NEUROSURGERY

A Guide to the Six Year Specialty Training Program
# Contents

Introduction.................................................................................................................. 1

Program Administrators............................................................................................... 2

Program Structure & Rotations .................................................................................... 3

Syllabus .......................................................................................................................... 4

Schedule of Surgeries ................................................................................................... 21

Clinical Research ......................................................................................................... 22

References ..................................................................................................................... 24
Introduction

This document sets out the details for Dubai Residency Training Program (DRTP) for Neurosurgery. DRTP is governed by the Department of Medical Education at Dubai Health Authority. This document describes the entry requirements, knowledge and skills content, rotations, assessment methods, accreditation and certification for training in Neurosurgery.

The mission of the program is to develop and train neurosurgeons who are competent to practice Neurosurgery independently. Our vision is to provide the highest standard of care in neurosurgery by locally trained specialists.

Goals & Objectives
The goal is for the resident to acquire the knowledge, expertise and skills in the management of conditions of the nervous system and spine.

Objectively, the resident will go through a structured training program. He will be competent to sit exit examinations in Neurosurgery such as the Saudi Board, Fellowship of the Royal Colleges of Surgeons (FRCS) and the European Examination in Neurosurgery accredited by the Union of Medical Specialties (UEMS).

Furthermore, by satisfying the program requirements and passing the exit examination, the candidate may pursue subspecialty training overseas.
Program Administrators

Our Program Administrators in partnership with an expert team of supervisors & faculty steer the Neurosurgery Program towards the zenith of quality Residency training education offered in Dubai.

Under their expert care, your training journey is guaranteed to be an enlightening experience.

Dr. Abdulla Mohammed Qassim
PROGRAM DIRECTOR
Consultant, Rashid Hospital

Dr. Mohammad Abdulaziz M.A.A.Sultan Alolama
PROGRAM CO-DIRECTOR
Consultant, Rashid Hospital
Program Structure & Rotations

The Neurosurgery residency program is a six year program. The program director announces the number of vacancies which may vary from year to year. Over the six year period, the resident rotates in various specialties as detailed below. Each rotation is for a three months period, and is referred to as a “block”. The six year programme is divided equally into initial and advanced section.

There are a total of 24 blocks, 18 of which are Neurosurgery blocks, and 5 in other disciplines: General surgery, Intensive Care, Neurology, Neuroradiology, Neuropathology. The resident is entitled for 1 block in a discipline of his choice, subject to the approval of the programme director. The layout of the blocks over the six years is determined by the programme director to meet the educational needs of the residents.
The residents spends 9 neurosurgery blocks in Rashid Hospital, and the other 9 blocks in an accredited centre, subject to the approval of the programme director.
During neurosurgery blocks, the resident is supervised with a named consultant-trainer (supervisor). The resident will rotate with different consultants on consecutive rotations. The program director decides on rotations according to competencies achieved. The resident will participate actively in all departmental educational activities including audit. The resident will attend relevant local and international conferences and courses as recommended by the program director.

Teaching and Learning
There are regular teaching sessions delivered by teaching staff to cover topics of the syllabus. Furthermore, the resident is expected to attend all departmental educational activities (Neuroscience Meeting, Neurovascular Meeting, Neuroradiology Meeting, Journal Club and Morbidity & Mortality Meeting), conducting clinical audit. The resident has to attend relevant courses and conferences, as recommended by the program director. Successful completion of Advanced Trauma Life Support (ATLS) is mandatory in the initial stage of training.
Learning is on-the-job training and is self-directed and guided by the supervisor with reference to the syllabus. Through this method, the resident builds his clinical acumen and technical skills as detailed in the syllabus. During every rotation, the resident is assigned to a named consultant trainer (supervisor), and must aim to achieve the relevant competencies as described in the syllabus. At the start of every Neurosurgery rotation, the program director, the training consultant and the resident, agree on a set of competencies. These competencies are selected from the syllabus according to the year of residency, competencies achieved thus far and potential competencies that can be achieved during the up-coming rotation.

The resident has to maintain a log-book of all procedures he is involved in. The log-book is to be signed by the supervisor at the end of the six-month rotation. As clinical practice varies, the competencies may not be completely achieved on a particular rotation, e.g. the resident maybe expected to assist or perform a certain number of operations which were not encountered during the rotation. The minimum number of procedures and the role of the resident during them is enlisted in The Schedule of Operations (Appendix I). As the schedule doesn’t enlist the breadth of procedures that might be encountered, the total number of the procedures in the log-book should exceed 500 procedures. An electronic consolidation sheet of all procedures should also be maintained.

The resident has to gain knowledge of scientific research. This is achieved by actively participating in:

- Journal Clubs
- Morbidity and Mortality Meetings Clinical Audit
- Relevant Courses Publications and Posters

The resident has to keep a learning portfolio folder. This folder contains:

- Letter of offer of Resident Training Number
- Copies of Competencies forms
- Copies of assessment forms
- Certificates of conferences/courses attended
- Copies of papers/audits published and presentations made
- Surgical logbook, paper/electronic
- Copies of the Clinical Rotation Evaluation forms
- A list of recommended textbooks, Journals and on-line resources will be given to the residents.

