

## Supplemental Materials

### Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) was performed using a 3.0 Tesla scanner (Signa HDxt, GE Healthcare, Milwaukee, Wisconsin, USA). For the MRI sequence, a 1-mm thick axial section was achieved using the fast spoiled gradient recalled echo inversion recovery sequence with the following parameters: TR, 1000 ms; TE, 5 ms; TI, 400 ms; flip angle, 20°; interslice space, 0 mm; field of view, 24×24 cm<sup>2</sup>; and acquisition matrix, 256×256. All patients underwent three-dimensional T1-weighted MRI with inversion preparation.

### Digital Subtraction Angiography (DSA)

A right femoral artery puncture with a 5-French sheath was performed under local anesthesia. All patients were pretreated with a loading dose of 1/3 mg heparin/kg. The DSA mode of the angiography machine (Innova IGS 630, GE Healthcare, Milwaukee, WI, USA) was used on both sides of the internal carotid artery, external carotid artery, and vertebral artery with frontal and lateral images obtained simultaneously using a biplane system to evaluate the angioarchitecture. Subtraction and auto-injection of contrast medium were performed before the three-dimensional computed tomography (3D CT) scans. Subsequently, 3D CT was performed with a small focal point of 0.6 mm and a 1536×1536-pixel matrix at 16 degrees/second (12.5 seconds in total) on a single-plane system. All data, including vessels and bones from the 3D CT, were automatically transferred to a workstation (Advantage Workstation 4.6, GE Healthcare, Milwaukee, WI, USA) and were reconstructed using Innova 3DXR software. The distribution of the feeding and recipient arteries was determined for further processing.

### Arterial Spin Labelling (ASL)

All images were acquired on a simultaneous time-of-flight enabled 3.0 Tesla MRI scanner (Signa HDxt, GE Healthcare, Milwaukee, Wisconsin, USA). In addition to routine imaging sequences, three-dimensional, pulsed, continuous ASL images were acquired with stack-of-spirals readout trajectory and a similar scan time of five minutes using the following parameters: TR, 4521ms; TE, 9.8ms; field of view, 24×24 cm<sup>2</sup>; 512 sampling points on eight spirals (matrix size 512×8); slice thickness, 4 mm; number of slices, 30; number of excitations, 3; and band width, 62.50 Hz. Two post-labeling delays (PLDs) of 1,525 ms and 2,525 ms were used. These delays were termed short ASL (sASL) and delayed ASL (dASL), respectively. The quantitative ASL-CBF map was generated using a workstation (Advantage Workstation 4.6, GE Healthcare, Milwaukee, WI, USA) with Functool software attached to the scanner. The acquisition times

were 4 min 22 s for sASL and 5 min 3 s for dASL. The total acquisition time of each MRI scan was within 30 min. Perfusion values were calculated for each brain region. Abnormal areas with hemodynamic defects were defined as those with decreased uptake below two standard deviations of the normal mean.

### **Positron Emission Tomography (PET)**

All patients underwent  $^{18}\text{F}$ -FDG PET scanning using a PET system (Biograph Truepoint HD 64 PET/CT; Siemens, Erlangen, Germany), as previously described.<sup>18</sup>  $^{18}\text{F}$ -FDG was synthesized according to the protocol provided by the manufacturer and was inspected by the State Food and Drug Administration. All patients were asked to fast for at least six hours to maintain the blood glucose level between 3.9–6.1 mmol/L prior to the FDG-PET scans. The patients received an intravenous injection of  $^{18}\text{F}$ -FDG (mean dose: 5.55 MBq/kg [0.15 mCi/kg]) and then rested quietly in a dim room for 50 minutes. Subsequently, a 10-min PET scan was conducted using low-dose CT scanning. After acquisition, PET images were reconstructed using a filtered back-projection algorithm with corrections for decay, normalization, dead time, photon attenuation, scatter, and random coincidences. The reconstructed PET image matrix size was  $168 \times 168 \times 148$ , with a voxel size of  $2.04 \times 2.04 \times 1.5 \text{ mm}^3$ .

### **Indocyanine Green Video angiography (ICG-FLOW 800)**

ICG-FLOW 800 was performed after a craniotomy to identify alternative recipient arteries within the previously-determined surgical field. ICG was performed at  $3\times$  magnification using a microscope (Zeiss Meditec, Oberkochen, Germany) to ensure that the surgical area was covered. Color mapping was available with the application of FLOW 800 to evaluate the perfusion status for the anastomosis. As the regions of interest (ROIs) were set at the artery branches in these areas, several parameters, such as the maximum fluorescence intensity (average intensity, also represented as CBV), time to maximum intensity (delay time, also represented as TTP), and slope of the intensity curve at a specific time point (slope, also represented as CBF), could be calculated and compared to confirm the hemodynamic characteristics of each recipient artery for intraoperative decision-making. The STA graft was anastomosed to the MCA (M4 segment) in an end-to-side manner. Postoperative ICG-FLOW 800 was performed to confirm the patency of the bypass vessels and to compare the blood flow changes in the surgical area.

### **Electrocorticography (ECoG)**

All patients were anesthetized via inhalation anesthesia with an end-tidal sevoflurane volume maintained at 2% during the ECoG recording. The ECoG data were recorded using BrainAmp

MR PLUS (Brainproduct, Gilching, Germany) with a preamplifier bandwidth of 0.5–250 Hz at a sampling rate of 500 Hz. Two 1×6 subdural electrode grids were placed parallel to the middle frontal gyrus and superior temporal gyrus around the recipient arteries. Their placement was confirmed intraoperatively using a navigation system (Brainlab AG, Munich, Germany). Reference and earth electrodes were placed on the scalp. The ECoG data were recorded continuously until the closure of the dura.