
# A Novel Robotic Device for Increased Precision of Stereotactic Neurosurgical Procedures

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## Introduction

Submillimetric precision is essential for stereotactic neurosurgical procedures. However, accuracy of frameless stereotaxy is currently limited due to manual alignment of the stereotactic device. Consecutively, tissue sampling error, catheter and electrode malpositioning and complications such as cerebral hemorrhage or shunt failure are not uncommon and a major cause of morbidity. The aim of this study is to evaluate the feasibility and accuracy of a novel robotic positioning device for stereotactic procedures.

## Methods

In a preclinical phantom trial we compared the accuracy and procedural duration of a representative stereotactic neurosurgical procedure performed with the robot to standard manual alignment. Further, we assessed the robot in 23 clinical cases (tumor biopsy n=16, shunt placement n=3, cyst catheter placement n=3, depth electrode placement n=1) for feasibility, setup and application time and accuracy in the clinical setting within an approved trial.

## Results

Application of the robotic device was feasible in all cases and seamlessly integrated into the operating workflow in all cases. The preclinical trial revealed a mean target error of 0.6mm for robotic guidance versus 1.2mm for manual positioning ($p<0.001$), the mean procedural duration was 2.6min for robotic guidance versus 3.7min for manual positioning ($p<0.001$). In the first 23 clinical applications a navigation calculated target accuracy of =0.1mm was always achieved, the mean setup and application times were 10 and 5 minutes, respectively.

## Conclusions

Our preclinical and preliminary clinical results indicate that the application of this robotic device in stereotactic neurosurgical procedures is feasible, provides high accuracy and may in future reduce operating time.

## Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe the importance of high accuracy in stereotactic procedures, 2) Discuss, in small groups, currently available alternatives to frame-based stereotaxy, 3) Identify the presented robotic device as novel candidate-tool for frameless stereotactic procedures.

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