Assessment of Residents
This is done at regular intervals and aims to assess his progress and provide him and the program administrators with feedback

Clinical Performance
The resident is evaluated at the end of each block by the supervising consultant.

Specialty Examination in Neurosurgery
Towards the final years of training, the resident will be encouraged to sit an exit examinations in Neurosurgery such as the Saudi Board, Fellowship of the Royal Colleges of Surgeons (FRCS) and the European Examination in Neurosurgery accredited by the Union of Medical Specialties (UEMS).
The program director should support residents who may wish to sit other exit examinations.
Syllabus

This is detailed in Appendices A and B. The syllabus is designed to prepare the resident to sit for exit examinations in Neurosurgery. The Fellowship of the Royal Colleges (FRCS Neurosurgery) is taken as a model examination, therefore, the syllabus is extracted from the British Intercollegiate Surgical Curriculum (Neurosurgery syllabus - August 2010). In addition, the syllabus has been cross checked with the American and Swedish Boards and found to be compatible. Therefore, the syllabus prepares the resident to sit for exit examinations such as the Saudi Board, FRCS, Swedish board, the European examination accredited by the Union for Medical Specialties (UEMS) and the Arab Board.

This framework is to guide the resident's learning process, and to prepare himself for assessment at various stages of the residency training. Yet, the resident may feel free to study the topics of the syllabus in any order. In addition, the gain in knowledge is cumulative, and residents at later stages of training are expected to demonstrate knowledge gained from earlier years.

There are three components to be learned for each topic: knowledge, clinical skills and technical skills. There are numerical descriptors of competency for each component. These descriptors are numbered in a way to indicate the depth of competency required. The numbering system is as follows:

Knowledge:
K1 knows of
K2 knows basic concepts
K3 knows generally
K4 knows specifically and broadly

Clinical and Technical Skills:
C1/T1 Has observed
   Has adequate knowledge of the steps through direct observation.
   Demonstrates that he can handle instruments relevant to the procedure appropriately. Can perform some parts of the procedure with reasonable fluency.

C2/T2 Can do with assistance
   Knows all the steps - and the reasons that lie behind the methodology. Can carry out a straightforward procedure fluently from start to finish.
   Knows and demonstrates when to call for assistance/advice from the supervisor.

C3/T3 Can do whole but may need assistance
   Can adapt to well-known variations in the procedure encountered. Recognizes common problems that are encountered and deal with them. Knows and demonstrates when he needs help. Requires advice rather than help that requires the trainer to scrub.

