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NUMERICAL SIMULATION OF SELF-EXPANDABLE FLOW DIVERTER STENT IMPLANTATION IN THE BASILAR ARTERY

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The modelling of self-expandable stents is challenging in numerical analyses. Standard coronary stents, due to their relatively small number of struts with a relatively significant cross-sectional area, have a limited level of complexity for modelling. On the other hand, flow diverter stents, which are implanted into cerebral vessels to reduce the risk of rupture of cerebral aneurysms, are much more difficult to represent in modelling. The large number of very thin wires that interact with each other and are subjected to significant displacements (translational and rotational) severely complicates numerical studies, especially in quasi-static analysis. In the present study, the authors focused on reproducing the expansion process of a stent with a nominal length of 18 mm in a 3.5 mm diameter basilar artery (BA). The geometry of the artery was created using highly accurate computed microtomography. The stent model was reproduced using beam elements, but the thickness of the beams was taken into account in the contact analysis with the vessel walls. The interaction between the struts was reproduced by locally directed kinematic constraints, allowing the struts to rotate relative to each other. The result is a method that has good numerical performance, achieves a satisfactory level of adjacency of the stent struts to the vessel and provides a final expansion state for further flow analyses. Furthermore, the results obtained for stent implantation, allow an accurate estimation of the level of occlusion of the perforator branches from the BA and further analysis of the risk of blood flow blockage.

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