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TITLE

Two Heads are Better than One: Stereotactic EEG and Deep Brain Stimulation Surgery Workflow Refinement using 3D Printed Heads

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ABSTRACT

INTRODUCTION
In 2020, Beaumont Hospital accepted the delivery of a new neurosurgical navigation robot, the Zimmer Biomet ROSA One Brain for use in SEEG, DBS, and biopsy procedures. ROSA is a robotic platform to assist surgeons in planning and performing procedures in a minimally invasive manner. As the manufacturer is based in France, organising in-depth training was a challenge, since the Covid-19 pandemic resulted in the closure of international borders for many months. The neurophysics and neurosurgical team recognised a necessity to get familiar with ROSA workflows in a quick and safe manner but surgical opportunities and company support were limited.

METHODOLOGY
This project followed a Plan Do Study Act (PDSA) methodology.

AIM
To explore the use of 3D printing as a means of developing imaging phantoms which have the potential to be used to validate imaging modalities and processes in robotic-assisted neurosurgery.

CHANGE IMPLEMENTED
Due to travel restrictions, options for training on a new precision tool for neurosurgery were limited. Use of a realistic phantom allowed neurosurgeons to train on the ROSA and curate new surgical workflows prior to treating a patient.

MEASUREMENT
Desk-top workflows were tested and refined with a phantom head. Integration with existing and new surgical equipment and tools were tested.

RESULTS
CT images of the phantom heads, which incorporated surgical targets, were imported into the ROSA planning software and used to illustrate the robotic alignment process. This allowed all members of the team to gain confidence with the ROSA system and develop innovative, effective workflows with limited applications support prior to commencement of surgical programmes. Significant local expertise was developed due to the opportunities to familiarise the team with the ROSA system.

VALUE
The use of realistic 3D-printed heads as phantoms allowed the development of local expertise and skill when introducing a neurosurgical robotic assistant. This avoided delays in commencement of SEEG and DBS surgery programmes which could have been affected by pandemic-related travel restrictions resulting in reduced availability of international on-site applications support.

SUSTAINMENT
This work is a foundation for further investigation of the potential for phantom design, materials, and applications to support quality and patient safety initiatives. It also demonstrates the potential for using 3D-printed models in clinical teaching and training.

ADDITIONAL INFORMATION
We acknowledge the advice and guidance of the School of Mechanical and Manufacturing Engineering, DCU on 3D-printing processes and materials.