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"neuro I inspire™ surgical planning software increases safety of paediatric brain stem glioma biopsies"

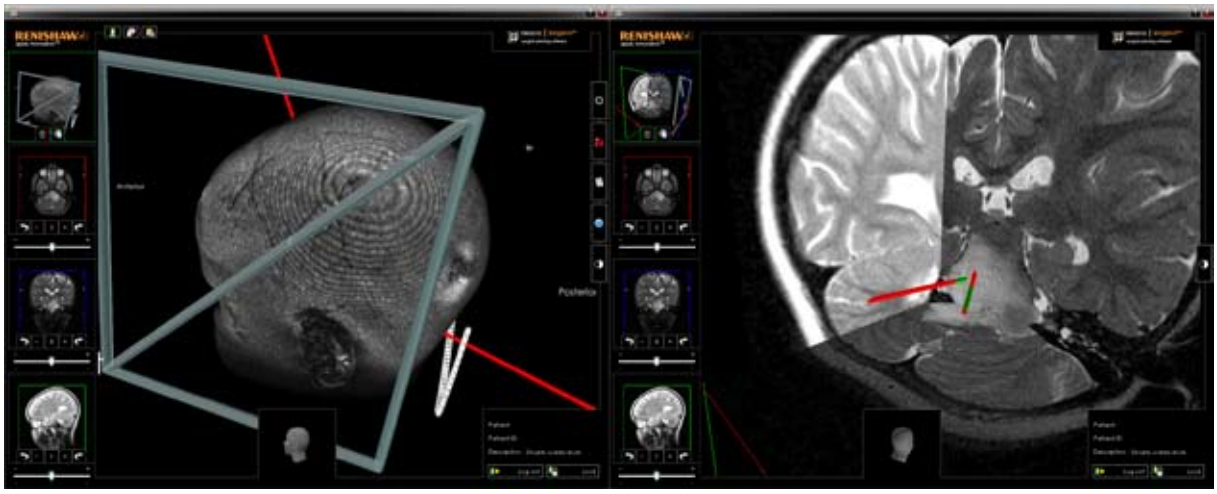
Professor Gill believes the image distortion correction function within Renishaw neuro I inspire™ software has been key to successfully performing stereotactic brain stem glioma biopsy via a transpeduncular route

Paediatric brain stem glioma is typically diagnosed with clinical findings and Magnetic Resonance Imaging (MRI) scans rather than biopsy specimens (1), because of the difficulties of taking samples from the brain stem region; however the lack of a histological diagnosis can make treatment difficult. The new Renishaw neuro I inspire™ surgical planning software, with innovative MRI image distortion correction, works round some of these problems by providing clinicians with highly detailed and accurate visualisation of patient brain structure and anatomy. This enables reliable planning of a choice of routes to biopsy targets that avoid blood vessels, ventricles and vital areas of the cortex.

With his extensive experience of stereotactic procedures, Professor Steven Gill at Frenchay Hospital, Bristol, has been working with Renishaw to develop the neuro I inspire software. It can be used for planning various neurosurgical procedures including Deep Brain Stimulation (DBS) (2), with the potential to extend use to any procedure requiring high-accuracy targeting within the brain. neuro I inspire works by merging MRI sequences from the axial, coronal and sagittal planes and compensating for MRI distortion using 2.5D error mapping. This allows the surgeon to visualise the path of the surgical tool in three dimensions, identifying key anatomical structures using multi-planar reconstruction and cross correlation.

Professor Steven Gill taking a sample from the biopsy needle

neuro I inspire has a feature known as the 'bomb's-eye' view that enables the user to precisely visualise and track the route of the tool being used, from its entry point at the skull down to the target. As the software simulates this route the user can detect whether any blood vessels or other important anatomical structures lie in the tool's path, or in close proximity.



Comparing transventricular and transpeduncular approaches using neuro I inspire

Brain stem glioma biopsy – surgical planning
In a recent case Professor Gill performed a stereotactic biopsy to confirm the histological diagnosis of a suspected brain stem glioma in a 4 year old patient, using the neuro | inspire surgical planning software to plan both the target position for the biopsy and the trajectory to that position.

The first stage of the biopsy involved a series of MRI scans under general anaesthesia, delivering the appropriate region in all three planes. The scans were acquired at a thickness of 2 mm with 0.4 mm separation in between, and loaded into the neuro | inspire software. Professor Gill used the software to consider three different approaches to the glioma before deciding on the safest possible path. The neuro | inspire software allows the simulation of different surgical tools and in this case a 2 mm diameter needle was selected.

Initially Professor Gill plotted a transventricular approach but the software clearly indicated that this trajectory would encounter a blood vessel. A second transventricular route was then attempted, via the opposite hemisphere; this route missed a blood vessel by 2 - 3 mm.

A third option was attempted using a more unusual transpeduncular approach, via the posterior cerebellum, which can be a very vascular region. The visualisation demonstrated that this was the safest route of the three with optimum chance of obtaining a good sample, and the trajectory and coordinates were recorded for the biopsy.

Often the size of these tumours can be small, thereby making it difficult to make multiple passes for a biopsy. Also, with the substantial histologic variability within a tumour, biopsy sampling error can often result in a misleading specimen. This emphasises the need to maximise the chances of taking a good sample at the first instance.

Planning biopsy target position and trajectories with neuro | inspire, using MRI sequences in three planes

Insertion of the biopsy needle using the stereotactic frame

The surgical procedure
The patient was laid supine and the stereotactic frame base was connected to the arc; the trajectory and coordinates were checked prior to the drilling of the burr hole. The biopsy needle, guided by the frame, was used to safely and successfully take an initial single-cell smear sample at the target position with no complications. The sample was confirmed by an in-theatre pathologist to be representative of an aggressive astrocytic tumour. A second sample was taken to be used as a frozen section, which would allow a further analysis of the cyto-architecture of the tumour and surrounding regions.

Potential for the future
This procedure demonstrates the capabilities of the neuro | inspire surgical planning software, allowing the surgeon greater flexibility in choosing multiple trajectories to a target position, based on 3D modelling. Currently, neuro | inspire is being trialled at Frenchay Hospital for Deep Brain Stimulation (DBS) surgery. The software, with its MRI distortion correction, significantly reduces the time taken to plan for procedures and consistently enables targeting with sub-millimetre accuracy.

www.renishaw.com/neuro

Bibliography
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2. Patel NK, Plaha P, Gill SS. Magnetic resonance imaging-directed method for functional neurosurgery using implantable guide tubes. Neurosurgery. 2007 Nov; 61(5 Suppl 2):358-65; discussion 365-6