Motor Strip Sparing Partial Hemispherotomy

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Clinical Presentation

The patient is a 17-year-old female with a history of medical refractory epilepsy with increased generalized tonic/clonic seizure frequency and severity over the past several years, now occurring at a rate of 4-6 seizures/day with frequent violent falls causing injuries. Her early childhood history is unknown secondary to being adopted from an orphanage with little medical attention. Her imaging is consistent with early perinatal stroke on the right side. She was independently ambulatory but had no functional use of the left upper extremity. Her seizures all originating from the right hemisphere.

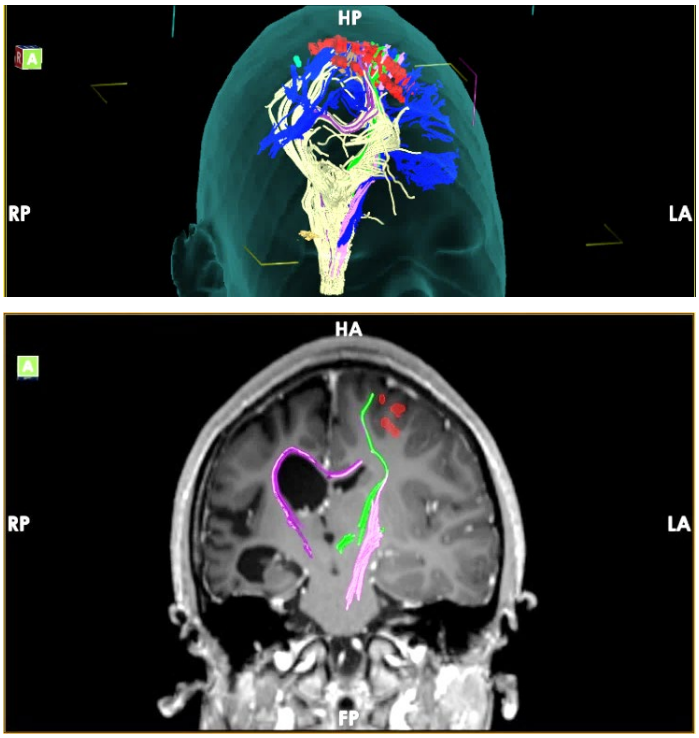

Figure 1. Pre-operative MRI with Synaptive Tractography demonstrating important motor fibers, specifically contralateral motor pathways controlling leg function (purple).

Surgical Plan and Approach

Preoperative surgical planning involved MRI, Tractography using Synaptive's Modus Plan™, Transcranial Magnetic Stimulation, Scalp/Video EEG and Neuropsychological testing. Given the findings of potentially functional right-sided motor fibers being rerouted to the normal left-sided brain, intraoperative motor-mapping and direct cortical stimulation was planned with the intention of leaving left leg motor fibers preserved.

Figure 2. Decoupled positioning of Modus V from the surgeons allows for optimal surgical access and views in otherwise challenging areas.

Synaptive navigation was used to map out the surgical corridors for the 4-step right-sided peri-insular functional hemispherotomy: (1) mesial temporal disconnection and resection including amygdalohippocampectomy, (2) transventricular corpus callosotomy, (3) insular disconnection, and (4) lateral (frontal-basal) disconnection.

Prior to initiation of these surgical steps motor mapping/direct cortical stimulation determined the extent of transection of the right-sided anatomical motor strip fibers. Intraoperative motor mapping and direct cortical stimulation demonstrated undeniable functional motor fibers originating in the anatomical

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right motor cortex. Therefore, a motor strip-sparring partial functional hemispherotomy was performed using Synaptive's Robotic Exoscope, Modus V™ and tract-based navigation for deep internal capsule fiber-sparring disconnection.

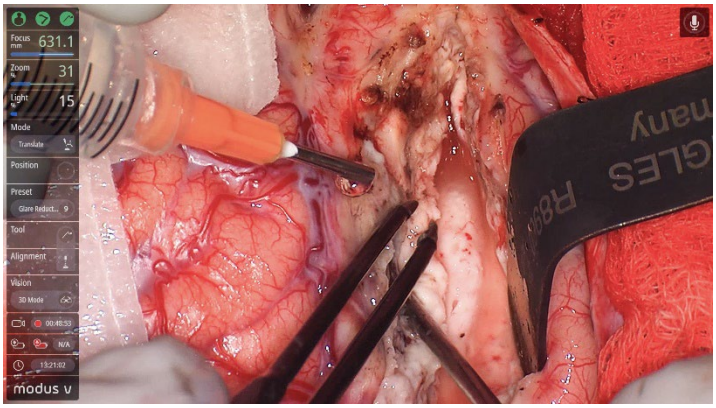

Figure 3. Surgical image from Modus V displaying the precision and clarity during micro-surgical dissection with extensive depth of focus.

Clinical Outcome

The patient awoke with contralateral motor function preserved in the lower extremity and was discharged after an uneventful post-operative course on day three. Her pre-operative seizures immediately stopped while recovering in the hospital. Three focal hand tremor-seizures were noted without any generalized tonic/clonic seizures noted at her most recent post-operative follow up (8 weeks). Her family noted that they had never seen her seizure free for this long since adoption as a young child. Her speech was noted to be clearer, her attention span better, and paretic side motor function had improved.

Figure 4. Operative set up illustrating positioning of Modus V components at an appropriate stand-off distance to enable unobscured line of sight while providing optimal optics.

Highlights

- The ergonomic advantages provided by Modus V minimize surgical team fatigue during long and delicate cases.
- With superb clarity and illumination, Modus V provides optimal visualization during intricate tissue handling.
- The severely acute microsurgical angles accomplished to spare the motor cortex made the robotic exoscope invaluable to the success of this operation.
- Having extensive white matter fiber tract-based navigation allowed for extensive disconnection while sparing the known posterior limb of the internal capsule which carried the right sided-motor fibers.
- Dramatic seizure control was achieved while sparing contralateral lower extremity motor function, allowing significant functional improvement post-operatively.

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