Epilepsy Navigation (EpiNav™)

Navigator software for planning epilepsy neurosurgery

Category
Software/Surgical

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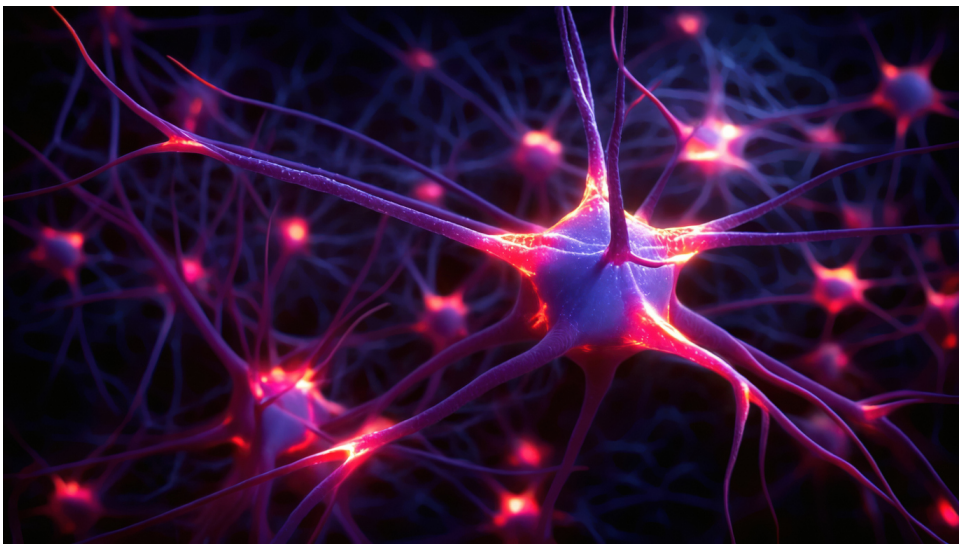

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Background

For epilepsy patients whose epilepsy does not respond to antiseizure medication, neurosurgery to remove the areas of the brain causing the epileptic seizures may offer a cure.

Prior to such surgery clinicians need to pinpoint the areas where the seizures are arising from. This is achieved by inserting special electrodes into different areas of the brain and measuring electrical activity during a seizure. This procedure itself requires the generation of a precise pre-operative plan for the trajectory of these electrodes from entry point on the skull to target point in the brain. The plan needs to ensure minimal damage to vital areas of the brain and avoid large blood vessels. Prior to the development of EpiNavTM, these plans were generated manually by clinicians considering multiple brain scans. Manual planning is a highly challenging and time-consuming activity.

Once the area of the brain that are causing epileptic seizures have been identified, further detailed pre-operative plans and 3D maps are generated to enable surgery to remove these. Again these procedures need to be precisely planned to minimise damage to vital structures and large blood vessels. During surgery these 3D maps are used to guide the surgery and to increase its precision and accuracy.

Technology Overview

EpiNav™ is a software system that helps the surgeon to a) precisely plan electrode trajectories in the brain, b) precisely plan neurosurgical procedures to remove areas that are giving rise to epileptic seizures, or lesions such as tumours.

The key underpinnings of EpiNav™ are the use of multimodal imaging in a clinical context to (1) construct a 3D patient specific anatomy models and (2) use these models in combination with efficient collision detection and nearest point graphics-based algorithms to identify trajectories which meet well defined surgical constraints including the length of trajectories, entry angle with respect to the skull, distance from vasculature and other “critical structures”, ability to record from grey matter brain regions. EpiNav™ also provides a user interface to assess trajectories automatically, adjust trajectories either semi-automatically or manually when necessary and measure relevant quantitative measures (length, angle, grey matter capture, distance to nearest critical structure). In combination this provides a system that we have demonstrated (a) alters surgical decision making1, 2 (b) can provide trajectories that are quantitatively “better” than those planned manually3, 4, (c) are qualitatively similar to trajectories planned manually, and independent expert neurosurgeons rate them with similar feasibility scores as those planned by a clinician5, and (d) in a prospective study these trajectories were

safely implanted in a small case series of patients (N=13)6.

See figure 1, 2 & 3.

Stage of Development

Currently we are at TRL Stage 7- System prototype demonstration in operational environment, EpiNav™ is currently deployed at the National Hospital for Neurology and Neurosurgery (NHNN) as part of routine clinical care. We also have several secondary sites which either actively use or are training to use EpiNav™.

Although the placement of multiple intracranial recording electrodes to define the source of epilepsy, and the development of imaging tools to plan neurosurgical resections has been the primary clinical use case driving development and evaluation, we have evaluated the technology in several other use cases. These include biopsy of deep brain tumours7, selective laser amygdalohippocampectomy8, Anterior Two-Thirds Laser Corpus Callosotomy9.

Further details:

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Benefits

There are currently several methods that will display and visualise 3D geometry and allow clinicians to manually adjust trajectories using their own assessment of the risk. Where EpiNav™ is unique is that it

• provides quantitative measures of trajectory suitability using measurements related to distance to critical structures (i.e. risk), grey matter capture, tool length and angle and

• has an algorithm to balance these criteria and automatically make suggestions of appropriate trajectories. Thereby reducing time spent evaluating trajectories.

Applications

• Planning for electrode implantation into brain

• Planning minimally invasive laser ablation procedures

• Planning tumour biopsy

Opportunity

We are seeking market feedback on the opportunity and future commercial and collaboration partners.

Patents

• EP 3142589

• US 10,226,298 B2

• PCT/GB2017/052842

• PCT/GB2019/051198

Seeking

Development partner,

Commercial partner,

Licensing

IP Status

Patented,

Patent application submitted,

Provisional patent