C4/T4 Competent to do without assistance, including complications
   Can deal with straightforward and difficult cases to a satisfactory level and without the requirement for external input. Is at the level at which one would expect an independent consultant neurosurgeon surgeon to function. Is capable of supervising trainees.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
</tr>
</thead>
</table>
| Embryology & maldevelopment | - Embryogenesis of the brain and spinal cord (K4)  
- Embryogenesis of supporting structures - skull and vertebral column (K4)  
- Common anatomical variations & developmental abnormalities (K4) | N/A | N/A |
| Anatomy of the skull | Structure, blood supply, innervation, surface and three-dimensional relationships of the scalp, skull, meninges, orbit, cranial fossae, cranial foraminae, cranial nerves (K4) | N/A | N/A |
| Anatomy of the brain | - Cortical topography, projection and association tracts (K4)  
- Organization of the basal ganglia (K4)  
- Structure, organisation and connections of the cerebellum, pons and brainstem (K4)  
- Cranial nerves and their relationships (K4)  
- Visual and auditory pathways (K4)  
- Ventricular system and choroid plexus (K4)  
- Subarachnoid space and cisterns (K4)  
- Circle of Willis & principle regional & segmental blood supply (K4)  
- Venous drainage and dural sinuses (K4) | N/A | N/A |
| Anatomy of the spine | Structure, blood supply, innervation, surface and three-dimensional relationships of the vertebral column, spinal cord: ascending and descending tracts, spinal nerve roots, cauda equina (K4) | N/A | N/A |
| Anatomy of the autonomic and peripheral nervous system | - Sympathetic and parasympathetic pathways (K4)  
- Visceral and pelvic innervation: control of sphincter function (K4)  
- Brachial and Lumbosacral plexus (K4)  
- Course, distribution and innervation of the major peripheral nerves (K4) | N/A | N/A |
| Functional neurophysiology | - Structure and function of neurones and glial cells (K4)  
- Synaptic function, action potentials and axonal conduction (K4)  
- Higher cerebral functions (K4)  
- Sleep and coma (K4)  
- Memory and disorders of the limbic system (K4)  
- Control of motor function: ascending/ descending pathways, basal ganglia & cerebellar function (K4)  
- The special senses (K4)  
- Functions of the autonomic nervous system (K4)  
- Hypothalamic-pituitary function (K4) | N/A | N/A |
| Principles of clinical neurophysiology | - Principles of electroencephalography (K4)  
- Principles of somatosensory, motor and brainstem evoked potential monitoring (K4)  
- Peripheral neuropathies and entrapment neuropathies including structure and function of peripheral nerves and use of nerve conduction studies (K4)  
- Disorders of the neuromuscular junction including structure & function of smooth & striated muscle & use of electromyographic studies (K4) | Interpretation of the results of EEG, EMG & NC studies | N/A |
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<tr>
<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
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<tbody>
<tr>
<td>Pathophysiology of intracranial disorders</td>
<td>- Cerebral blood flow and metabolism (K4)</td>
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<td>- Cerebral auto regulation and vasospasm (K4)</td>
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<td>- Blood brain barrier and cerebral edema (K4)</td>
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<td>- Intracranial pressure dynamics (K4)</td>
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<td>- Cerebral ischemia and neuroprotection (K4)</td>
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<td>- CSF hydrodynamics - production and absorption (K4)</td>
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<td>Principles of neuropharmacology</td>
<td>- Receptors, ion channel function, neuropeptides and neurotransmitters (K4)</td>
<td>N/A</td>
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<td>- Principles of pharmacological neuroprotection (K4)</td>
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<td></td>
<td>- The pharmacology of anesthetic agents, muscle relaxants, barbiturates, anti-convulsants and corticosteroids including mechanisms of action - pharmacodynamics - interactions (K4)</td>
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<td>Principles of neuropathology</td>
<td>- Acute and chronic inflammatory processes in the CNS including demyelination (K4)</td>
<td>N/A</td>
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<td>- Bacterial, fungal and parasitic meningitis, encephalitis and abscess formation (K4)</td>
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<td>- Viral encephalitis (K4)</td>
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<td>- Slow viruses, CJD and vCJD 4 HIV associated infections, tumors and leucoencehalopathies (K4)</td>
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<td>- Cytopathology of neurons and glial in response to ischemia, hypoxia and trauma (K4)</td>
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<td></td>
<td>- Diffuse axonal injury (K4)</td>
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<td>- Macroscopic brain and spinal cord injury including effects of brain shift, herniation and raised ICP (K4)</td>
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<td>- Classification, epidemiology and pathology of CNS tumors (K4)</td>
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<td>- Tumor biology, cell kinetics, tumor markers, immunocytochemistry (K4)</td>
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<tr>
<td>Principles of neuroradiology</td>
<td>- Interpretation of plain radiographs of the skull and spine (K4)</td>
<td>N/A</td>
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<td></td>
<td>- Principles of computerized tomography of the brain, skull and spine 4 Interpretation of CT scans with particular reference to acute spinal disorders, cranial trauma, hydrocephalus, intracranial tumors and spontaneous intracranial hemorrhage (K4)</td>
