Elective Report: Department of Neurosurgery, King's College London

As a medical student with a strong interest in neurosurgery and neurophysiology, my elective at the Department of Neurosurgery at King's College London was an invaluable learning experience. Under the guidance of esteemed surgeons, I gained exposure to a wide range of neurosurgical procedures, gaining insights into the precision, technical skill, and collaborative dynamics fundamental to this specialty.

Connectome-informed Awake Craniotomy

One of the most enlightening aspects of my elective was observing awake craniotomy procedures with Mr. Lavrador's team. These surgeries provided a unique opportunity to witness the balance between tumour resection and the preservation of essential brain functions. I gained a deep appreciation for intraoperative neurophysiological monitoring as a crucial safeguard during surgery. Techniques such as motor evoked potentials, direct cortical stimulations, and somatosensory evoked potentials allowed me to see the impact of intraoperative decisions on preserving critical structures in eloquent brain regions.

Preoperative planning also proved essential, especially using tractography to visualise white matter tracts surrounding tumours. Advanced imaging and tractography software enable visualisation of critical structural connections such as the uncinate fasciculus, inferior fronto-occipital fasciculus, and frontal aslant tract, helping guide the team's surgical approach and minimise damage to functional pathways. These preoperative maps served as a surgical blueprint, highlighting the importance of thorough preparation to achieve optimal patient outcomes.

Alongside these established techniques, I developed a scientific interest in newer intraoperative neurophysiological methods, such as single pulse electrical stimulations (SPES) and cortico-cortical evoked potentials (CCEPs). These approaches offer real-time mapping of effective cortical connectivity, revealing networks underlying functions such as language, and refining surgical navigation. Observing SPES and CCEPs reinforced my interest in personalised neurophysiology and their potential to preserve function while maximising resection margins.

Additionally, I observed the importance of effective teamwork in awake craniotomies. The coordination between anaesthetists, neurophysiologists, nurses, patients, and surgeons in the operating room highlighted the significance of clear, efficient communication. This collaborative effort ensured patient safety and comfort, especially when the patient was awake for functional assessments.

Functional Neurosurgery and Neural Interfacing

I also gained insights into functional neurosurgery by observing deep brain stimulation (DBS), epidural spinal cord stimulation, and robotic stereo-encephalography (SEEG) implantation procedures with Prof. Ashkan's team. Each of these procedures required a detailed understanding of subcortical neuroanatomy and pathways to ensure precision. Observing DBS surgeries underscored how personalised electrical stimulation can be transformative for patients with movement disorders, including Parkinson's disease, essential tremor, and dystonia. Robotic SEEG implantation provided insights into the interface of technology and neurosurgery, where robotic advancements enhance accuracy in accessing deep or challenging brain structures and open opportunities for further innovation. Through these procedures, I learned the principles of electrode positioning, trajectory planning, and the critical role of stereotactic accuracy in functional neurosurgery.

These experiences deepened my interest in neural interfacing technologies, such as cortical prosthetics and adaptive neuromodulation. I also explored computational signal processing techniques used in cortical electrophysiology, which are fundamental to brain-computer interfacing. Such technologies hold transformative potential for those with neurological disorders by creating direct communication pathways between the brain and external devices. This exposure has greatly motivated me to pursue further work in this scientific area to advance neurotechnologies and improve lives affected by neurological conditions.

Observing epilepsy surgeries, including temporal lobectomy and selective amygdalohippocampectomy, enriched my understanding of the anatomy and pathology of drug-refractory epilepsy. These cases illustrated the importance of surgical precision and individualised approaches in targeting epileptic foci while preserving function. The experience allowed me to explore surgical anatomy, particularly of the limbic system, and to appreciate the nuanced decision-making that goes into tailoring each procedure to the patient's specific needs.

Insights into Spinal Surgery Techniques

In spinal surgery, I had the opportunity to observe procedures such as lateral lumbar interbody fusion, extra- and intramedullary spinal tumour resections, and spinal cord detethering with Mr. Bell's team. These experiences highlighted the broad scope of spinal surgery and the importance of techniques for anatomical stability and decompression. Minimally invasive and robotic spinal techniques stood out as rapidly evolving fields, with potential benefits like shorter recovery times and reduced postoperative discomfort. Observing these methods gave me insight into the complexities of accessing and navigating the spinal column through smaller incisions, and I developed a strong appreciation for the advancements shaping this subspecialty.

Summary

My elective at King's College London was a transformative experience, showcasing the depth and breadth of neurosurgery and the specialty's commitment to integrating scientific and technological innovations. Observing complex cases and advanced techniques in brain, functional, epilepsy, and spinal surgery strengthened my passion for neurosurgery. I am immensely grateful for the opportunity to learn from leading experts and gain hands-on exposure to intraoperative neurophysiology and cutting-edge surgical techniques. This experience has further solidified my aspiration to pursue a career as a neurosurgeon-scientist, dedicated to advancing both patient care and neurotechnological innovation.