**Supplementary Data 1**

***BananaVisionTM***

BananaVisionTM is a networked, multiuser virtual reality (VR) software modeling program that is used to manipulate and visualize three-dimensional (3D) medical imaging. The use of high powered graphics processing units converts the two-dimensional stacks of images into 3D volumes in 1–2 minutes, thus ensuring fast processing time. This fast processing time contrasts the increased time needed to construct segmented data that are widely used in VR applications, making the conversion process faster and more accurate.

***Image processing***

Since 3D-computed tomography (CT) angiography (CTA) is commonly used for planning before cerebrovascular surgery, original CTA images of patients were imported and displayed in VR system. CTA images were acquired using a 320-row CT scanner with a 0.5-mm slice thickness (both arterial and venous phases).

In accordance with the Digital Imaging and Communications in Medicine standard for medical imaging data, data were formatted as 512 × 512 pixel uncompressed single-plane images, which were transferred to the planning station. Using the third party program ImageJ, the arterial and venous phases of CT images were merged and converted into the 24-bit (8-bit × 3-channel) *Raw files* format for import into BananaVisionTM.

The personal computer (PC) we used at the VR surgical planning station had an Intel Core i7-8700 processor with 32 GB of main memory, equipped with an NVIDIA GeForce RTX 2070 graphic card. The operating system was Windows 10 Pro. The HMD used was a Samsung Odyssey and Windows Mixed Reality headset.

The PC required for the use of BananaVisionTM were as follows. Processor: Intel Core i5 4590 (4th generation), quad-core (or better), AMD Ryzen 5 1400 3.4 Ghz (desktop), quad-core (or better), RAM: 8 GB DDR3 (or better), Free disk space: 10 GB minimum + additional space for data set files, Graphics Card: NVIDIA GTX 1060 (or greater) DX12-capable discrete GPU, AMD RX 470/570 (or greater) DX12-capable discrete GPU, and Operating System: Windows 10 Fall Creators Update (RS3) or greater.