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<td>- Principles of basic magnetic resonance imaging (K3)</td>
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<td>- Interpretation of MRI scans with reference to acute spinal disorders, cranial trauma, hydrocephalus &amp; intracranial tumors (K3)</td>
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<td>- Principles of advance magnetic resonance imaging including fMRI, DWI and spectroscopy</td>
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<td>- Interpretation of angiographic images: CTA, MRA and DSA</td>
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<td>Principles of neuropsychology</td>
<td>- The principles of neuropsychological assessment (K3)</td>
<td>Ability to undertake bedside assessment of cognition &amp; memory (C3)</td>
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<td></td>
<td>- Common neuropsychological problems associated with head injury, subarachnoid hemorrhage, hydrocephalus, structural lesions of the frontal and temporal lobes and disorders of the limbic system (K3)</td>
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<td>- Application of Mental Health Act (K3)</td>
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<td>Principles of neurological rehabilitation</td>
<td>- The principles of neurological rehabilitation including strategies to optimize the recovery of cognition, communication, continence, selective movement, gait, self-care, psychological stability, social adjustment and employment (K3)</td>
<td>N/A</td>
<td>N/A</td>
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<td>Medical ethics</td>
<td>- Criteria for the diagnosis of brainstem death (K4)</td>
<td>Ability to empathize with and support patients and caregivers (C3)</td>
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<td>- Diagnosis and management of persistent vegetative states (K3)</td>
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<td>- Prognosis in chronic progressive neurological disorders (K3)</td>
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<td>- Professional and statutory framework governing living directives and end-of-life decisions (K3)</td>
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<td>Principles of neurogenetics</td>
<td>- Inherited neurological disorders (K3)</td>
<td>N/A</td>
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<td>- Genetic control of neural connectivity (K3)</td>
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<td>- Inborn errors of metabolism (K3)</td>
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<td>- Molecular genetics of CNS tumors (K3)</td>
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<td>Topic</td>
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<tr>
<td>Impaired consciousness and non-traumatic coma</td>
<td>The aetiology, pathophysiology and differential diagnosis of altered consciousness and coma due to: meningitis, encephalitis, ICH, acutely raised ICP, hydrocephalus, hypoxaemia and ischaemia, cardiogenic shock, hypoglycaemia, epilepsy, metabolic encephalopathies, drugs and toxins (K4)</td>
<td>- Neurological assessment and initial resuscitation of patients in coma or with impaired consciousness (C4) - Indications for intubation and ventilation (C4) - Treatment of seizures (C4) - Establishing a neurological differential diagnosis (C4) - Planning &amp; interpreting scans &amp; other investigations (C4) - Presentation &amp; summary of cases (C4)</td>
<td>- Maintenance of airway (T4) - Endotracheal intubation (T3) - Central Venous Cannulation (T3) - Lumbar puncture (T4)</td>
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<tr>
<td>Diagnostic Lumbar Puncture</td>
<td>- Indications for diagnostic lumbar puncture (K4) - Interpretation of basic microscopy and biochemistry (K4) - Principles of spectrophotometry (K3)</td>
<td>Lumbar puncture (T4)</td>
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<tr>
<td>Headache - acute and chronic</td>
<td>The aetiology and differential diagnosis of acute and chronic headache including headache associated with (K4) - benign headache syndromes - migraine, cluster headache &amp; related - space occupying lesions, meningitic disorders; intracranial hemorrhage - trigeminal neuralgia - atypical craniofacial pain syndrome - Indications for investigation including scanning, lumbar puncture &amp; angiography</td>
<td>- Neurological history taking &amp; Neurological examination (C4) - Establishing a neurological differential diagnosis and Planning investigation (C4) - Interpretation of scans and other investigations (C4) - Presentation and summary of cases (C4)</td>
<td>Lumbar puncture (T4)</td>
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<tr>
<td>Weakness and paralysis</td>
<td>Common causes of ocular, cranial nerve, limb, trunk &amp; respiratory muscle weakness (K4)</td>
<td>N/A</td>
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<tr>
<td>Pain and sensory loss</td>
<td>Common causes of musculoskeletal, neurogenic and neuropathic pain &amp; sensory loss (K4)</td>
<td>N/A</td>
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<tr>
<td>Dizziness, unsteadiness and falls</td>
<td>Common causes of cerebellar, vestibular, extrapyramidal &amp; autonomic dysfunction (K4)</td>
<td>N/A</td>
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<td>Swallowing disorders</td>
<td>Neurological causes of dysphagia (K4) - Indications for laryngoscopy, videofluoroscopy, nasogastric &amp; percutaneous gastric feeding (K2)</td>
<td>- Neurological history taking &amp; Neurological examination (C4) - Establishing a neurological differential diagnosis &amp; Planning investigation (C4) - Interpretation of scans and other investigations (C4) - Presentation &amp; summary of cases (C4)</td>
<td>N/A</td>
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<td>Disorders of sexual &amp; Sphincteric function</td>
<td>Common causes of sphincteric and sexual dysfunction (K4) - Indication of urodynamic studies (K2)</td>
<td>N/A</td>
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<td>Movement disorders</td>
