



UNIVERSITY OF
CAMBRIDGE

Amir Rafati Fard, University of Cambridge
Clinical and Research Elective at National Hospital for Neurology and Neurosurgery

I am greatly passionate about pursuing a career in neurosurgery – a specialty that has always fascinated me from both a clinical and academic perspective. As a medical student, I spent significant time attending neurosurgical wards and theatres to develop my understanding of what a career in neurosurgery entails. As my time as a medical student was drawing to an end (albeit with the exciting prospect of starting work as a doctor next), I was keen to spend my final summer immersing myself in the field of neurosurgery once more.

The National Hospital for Neurology and Neurosurgery (NHNN) is a leading centre for neurosurgery both within the UK and globally. It is well-positioned next to the UCL Queen Square Institute of Neurology, which together have a rich history in surgical innovation and technology. This is a field that I have a particular interest in and so an elective at NHNN would prove to be a fantastic opportunity to get direct exposure to the development of surgical technologies and their clinical incorporation that ultimately aims to improve outcomes for neurosurgical patients. I was, therefore, fortunate enough to organise a four-week elective at NHNN under the kind supervision of Mr Ciaran Hill, where my objectives were broadly to fully submerge myself in both clinical and academic neurosurgery at NHNN.

Clinical Component

A typical day would start with handover at 08:00, where newly admitted patients and inpatients were discussed. This was often an excellent learning opportunity, particularly for revising my neuroradiology when patient scans were discussed. I would then split my time between theatre and wards aiming to be flexible to any opportunities that were presented to me.

Overall, I was fortunate enough to observe over 30 surgical cases across the full spectrum of neurosurgical specialties that NHNN offers, ranging from intracranial tumour excision, trans-sphenoidal endoscopic pituitary resections, microvascular decompressions of the trigeminal nerve, MCA aneurysm clippings, and cervical and lumbar discectomies. I tried to be as proactive as possible, including setting up of the operating theatre, aiding the registration of stereotactic navigation, and assisting in cases (where I had both patient and consultant consent). As such, I developed skills, such as depth perception associated with visualisation under microscope, positioning when assisting the operating surgeon, bone flap creation, and closing with staples or suture. In cases where I was not scrubbed in, I made a conscious effort to familiarise myself with the basic principles of the surgery, such as anatomical approach and surgical adjuncts, whilst finding it the best time to revise key anatomical structures and landmarks. I experienced first-hand the vast array of surgical tools and technologies in the neurosurgeon's ever-expanding arsenal, including both within the surgical operating theatre (e.g. intra-operative imaging) and outside (e.g. Gamma Knife). I was reminded that medicine, and in particular neurosurgery, is a profession of life-long learning, such as through consultant-led sessions where video footage from each consultant's trans-sphenoidal surgery would be constructively critiqued ensuring the highest standard of care is provided to their patients. Through involvement with a research study evaluating the role of simulations, I gained exposure to the wide array of educational adjuncts available to trainees as they develop their surgical skills, and the growing role that these tools are likely to play in future neurosurgical training programmes.

Spending time on wards and in clinics highlighted a different aspect to the care of neurosurgical patients that was equally as rewarding. Taking histories and performing full neurological examinations from a range of patients each with a unique combination of symptoms and signs enabled me to develop my communication skills and clinical reasoning. Through ward-based procedures, such as removal of drains and adjusting VP shunts, I gained important insight into the skills required to be a proficient neurosurgical SHO. Joining the on-call during weekend shifts provided me the invaluable opportunity to learn how to approach critically ill neurosurgical patients, including systematic A-E assessments, commencement of initial investigations and management, and when to escalate to a senior. Joining clinics allowed me to experience the multi-disciplinary nature of neurosurgery, with the neurosurgeon, neuro-oncologist, and specialist nurse each providing their unique input to ensure optimal management of complex neurosurgical cases – this was again reinforced during the weekly neuro-oncology multi-disciplinary meetings. Through consultations, I observed how

neurosurgeons must frequently break bad news to patients and their families and how this can be done sensitively through effective communication. Reflecting on these experiences has been particularly useful in identifying skills that I can employ during my own clinical practice to ensure that I am the most effective doctor that I can be.

