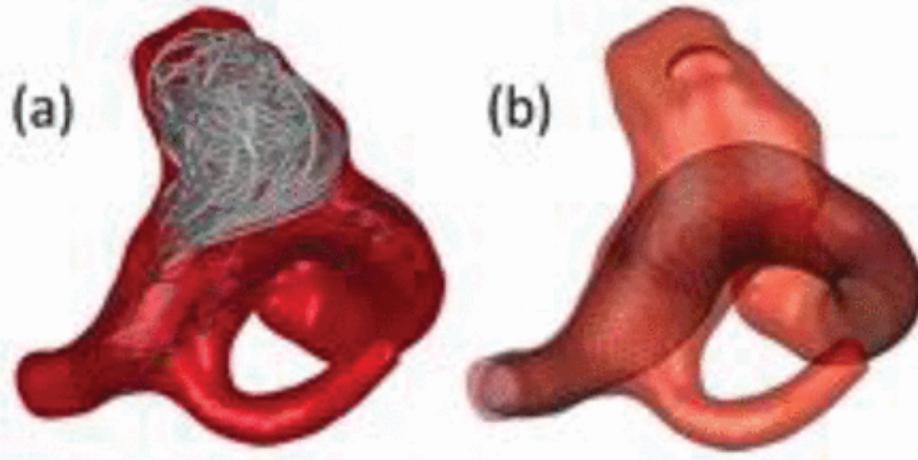
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Abstract

Over the last decade, advances in medical imaging have led to a 75% increase in early diagnosis of cerebral aneurysms (CAs) along with a growing arsenal of medical devices that can now treat a wider range of CA cases. Endovascular treatment planning has shown limited progress. Current treatment planning is driven by prior training, convention and experience. Despite the best of plans, the process can involve an element of trial and error during treatment that increases procedural time, treatment costs, and the risk of procedural complications. Further, treatment planning can be unsuccessful in many cases with recurrence rates as high as 21.9% and retreatment rates of 11.0%. Therefore, there is a critical need to improve endovascular treatment planning.

Here we present a novel simulation algorithm that enhances clinical capabilities for personalised pre-surgical treatment planning. In the first step of the algorithm, a computational anatomy is generated from MR or CT image data. Next, the computational anatomy is used to simulate treatment using novel device-specific finite element (FE) models that consider the structural properties of the treatment device, its mechanics, and the clinical deployment strategy. Changes in blood flow are then simulated using computational fluid dynamics (CFD). Lastly, mechanical and fluid dynamic simulation results are used to evaluate the outcomes of different treatment options. The simulation algorithm was validated against in-vitro deployments of embolic coils, stents, and the Pipeline embolization device in 3 idealised and 2 anatomical CA models. Results showed excellent agreement between FE device simulations and physical device deployments. Fluid dynamics were also compared between CFD simulations and in-vitro flow velocity and pressure measurements in the treated CA models. Results showed good agreement in mean aneurysmal velocity magnitude and intra-aneurysmal pressure. Detailed 3D structural validations against microCT data will also be presented. The value of the simulation algorithm for treatment planning is demonstrated for 3 patient cases. In case 1, stent-assisted coiling ([Figure 1a](#)) and flow diverter treatment options ([Figure 1b](#)) are evaluated for a wide-neck posterior communicating artery (PCA) aneurysm ([Figure 1](#)). In case 2, the simulation algorithm is used to predict changes in fluid dynamics after 12 coil deployments in a large basilar-tip aneurysm. Clinical and simulations results of that case showed a persisting flow jet into the aneurysmal sac after treatment. In case 3, the simulation algorithm is used to compare stent-assisted coiling and coiling-alone in a basilar tip aneurysm.



Abstract E-061 Figure 1

Disclosures B. Chong: 1; C; Mayo Clinic Center for Individualised Medicine, Arizona State University. 4; C; Endovantage LLC. H. Babiker: 4; C; Endovantage LLC. D. Frakes: 4; C; Endovantage, LLC. J. Ryan: 5; C; Endovantage LLC. F. Gonzalez: 4; C; Endovantage LLC.