<td>- Parkinson's disease (K4) - Iatrogenic movement disorders (K4) - Dystonic syndromes (K2) - Choreiform syndromes (K2)</td>
<td>N/A</td>
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<tr>
<td>Memory &amp; cognitive disorders</td>
<td>Disorders of memory and cognition associated with head injury, subarachnoid hemorrhage, hydrocephalus, structural lesions of the frontal and temporal lobes and disorders of the limbic system (K4)</td>
<td>N/A</td>
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<tr>
<td>Behavioral disorders</td>
<td>The common acute and chronic presentations of organic and psychiatric behavioral disorders relating to alcohol and drug abuse, encephalitis, organic dementia &amp; psychosis (K4)</td>
<td>N/A</td>
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<td>Topic</td>
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<td>Clinical Skills</td>
<td>Technical Skills</td>
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</table>
| **Hearing disorder**          | Common causes of conductive and sensorineural hearing loss (K4)            | - Neurological history taking and Neurological examination (C4)  
- Establishing a neurological differential diagnosis & Planning investigation (C4)  
- Interpretation of scans, pure tone audiograms & auditory evoked potentials (C4)  
- Presentation and summary of cases (C4)                                                                 | N/A              |
|                              | Principles of audiological assessment (K3)                                |                                                                                                                                                                                                               |                  |
| **Visual disorder**           | Patterns of visual loss in relation to common bulbar, retrobulbar, sellar, parasellar and optic pathway disorders (K4) | - Neurological history taking and Neurological examination (C4)  
- Use of computerized visual field assessment (C4)  
- Detailed fundoscopy (C4)  
- Establishing a neurological differential diagnosis  
- Planning investigation (C4)  
- Interpretation of scans and other investigations (C4)  
- Presentation and summary of cases (C4)                                                                 | N/A              |
|                              | Analysis of diplopia and nystagmus in relation to common cranial nerve and brainstem disorders (K4) |                                                                                                                                                                                                               |                  |
| **Language & speech disturbance** | - Classification, causes & presentations of dysphasias, speech dyspraxia & dyslexia (K4)  
- Classification, causes and presentations of dysarthria (K4)  
- Role of speech and language therapists in assessment and treatment (K2) | - Neurological history taking and Neurological examination with assessment of dysphasia and dysarthria (C4)  
- Establishing a neurological differential diagnosis & Planning investigation (C4)  
- Interpretation of scans and other investigations (C4)  
- Presentation & summary of cases (C4)                                                                 | N/A              |
| **YEAR 2**                    | **Management of the head injured patient**                                | - Clinical assessment of the multiply-injured (C4)  
- Neurological assessment of head-injured patients including (C4)  
  - Assessment & categorization of impaired consciousness  
  - Recognition & interpretation of focal neurological deficits  
  - Prioritization of clinical risk (C4)  
  - Interpretation of CT scans and plain radiology (C3)                                                                 | N/A              |
|                              | - Pathophysiology of head injury & multiple trauma including an understanding of:  
  - Cerebral perfusion and oxygenation (K4)  
  - Raised intracranial pressure and impaired intracranial compliance (K4)  
  - Intracranial herniation (K4)  
  - Medical management of acutely raised intracranial pressure (K4)  
  - Indications for operation intervention including use of pressure monitoring (K4)  
  - Principles, diagnosis and confirmation of brain death (K4)  
  - Principles of intensive care of head injured patients (K4)  
  - Principles of spinal stabilization and radiological assessment in head injured (K4)  
  - Natural history of recovery from head injury including neurological, cognitive and behavioral disability and post- traumatic epilepsy (K3)  
  - Role of neurological rehabilitation (K2) |                                                                                                                                                                                                               |                  |
|                              | - Indications for ICP monitoring (K4)  
- Applied anatomy of the skull vault (K4)  
- Calibration, zeroing and interpretation of ICP traces (K4)  
- Potential complications of the procedure (K4) |                                                                                                                                                                                                               | Insertion of frontal subdural & intraparenchymal ICP monitors using a standard frontal burr hole and/or twist drill craniostomy (T4) |
<table>
<thead>
<tr>
<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burr hole evacuation of chronic subdural</td>
<td>Pathophysiology of chronic subdural hematomas (K4)</td>
<td>Neurological assessment of patients with CSDH (C4)</td>
<td>Performance of single and multiple frontal and parietal burrhole evacuation of CSDHs (T4)</td>
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<td>hematoma</td>
<td>Applied anatomy of the skull vault and subdural space (K4)</td>
<td>Interpretation of CT scans (C3)</td>
