

Independent Evaluation of an FDA Approved Computational Simulation System for Deployment of Flow Diverters in Intracranial Aneurysm Treatment

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Introduction

The braided design of flow diverters (FD) can sometimes result in challenges with their deployment for the treatment of intracranial aneurysms (IAs), particularly when there is vast discrepancy in parent vessel diameters at the proximal and distal landing zones and when there is significant vascular tortuosity.

Appropriate selection of device sizes and landing zones is extremely important for success with FD in such cases. We present preliminary results from our independent evaluation of a computational simulation (CS) system, which models the deployment of FDs in a small series of IAs.

Materials and Methods

CS of FD deployment was performed in a series of 4 IAs (3 in the anterior circulation and one in the posterior circulation) using commercially available SurgicalPreview® (EndoVantage, USA) software.

A library of virtual flow diverting stent models, which have been validated against physical devices, was then used to simulate deployment of the same devices into the vessels.

CS was performed retrospectively in 2 of the IAs, and prospectively before FD placement in 2 others. For CS, pre-procedure CTA mages were segmented and then reconstructed to form computational models of the anatomy.

The results from CS were compared with the clinical results from FD deployment for each of the IAs.

Results

All IAs were treated using Pipeline Flex (Medtronic, USA) as the FD. There was good qualitative agreement between CS results and the actual clinical deployment in terms of final length and configuration of the FD as well as IA neck coverage.

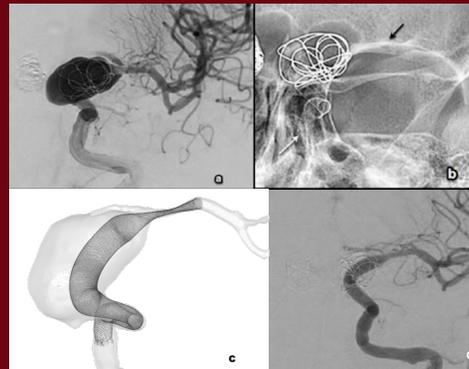


Figure 1. (a) Showing a giant IA arising from the left ICA, (b) showing placement of a single 4.75 X 35 mm FD across the neck of the aneurysm, with distal landing zone (black arrow) in the MCA and proximal landing zone (white arrow) in the ICA below the IA neck, (c) showing the results from CS of a 4.75 x 35 mm FD deployment for this aneurysm. Note the excellent concordance of the landing zones and device configuration between the clinical result and CS, (d) follow-up angiography showing almost complete resolution of the giant IA.



Figure 2. (a) Showing left vertebral artery IA with left PICA incorporated into the aneurysm sac, (b) a single 4.0 X 35 mm FD was placed across the neck of the aneurysm, (c) post-deployment run shows good landing and wall apposition of the stent. (d) there was excellent concordance between the simulated and the actual clinical deployment of the FD.

Conclusion

Our initial experience suggests that CS of FD deployment has the potential to accurately predict the actual behavior of FDs during the treatment of IAs and can serve as a useful adjunct tool for appropriate device and landing zone selection in the treatment of complex IAs.

References

1. Egger J et al, Modeling and visualization techniques for virtual stenting of aneurysms and stenoses Computerized Medical Imaging and Graphics 2012,36(3):183-203