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Stent-assisted coiling of intracranial aneurysms: Separating thehemodynamic impact of vessel deformation, coils, and stent using CFD

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The treatment of intracranial aneurysms based on stent-assisted coiling can lead to local vascular deformations. It is not clear how this affects the local hemodynamics and thus the success of the treatment procedure. Pre- and post-interventional image data of three aneurysms in combination with Computational Fluid Dynamics are used in order to investigate the intra-aneurysmal hemodynamics after vascular deformation. In addition, the effect of coiling (porous media) and stenting (explicitly resolved) is simulated. Finally, the separated and combined effect of deformation, coils, and stent is quantified based on flow and shear parameters. The effect of coiling clearly has the highest potential of reducing the intra-aneurysmal flow as well as shear parameters. However, this strongly depends on the actual packing density of the coils. Vascular deformations on the other hand, have the ability to redirect the aneurysm inflow jet and thus cause moderate hemodynamic changes, which can increase or decrease the ostium inflow rate. Stents alone have a rather small effect on the local hemodynamics. Therefore, the consideration of stent-induced vessel deformations might be an important aspect in order to better understand certain treatment mechanisms and improve the clinical outcome for patients with aneurysms at locations that are prone to vascular deformations.