Two Heads are Better than One
SEEG & DBS Surgery Workflow Refinement using 3D Printed Heads

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Purpose

In 2020, the ROSA One Brain was introduced into Beaumont Hospital for use in planning and performing Stereoelectroencephalography (SEEG), Deep Brain Stimulation (DBS), and biopsy procedures.
The manufacturer is based in France; organising in-depth training was a challenge due to the Covid-19 pandemic with the intermittent closure of international borders.

The neurophysics and neurosurgical team recognized a necessity to get familiar with ROSA workflows in a quick and safe manner but surgical opportunities and company support were limited.

We aimed to explore the use of 3D printing as a means of developing imaging phantoms & replicate patient-specific features. Phantoms have the potential to test imaging modalities, processes and curate workflows in robotic-assisted neurosurgery and in this instance helped to facilitate the introduction of SEEG & DBS procedures to Beaumont Hospital

Fig 1 (Above): ROSA Robot

Fig 2 (Top Left): SEEG Head Model
Fig 3(Top Middle): Laser Alignment on DBS Head Model in Leksell Frame during Laser Registration
Fig 4 (Right): ROSA & DBS Head During Pointer Registration

Materials & Methods

A head model was created from the first SEEG & DBS patients' pre-operative scans and printed using a FDM printer. Both SEEG & DBS head models were hollow, with structures of interest included in the DBS print.

The heads were used in conjunction with ROSA to trial the registration process using various registration techniques. Since each head model was based off a CT of that patient, a good correlation exists between the anatomy of the printed head and the imaging

Results

Heads were created in collaboration with the Department of Materials & Manufacturing, DCU. Using the head models allowed curated workflows for both SEEG and DBS to be established, which enabled the team to practice with ROSA as much as necessary before the actual surgery. Local expertise and skill was developed.

This avoided delays in the commencement of robotic 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.

Conclusion

We created 3D printed head models for neurosurgical planning. 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.

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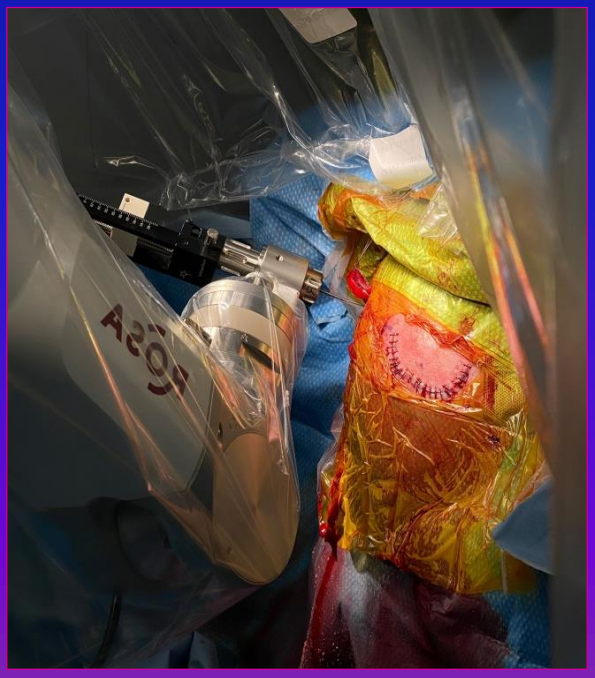

Fig 5 (Above): DBS Procedure at Beaumont underway using ROSA