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Stent-induced straightening of intracranial arteries reduces the shear stress at the aneurysm region of the reconstructed parent artery.

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Background and purpose: For wide-necked intracranial aneurysms, stent-assisted coil embolization can be performed to prevent the coils from migrating into the parent vessel. As an additional effect, stents can reduce the curvature of parent arteries. This straightening effect might change the hemodynamic environment and therefore change the risk of recanalization.

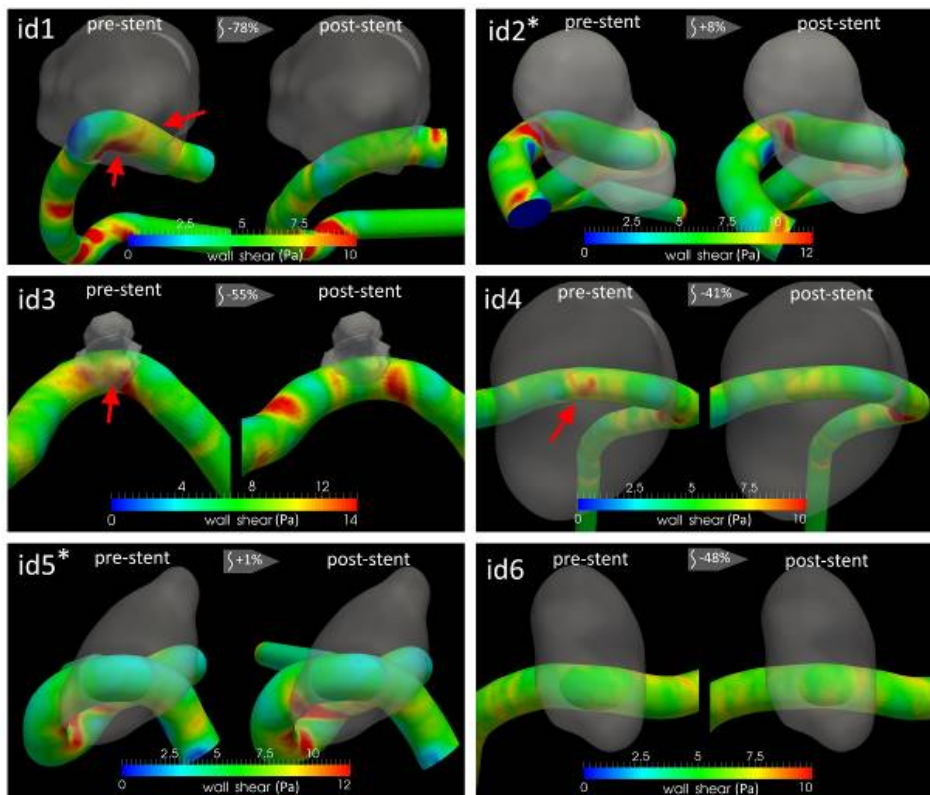
Methods: In this retrospective study, pre- and post-treatment 3DRA (n=11) and MRA (n=1) imaging was selected for 6 patients with 6 aneurysms. The aneurysms and parent arteries were segmented using VMTK by combining level set segmentation and vesselness filtering. Parent vessels were reconstructed with equal diameters for pre- and post-treatment models. Centerlines were calculated and were used to calculate the tortuosity. Hemodynamics were simulated using computational fluid dynamics. WSS magnitudes were assessed for the aneurysm region of the reconstructed parent artery.

Results: Figure 1 shows the WSS distributions of all 6 cases before and after stent-treatment. Stenting reduced the tortuosity with more than 50% for stents positioned completely in the intradural space (4/6). The maximum wall shear stress magnitudes decreased after this straightening effect. For stents located partially in the extradural space (2/6), no substantial changes were observed.

Conclusion: Stents can reduce the curvature and change the hemodynamics along the vessel wall. This is especially the case for stents located entirely in the intradural space. More data will be analyzed to see if this relates with future recanalization.

Figure 1: WSS distributions for 6 reconstructed parent arteries, both before and after stent-treatment. Aneurysm segmentations are shown as grey transparent overlays. Stents in cases 2 and 5 were located partially in the extradural space and did not result in clear changes in WSS distribution and tortuosity. Cases 1,3,4, and 6 showed an overall decrease in tortuosity of more than 50%, accompanied with reductions in maximum WSS values at the aneurysm region of the reconstructed parent arteries (red arrows).

Figure 1:



* Stent located partially in the extradural space } Tortuosity change