

“Stereo-EEG in children with therapy-refractory epilepsies: Robot-assistance plus stereotaxy combines speed with maximal precision for the implantation of multiple depth electrodes”

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Aims: “Stereo-EEG” is an invasive diagnostic procedure for the presurgical evaluation of therapy-refractory epilepsies, during which depth electrodes are implanted stereotactically into the brain parenchyma via multiple burr holes. A comprehensive evaluation often requires up to 20 depth electrodes in multiple brain areas, which can lead to long operations (20 to 30 minute per electrode) when conventional stereotaxy is used. Special assisting robots can make these implantations much faster (< 10 minute per electrode) by automatically defining the preplanned implantation trajectories for the surgeon. Without the use of a stereotaxic frame (“frameless”); however, the same precision as with conventional stereotaxy cannot be achieved. Here, we present the first cases of our new approach which combines both techniques, aiming at combining the speed of robot-assistance with the precision of conventional stereotaxy.

Methods: Preoperatively, the trajectories are planned on 3D-MRI. On the day of the surgery, the frame (Leksell) is fixed to the skull in general anesthesia, followed by a CCT for frame registration. After fusing the MRI and CT data, a physical connection between the stereotaxic frame and the robot (ROSA, Medtech) is established, and the frame is registered by the robot. The implantations of the electrodes are then performed using standard techniques.

Results: To date, 9 patients (age range: 7 to 23 years) have been operated with this technique (115 implanted electrodes, average time of surgery < 10 minutes/electrode). The precision at the entry point, measured by fusing preoperative MRI with postoperative MRI, was 0.5 mm (median; range: 0 to 2.9 mm).

Conclusion: The combination of stereotaxy with robot-assistance achieves high precision and short surgeries when implanting multiple depth electrodes for stereo-EEG.