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AUSTRIAN CENTER FOR MEDICAL INNOVATION AND TECHNOLOGY

# AUTOGUIDE – A SMALL AND LIGHTWEIGHT ROBOT SYSTEM FOR NEUROSURGERY

## BASED ON THE MODULAR ROBOT SETUP DEVELOPED AT ACMIT, A NEW GENERATION OF A NEUROSURGICAL ROBOT WAS DEVELOPED AND SUCCESSFULLY EVALUATED IN A MULTI-CENTRIC CLINICAL TRIAL.

Constant high accuracy and a streamlined clinical workflow are crucial aspects for successful stereotactic interventions and for a short procedural duration in neurosurgery. Although widely used, currently available robotic systems do not fully meet the requirements for a stereotactic guidance system that unites the advantages of frameless surgery and robotic technology. In the framework of the ACMIT project “Robotics and Instruments”, a novel approach has been investigated by adapting a small-scale, lightweight, but highly accurate robot system, which was originally developed for interventional radiology, for the use in stereotactic neurosurgical procedures. The robot is based on a very compact kinematic structure that is free of singularities in the entire working space and that offers a very high degree of intrinsic safety. Due to its design, the robot can be seamlessly integrated into established OR workflows. Interfaces to standard OR hard- and software, such as head-clamps, neuro-navigation systems, surgical tools, also allow simple integration into existing OR setups.

Besides the adaptation of the robot for this new application domain, the project also aims to investigate the advantages and limits of this new setup in a clinical trial at two neurosurgical departments. Parallel to extensive preclinical testing, adaptations were implemented in a first step to optimize the robot fixation, the software usability,

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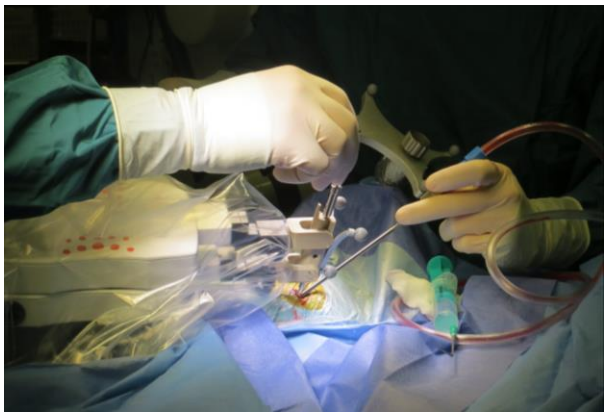
integration to the neuro-navigation system, and tool-sets. Development of the robotic system was then validated in a clinical series of 180 patients (141 needle biopsy procedures, 13 ventricular catheter placements, 26 stereo-electroencephalography (SEEG) electrode placements) between 2013 and 2020. For each of the three applications, specific setup time, OR duration and procedural accuracy were evaluated.

Successful completion of the complete surgical task with the developed robotic system was possible in 178/180 cases. The HW/SW setup in each procedure could be performed without adding any significant OR time - the workflow was fully integrated into the preexisting procedure. Most importantly, the study clearly demonstrates improvement of the procedural accuracy. For the biopsy procedure, the real target error (RTE) could be reduced from median 1.7mm to 1.5mm at both entry and target position. For the SEEG procedures, the RTE could be reduced from mean 1.43 mm to 1.12 mm at entry and from 1.82 mm to 1.57 mm at target position. No healing complications or infections were observed in any of the cases. The novel minimally-invasive approach for trepanation, developed and introduced during the clinical trial, has shown a clear advantage in terms of incision length, muscle trauma, and cosmetic result.

**Impact and effects**

The developed robot system could prove its versatility and seamless integration into preexisting workflow by successful application in 180 stereotactic procedures. The clinical evaluation revealed that the robot can significantly improve targeting accuracy without adding procedural time.

In mid of 2020, a re-designed version of this small form-factor neurosurgical robot successfully passed FDA and CE certifications for routine clinical application. The AutoGuide robot setup is now marketed world-wide by one of the leading providers of neuro-navigation technology.



Robot-assisted tool placement. Copyright ACMIT © 2021

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- Medical University Vienna, Dept. of Neurosurgery, Austria
- Istituto Neurologico „C. Besta“, Italy

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