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<td>Indications for surgery and Surgical options and Complications (K4)</td>
<td>Obtaining informed consent (C4)</td>
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<td></td>
<td>Management of anti-platelet and anti-coagulant medication (K4)</td>
<td>Post-op assessment &amp; management (C4)</td>
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<td>Management of soft tissue trauma</td>
<td>Anatomy and blood supply of the scalp (K4)</td>
<td>Assessment of tissue perfusion and viability (C4)</td>
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<td>Indications for primary and secondary closure of wounds (K4)</td>
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<td>Indications for antibiotic prophylaxis (K4)</td>
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<td>General management of subarachnoid</td>
<td>Aetiology and Pathophysiology of SAH (K4)</td>
<td>Interpretation of CT scans including assessment of intracranial blood load, hematomas and hydrocephalus (C3)</td>
<td>Lumbar puncture (T4)</td>
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<td>hemorrhage</td>
<td>WFNS grading of SAH (K4)</td>
<td>Basic interpretation of cerebral angiography (C3)</td>
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<td></td>
<td>Principles of resuscitation and timing of interventions (K4)</td>
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<td>Indications for CT scanning, diagnostic lumbar puncture, CT angiography and</td>
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<td>digital subtraction angiography (K4)</td>
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<td>Principles of management of post-hemorrhagic hydrocephalus (K4)</td>
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<td>Indications for endovascular and surgical intervention (K4)</td>
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<tr>
<td>Management of delayed secondary</td>
<td>Pathophysiology of delayed cerebral ischemia &amp; the impact of secondary</td>
<td>Assessment of a deteriorating patient (C4)</td>
<td>Insertion of central venous catheter (T2)</td>
</tr>
<tr>
<td>ischemia</td>
<td>insults (K4)</td>
<td>Recognition &amp; management of secondary insults (C4)</td>
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<td></td>
<td>Principles governing the augmentation of cerebral blood flow (K4)</td>
<td>Interpretation of CT scans (C4)</td>
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<td>Management of hypervolemia hypertension (C3)</td>
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<tr>
<td>Management of post-hemorrhagic</td>
<td>Pathophysiology of hydrocephalus (K4)</td>
<td>Assessment of the unconscious &amp; deteriorating SAH patient (C4)</td>
<td>Lumbar drain insertion (T4)</td>
</tr>
<tr>
<td>hydrocephalus</td>
<td>Indications for external ventricular &amp; lumbar subarachnoid drainage (K4)</td>
<td>Interpretation of CT scans (C3)</td>
<td>Insertion of external ventricular drain (T4)</td>
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<td></td>
<td>Applied anatomy of skull vault, subdural space &amp; ventricular system (K4)</td>
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<td></td>
<td>Complications of surgery (K4)</td>
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<tr>
<td>Image-guided biopsy of intracranial tumor</td>
<td>Indications and risks of biopsy of intracranial tumors (K4)</td>
<td>Interpretation of CT and MRI scans and selection of biopsy targets (C3)</td>
<td>Image-guided frameless and/or frame-based stereotactic biopsy including: (T3)</td>
</tr>
<tr>
<td></td>
<td>Principles of image-guided surgery (K4)</td>
<td></td>
<td>- Setting up a computer workstation and importing &amp; interrogating image data</td>
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<td></td>
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<td>- Positioning the patient and applying a cranial fixator</td>
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<td>- Obtaining &amp; confirming accurate patient registration</td>
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<td>- Positioning and performing a suitable burr hole</td>
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<td>- Passage of biopsy probe &amp; biopsy</td>
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<td>- Preparation of smear histology (when available)</td>
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</tbody>
</table>
| Acute Spinal Disorders | - Assessment and peri-operative management of patients presenting with spinal cord, cauda equina and spinal root compression (K4)  
- Management of spinal shock (K4)  
- Ward management of patients with spinal instability (K4)  
- Detection and initial management of post-operative complications including compressing hematomas, CSF fistula and spinal sepsis (K4) | - N/A                                                                         | N/A              |
| Adult hydrocephalus | - Pathophysiology of CSF circulation (K3)  
- Applied surgical anatomy of the ventricular system (K3)  
- Indications for external ventricular drainage, ventriculoperitoneal shunting, lumbar CSF drainage and shunting, ventriculo-cisternostomy (K3)  
- Complications of surgery (K3) | - N/A                                                                         | - Ventricular drain and access device Insertion (T3)  
- VP Shunt Insertion (T2)  
- VP Shunt Revision (T1) |
| Assessment and peri-operative management of patients with space-occupying intracranial tumors | - Neuropathology of primary and secondary intracranial tumors including: - classification - epidemiology - natural history (K3)  
- Clinical presentations of intracranial tumors and indications for neuroimaging (K4)  
- Management of raised intracranial pressure (K4)  
- Principles of operative management (K3)  
- Detection and management of post-operative complications (K3) | - Neurological history taking and examination (C4)  
- Basic interpretation of CT and MRI scans (C4) | N/A              |