Research Component

I spearheaded two neurosurgical research projects during my elective at NHNN.

First, under the supervision of Mr Ciaran Hill, I investigated the surgical outcomes of tubular retractors in neuro-oncology. Neuro-oncological surgery requires a fine balance between the oncological advantage gained from maximal resection versus functional deficit that may occur from damage to surrounding healthy tissue, including during the process of brain retraction. Conventional metal blade retractors apply a focal pressure to the brain that can result in retraction-induced brain injury, so tubular retractors represent an exciting and emerging alternative proposed to reduce this retraction-induced brain injury. To investigate the efficacy and safety of tubular retractors in neuro-oncology, I led a systematic review and meta-analysis that showed their promising potential in neuro-oncological surgery, whilst highlighting the need for further prospective studies with larger sample sizes and direct comparison to conventional retractors. This work has been presented as a poster at the British Neuro-Oncology Society conference and will be presented orally at the upcoming Society of British Neurological Surgeons conference. It is also currently under peer-review with view for publication in a neurosurgical journal.

Second, I was fortunate to secure a competitive position as a Medical Student Intern within the Surgical Technology at Queen Square (TeQ) group led by Mr Hani Marcus. The TeQ group broadly has three streams, of which I am working within the Digital Health stream that includes investigation of the use of artificial intelligence (AI) to enhance neurosurgical outcomes. AI is a rapidly expanding field in healthcare (and neurosurgery) that will inevitably revolutionise healthcare, in my opinion. The increasing availability of surgical and interventional videos, particularly through emerging fields such as surgical data science, results in a largely untapped data source that may be fully harnessed through the application of AI. However, despite this growing excitement surrounding AI, rigorous evaluation remains critical to ensuring the development of safe and clinically incorporable AI systems. As such, I am leading a systematic review and meta-analysis evaluating the performance of AI against healthcare professionals in the analysis of surgical and interventional videos, including its application to neurosurgical problems. This work is nearly finalised and will be both submitted for presentation at conferences of a national/international level and for publication.

On reflection, I greatly enjoyed the research component of my elective and found that it significantly enhanced my clinical experience. It provided me a framework for understanding how novel surgical technologies are developed and brought to the market from conception to early testing with observational studies and later testing with experimental studies (such as randomised-controlled trials) and the importance of continued evaluation, including the principles of internal and external validation studies. These projects provided me an opportunity to build upon my research skills, including manuscript writing, statistical analyses (e.g. hierarchical summary receiver operator curves), and coding. Perhaps the most enjoyable aspect of all, however, is working within a research group, where regular meetings enabled me to develop my presentation skills, whilst receiving constructive feedback from peers at both my level and senior level would enable me to continually improve the standard and impact of my work.

Conclusion

Overall, my time at NHNN was a hugely invaluable experience. Whilst balancing both clinical and academic components was challenging at times, it was one that I greatly enjoyed and benefited from as I have found that the two complement each other. Similarly, whilst my experiences have certainly highlighted some of the challenges associated with training in the field of neurosurgery, they have clearly highlighted how rewarding the profession can be – I truly believe that it is a privilege that neurosurgeons are able to be involved in some of the most life-changing points in patients' lives. Without doubt, this experience has cemented my desire to pursue a career in neurosurgery.

Acknowledgements

I would like to thank everyone at the National Hospital for Neurology and Neurosurgery for enabling me to have such a complete and fulfilling experience. In particular, I would like to greatly thank Mr Ciaran Hill, who has supervised my experience and has been an exceptional mentor and inspiration over the past two years. Finally, I would like to thank the benefactors of this grant and the Society of British Neurological Surgeons for awarding it to me.