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Stent Deployment Protocol for Optimized Real-Time Visualization During Endovascular Neurosurgery

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Introduction

Successful application of endovascular neurosurgery depends on high quality imaging to define the pathology and devices as they are being deployed. As endovascular approaches are applied to more diverse pathologies, they have increasingly relied on nuanced devices that require precise sizing, positioning, and wall apposition to function optimally. These approaches can be limited by suboptimal visualization during device deployment, especially in proximity to the skull base or in patients who have undergone prior endovascular treatment. We sought to optimize real-time image guidance using a simple algorithm that can be applied to any existing fluoroscopy system. We worked with Siemens to develop the Stent Deployment protocol designed to improve visualization during complex endovascular device deployment. Our experience in several cases demonstrates the utility of the protocol for improving device deployment.

Methods

Exposure management and image post processing parameters were modified compared to traditional fluoroscopy to improve visualization of device position and material density during deployment. We used this optimized protocol during critical stages of aneurysm coiling, carotid stenting, Woven EndoBridge (WEB) device deployment, and flow diverter device deployment, in addition to traditional fluoroscopy. Demonstrative examples of the application of the Stent Deployment protocol were

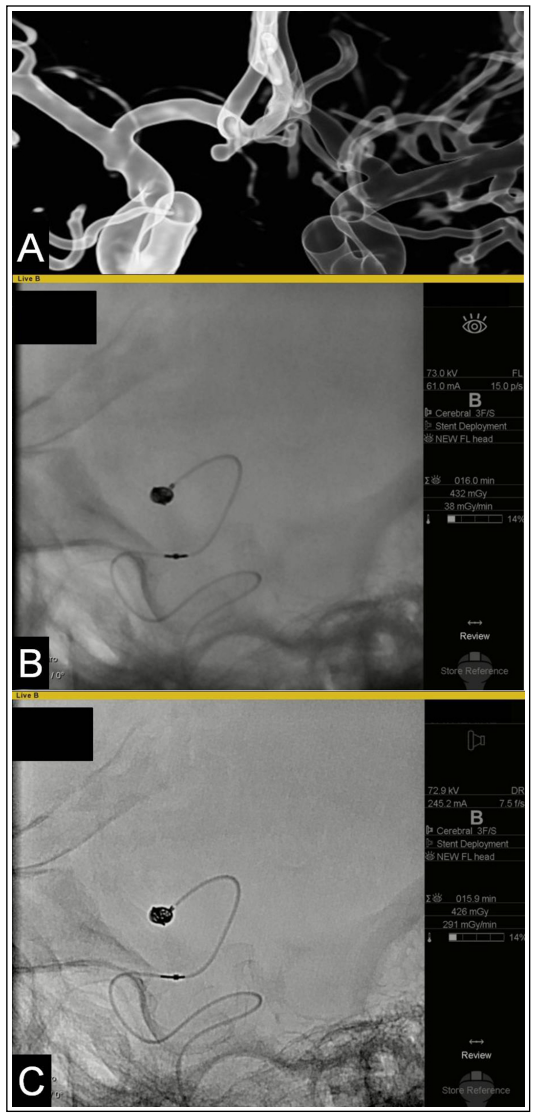

Figure 1. A) Fused 3D reconstruction of right and left internal carotid artery rotational angiograms demonstrating the anterior communicating artery aneurysm projecting inferolaterally. B) Standard fluoroscopic visualization of the coil mass. C) Stent Deployment visualization of the coil mass demonstrating the improved assessment of packing density.

Results

The Stent Deployment protocol improved real-time visualization of device position and deployment characteristics during key steps of endovascular procedures compared to traditional fluoroscopy. It was particularly useful for applications near the skull base or with overlying devices obscuring the field of view. This protocol aided assessment of coil packing density during aneurysm coiling (Figure 1). It also optimized deployment and positioning of carotid stents and the intrasaccular WEB device. Additionally, the Stent Deployment protocol improved appreciation of pipeline stent kinking and twisting that can result in poor wall apposition (Figure 2). Stent Deployment is of greatest utility for visualizing flow diverters and coiling of small aneurysms, especially when the field of view in obscured.

Conclusions

The Stent Deployment protocol is a simple image capture and post-processing algorithm that can be applied to existing fluoroscopy systems to improve real-time visualization of device deployment without hardware modifications. Improved image guidance facilitates aneurysm coil packing and proper deployment of carotid stents, flow diverters, and the WEB device.

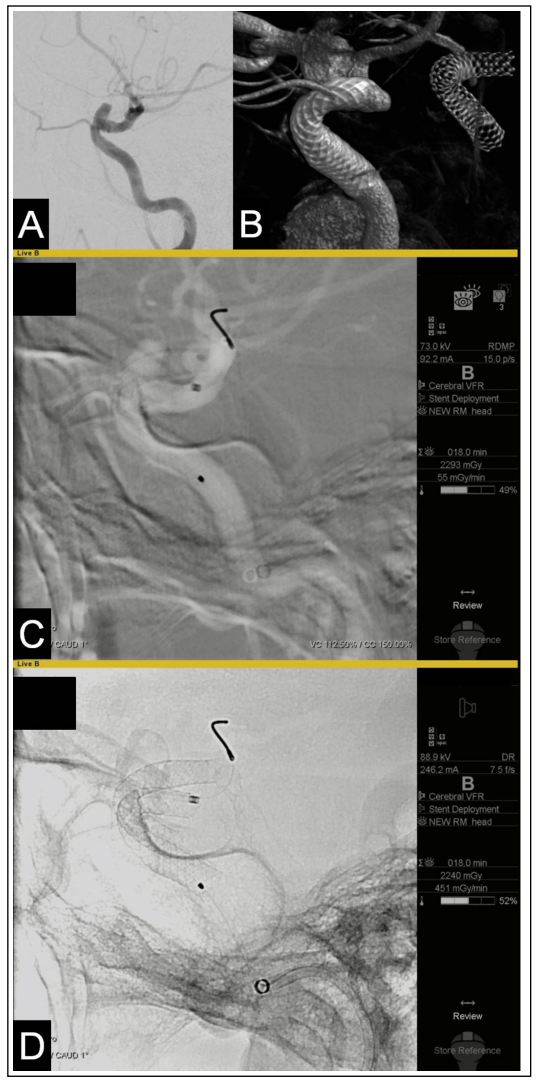

Figure 2. A) Lateral right common carotid artery angiogram demonstrating the right ophthalmic artery aneurysm. B) 3D reconstruction of right ICA angiogram demonstrating bilateral pipeline stents. C) Standard fluoroscopic visualization of the deployed right ICA pipeline. D) Stent Deployment visualization of the deployed right ICA stent demonstrating improved visualization of the stent.