**YEAR 3 & 4**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
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</table>
| Management of the head injured patient | - Pathophysiology of head injury & multiple trauma (K4)  
- Prevention of secondary insults (K4)  
- Indications for operative intervention (K4)  
- Medical management of acutely raised intracranial pressure (K4) | - Clinical assessment of the head-injured & multi-injured patient (C4)  
- Prioritization of clinical risk (C4)  
- Interpretation of CT scans & plain radiology (C4)  
- Interpretation of multi-modality cerebral monitoring (C4)  
- Ability to assess and advise on the transfer of head-injured patient using image-transfer & telemedicine (C4) | N/A              |
| Surgical management of cranial trauma | - Pathophysiology of raised intracranial pressure & space occupying hematomas (K4)  
- Applied surgical anatomy (K4)  
- Principles of peri-operative care (K4)  
- Indications for surgery & appropriate surgical approaches (K4) | - Assessment of the head-injured patient and interpretation of trauma CT scans (C4) | - Craniotomy for supratentorial traumatic hematoma (T3)  
- Planning and siting of craniotomies for evacuation of extradural and subdural hematomas (T3)  
- Handling the "tight" brain (T3)  
- Achieving hemostasis in the coagulopathic patient (T3)  
- Achieving hemostasis from skull base & venous sinuses(T3)  
- Elevation of compound depressed skull fracture with dural repair (T3)  
- Delayed cranioplasty of skull vault (T3) |
<table>
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<tr>
<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
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<tbody>
<tr>
<td>Neuro-intensive care of the head-injured patient</td>
<td>- Pathophysiology of head injury (K4)</td>
<td>- Assessment of the unconscious patient (C4)</td>
<td>N/A</td>
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<tr>
<td></td>
<td>- The management of raised intracranial pressure, impaired intracranial compliance, and cerebral ischemia (K4)</td>
<td>- Use &amp; interpretation of multimodality monitoring (C4)</td>
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<td></td>
<td>- Prevention &amp; management of secondary insults (K4)</td>
<td>- Interpretation of CT scans (C4)</td>
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<tr>
<td>Neurological rehabilitation</td>
<td>- The natural history of recovery from head injury (K4)</td>
<td>- Ability to advise on management of secondary complications &amp; further surgical intervention (C4)</td>
<td>N/A</td>
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<td>- Understanding of neurological, cognitive and behavioral disabilities following mild and severe head injury (K4)</td>
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<td>- Post-traumatic epilepsy Risks &amp; management (K4)</td>
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<td>Aneurysmal subarachnoid haemorrhage</td>
<td>- Pathophysiology of SAH (K4)</td>
<td>- Clinical assessment of patients with aneurysmal SAH (C4)</td>
<td>- External ventricular drainage and Lumbar subarachnoid drainage (T4)</td>
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<td></td>
<td>- Prevention and management of delayed cerebral ischemia, cerebral vasospasm &amp;hydrocephalus (K4)</td>
<td>- Non operative management of patients undergoing endovascular coiling (C4)</td>
<td>- Ventriculoperitoneal shunting (T3)</td>
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<td></td>
<td>- Relative indications for endovascular &amp; surgical interventions (K4)</td>
<td>- Management of delayed cerebral ischemia (C4)</td>
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<td>Primary intracerebral haematomas</td>
<td>- Aetiology of supra &amp; infratentorial intracerebral hemorrhage (K4)</td>
<td>- Assessment of patients with intracerebral hematomas and raised intracranial pressure (C4)</td>
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<td>- Pathophysiology of spontaneous intracerebral hemorrhage (K4)</td>
<td>- Interpretation of CT and MRI scans and identification of probable aetiology (C4)</td>
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<td>- Indications for surgical evacuation (K4)</td>
<td>- Indications for pre-operative CT angiography, MRA and digital subtraction angiography (C4)</td>
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<td></td>
<td>- Management strategies to reduce the risk of intra-operative re-bleeding in presence of suspected aneurysm or AVM including partial hematoma evacuation, pre/post-op embolization &amp; definitive surgical treatment (K4)</td>
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<td>Adult hydrocephalus</td>
<td>- The pathophysiology of CSF circulation (K4)</td>
<td>- The assessment, counselling and pre-operative preparation of patients with hydrocephalus, including interpretation of CT and MRI scans and identification of shunt malfunction (C4)</td>
<td>- Lumbar subarachnoid drainage (T4)</td>
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<td>- Applied surgical anatomy of the ventricular system (K4)</td>
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<td>- External ventricular drainage (T4)</td>
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<td>- Indications for external ventricular drainage, ventriculoperitoneal (K4)</td>
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<td>- Primary ventriculoperitoneal shunt (T3)</td>
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<td>- Shunting, lumbar CSF drainage &amp; shunting, ventriculo-cisternostomy (K4)</td>
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<td>- Revision of ventriculoperitoneal shunt (T2)</td>
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<td></td>
<td>- Complications of surgery (K4)</td>
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<td>- Lumbo-peritoneal shunt (T2)</td>
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<td>Paediatric hydrocephalus</td>
<td>- The pathophysiology of CSF circulation (K4)</td>
<td>- Assessment of the ill child with hydrocephalus, impaired consciousness and sepsis Differential diagnosis of shunt malfunction (C4)</td>
<td>- Taping and draining from an Ommaya reservoir (T4)</td>
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<td>- Applied surgical anatomy of the ventricular system (K4)</td>
<td>- Interpretation of CT scans in shunted children (C4)</td>
<td>- Taping a shunt (T4)</td>
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<td>- Indications for external ventricular drainage (K4)</td>
<td></td>
<td>- External ventricular drainage (T2)</td>
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<tr>
<td>General principles of neuro-oncology</td>
<td>- Classification, natural history and pathology of benign and malignant intracranial neoplasia (K4)</td>
<td>- Clinical assessment of patients with raised intracranial pressure and space occupying lesions (C4)</td>
<td>N/A</td>
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<tr>
<td></td>
<td>- Pathophysiology of raised intracranial pressure associated with space occupying tumours (K4)</td>
<td>- Ability to contribute to multi-disciplinary management of patients with intracranial neoplasia (C4)</td>
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<td>- Diagnostic imaging of intracranial tumors including the interpretation of CT &amp; MRI scans &amp; the role of MRS (K4)</td>
<td>- Empathetic communication with patients &amp; families (C4)</td>
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<td>- Principles of fractionated radiotherapy, stereotactic radiotherapy and radiosurgery (K4)</td>
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<td>- Role of adjuvant chemotherapy (K4)</td>
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<td>- Principles of clinical trials and their application to neuro-oncology (K4)</td>
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<td>- Principles of palliative care (K4)</td>
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| Principles of image-guided surgery     | - An understanding of the principles and practice of frameless image-guided  | Interpretation of CT and MRI scans (C4)                                       | - Image-guided biopsy of supratentorial intrinsic tumor (T3)  
- Ability to import, check and interrogate image data sets on a standard work station  
- Setting up an image-guidance system and obtaining satisfactory intra-operative registration (T4)  
- Planning & siting burr holes & craniotomy flaps using image guidance (T4)  
- Identification of an intra-cranial tumor and its margins using image-guidance (T4) |
|                                        |    surgery and the principles of frame-based stereotactic surgery (K4)     |                                                                                |                                                                                                                                                |
| Supratentorial intrinsic tumors        | - Indications for surgery (K4)                                            | The assessment, counselling & pre-operative preparation of patients with        | - Craniotomy for superficial, lobar supratentorial intrinsic tumor safe patient positioning (T3)  
- Planning and siting of craniotomy with and without image-guidance (T3)  
- Intra-operative management of raised ICP (T3)  
- Appropriate exposure of the tumor, using operating microscope as necessary (T3)  
- Safe use of fixed retractors (T3)  
- Precise use of suction, electro-coagulation and ultrasonic aspiration intracranial hemostasis (T3) |
