Robotic Placement of Intracranial Depth Electrodes for Long-Term Monitoring: Utility and Efficacy

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Introduction: To investigate the utility and efficacy of robotic stereotactic assistance in the placement of intracranial depth electrodes for invasive monitoring in patients with intractable focal epilepsy.

Methods: From November 2010 to January 2012, 33 patients underwent robotic assisted stereotactic placement of depth electrodes for long term monitoring. All patients were considered to have medically refractory focal epilepsy. ROSA device (Medtech, Montpellier, France) was used for planning and implantation guidance in all procedures. Implantation time, efficacy in mapping the epileptogenic zone, and complications were analyzed.

Results: Mean age was 30 years-old (4 to 59 years). Mean duration of the epilepsy syndrome was 13.8 years (0.83 to 52 years). 438 electrodes were implanted. Proprietary ROSA software facilitated an efficient trajectory planning stage. 19 patients underwent unilateral implantation. 14 patients underwent bilateral implantation. The mean OR time during implantation was approximately 2 hours. The robotic implantation was successful in localizing the electrophysiological epileptogenic zone in 31 patients (94%). Asymptomatic subdural hemorrhage occurred in 2 patients. A small intracranial contusion resulting in temporary leg weakness occurred in 1 patient. The complication rate per electrode was 0.68%.

Discussion: Planning times were reduced by the robot’s adaptability to the use of multiple variably angled trajectories. Implantation efficiency increased with the automated movement of the robotic arm platform to the appropriate working position in stereotactic space. Utility was increased by facilitating placement of electrodes in patients thought to require more complex electrode schema, while reducing overall planning and operative time. A randomized trial comparing standard methods of implantation versus robotic implantation is necessary to confirm these conclusions.

Conclusions: Robot assisted placement of intracranial depth electrodes streamlines the electrode implantation process, without sacrificing safety, in patients with intractable focal epilepsy.