First experience with ROSA and O-Arm guided stereotactic neurosurgery in Merheim

Erste Erfahrungen mit ROSA und O-Arm geführter stereotaktischer Neurochirurgie in Merheim

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OBJECTIVE: Robot guided stereotactic neurosurgery is considered a technique with great potential. Main technological advantages as compared to conventional, frame guided therapy include higher accuracy, shorter operation time and reduced number of human errors.

METHODS:

Retrospective evaluation of accuracy and precision of frame-based stereotactic procedures (4 biopsies and 4 deep brain stimulations) was performed in 8 patients using the ROSA robotic device (Medtech, France). Prior to surgery a stereotactic head frame (Leksell Modell G, Elekta Instruments, Inc., GA) was fixed to the patient's skull and CT imaging modalities were obtained for stereotactic treatment planning. After image fusion and planning of the surgical trajectory, registration of the frame was performed intraoperatively using a manual force-control pointer. Subsequently, registration was verified based on predetermined anatomical and frame-based landmarks. During the surgical procedure, burr hole craniotomy was performed and the probe was placed close to the cortical surface in alignment with the planned surgical trajectory. To control for accuracy, a flat-panel CT was done, which was then registered with the initial stereotactic CT scan. Robot micro movements allow a correction of misalignments. Thereafter, the probe was manually placed within the predefined target and a final flat-panel CT was done to evaluate definite probe placement.

RESULTS: Frame-based registration of the robot and verification of 3-5 landmarks took about 10 minutes. Registration accuracy ranged from 0.3 mm to 0.6 mm. The mean lateral displacement at the target point was 0.8 mm +/- 0.4 mm. Robotic micro movements to correct for misalignment of the probe before brain penetration were not performed.

CONCLUSION: The accuracy of robotic neurosurgery is comparable to conventional stereotactic methods. Improvement of accuracy might be achieved with micro movements detected via flat-panel CT. Implantation duration of one or two probes corresponds with operation times in conventional procedures, however, robot assisted stereotactic surgeries will be significantly shorter during the implantation of multiple probes e.g. stereoelectrocephalographic (SEEG) recordings. Human errors caused by manual adjustment of the phantom and/or guiding system and wear through sterilization no longer exist.