|                                        | - Applied surgical anatomy (K4)                                            | supratentorial intrinsic tumors (C4)                                          |                                                                                                                                                |
|                                        | - Principles of peri-operative care Complications surgery (K4)             |                                                                                |                                                                                                                                                |
| Convexity meningioma                   | - Indications for surgery (K4)                                            | The assessment, counselling and pre-operative preparation of patients with     | - Resection of a convexity meningioma (T3)  
- Safe patient positioning (T3)  
- Planning & siting of craniotomy with and without image-guidance intra-operative management of raised ICP (T3)  
- Appropriate exposure of the tumor (T3)  
- Precise use of suction, electro-coagulation and ultrasonic aspiration use of internal tumor decompression (T3)  
- Dissection in the subarachnoid plane using operating microscope as necessary (T3)  
- Intracranial hemostasis (T3)  
- Use of duraplasty and cranioplasty (T3) |
|                                        | - Applied surgical anatomy (K4)                                            | convexity meningiomas (C4)                                                    |                                                                                                                                                |
|                                        | - Principles of peri-operative care (K4)                                  |                                                                                |                                                                                                                                                |
|                                        | - Complications of surgery (K4)                                           |                                                                                |                                                                                                                                                |
| General microbiological principles      | - The pathophysiology of intracranial & spinal sepsis (K4)                | - Clinical assessment of patients with CNS infections (C4)                    | N/A                                                                                                                                              |
|                                        | - Principles of anti-microbial chemotherapy (K4)                           | - Interpretation of CT & MRI scans (C4)                                       |                                                                                                                                                |
|                                        | - Indications for operative intervention (K4)                             |                                                                                |                                                                                                                                                |
| Management of intra-cerebral abscess & | - Indications for surgery (K4)                                            | The assessment and pre-operative preparation of patients with a               | Burr hole aspiration of a cerebral abscess with and without image guidance (T4) |
| sub-dural empyema                      | - Applied surgical anatomy (K4)                                            | cerebral abscess (C4)                                                         |                                                                                                                                                |
|                                        | - Principles of peri-operative care (K4)                                  |                                                                                |                                                                                                                                                |
|                                        | - Complications of surgery (K4)                                           |                                                                                |                                                                                                                                                |
| Management of the spinal injury patient| - Pathophysiology of spinal cord injury (K4)                             | - Clinical assessment of the spinal injury patient (C4)                      | - Use of external mobilization including cervical collars and spinal boards (T4)  
- Application of halo traction (T3)  
- Application of a halo-body jacket (T2) |
<p>|                                        | - Classification of spinal fracture dislocations (K4)                     | - Management of spinal shock (C4)                                            |                                                                                                                                                |
|                                        | - Biomechanics of spinal instability (K4)                                 | - Interpretation of plain radiology, CT &amp; MRI scans(C4)                     |                                                                                                                                                |
|                                        | - Indications for halo traction &amp; external stabilization (K4)             | - Liaison with spinal injury units (C4)                                       |                                                                                                                                                |
|                                        | - Principles &amp; Indications for open reduction &amp; stabilization (K4)         |                                                                                |                                                                                                                                                |</p>
<table>
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<th>Topic</th>
<th>Knowledge</th>
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<th>Technical Skills</th>
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| Malignant spinal cord compression         | - The pathophysiology of spinal cord compression  
- The classification, aetiology and natural history of vertebral metastases (K4)  
- Spinal instability associated with vertebral malignancy(K4)  
- Indications for surgical intervention (K4)  
- Role of primary radiotherapy and adjuvant radiotherapy or chemotherapy (K4) | - Clinical assessment of patients with malignant spinal cord compression (C4)  
- Interpretation of plain radiology, CT & MRI scans (C4)  
- Liaison with medical oncologists & radiotherapist (C4) | N/A                                                                                                                                           |
| Surgical management of thoraco-lumbar metastases | - Indications for surgery (K4)  
- The principles of operative spinal decompression and stabilization of patients with spinal cord metastases (K4)  
- Applied surgical anatomy (K4)  
- Principles of peri-operative care (K4)  
- Complications of surgery (K4) | - The assessment, counselling and pre-operative preparation of patients with malignant spinal cord compression (C4) | - Extradural spinal biopsy and decompression by laminectomy in selected patients without segmental instability (T3)  
- Instrumented posterior spinal stabilization (T2) |
| Lumbar radiculopathies                    | - Indications for operative management of lumbar radiculopathies (K4)  
- Applied surgical anatomy of the lumbar spine with particular reference to degenerative neural compression & morphological variations in vertebral anatomy (K4)  
- Selection of minimally-invasive approaches (K4)  
- Principles of peri-operative care (K4)  
- Complications of surgery (K4) | - The assessment, counselling and pre-operative preparation of patients with lumbar radiculopathies (C4)  
- Interpretation of plain radiographs, CT scan, MRI scans and CT myelograms (C4) | - Primary lumbar microdiscectomy (T3)  
- Primary posterior decompression (laminotomy, hemilaminectomy etc): including - Identification of spinal level by pre and intra-operative fluoroscopy - Achieving safe access to the spinal canal by micro-surgical fenestration - Achieving full decompression of the spinal canal, lateral recess and foramen by appropriate bone & soft tissue resection - protection & safe retraction of neural tissues (T3) |
| Compressive cervical myeloradicularopathies | - Indications for operative management of cervical myeloradicularopathies (K4)  
- Applied surgical anatomy of the cervical spinal column with particular reference to the relationships between the bony elements, spinal cord, nerve roots and vertebral arteries (K4)  
- Selection of surgical approaches (K4)  
- Principles of peri-operative care  Complications of surgery (K4) | - The assessment, counselling and pre-operative preparation of patients with cervical myeloradicularopathies (C4)  
- Interpretation of plain radiographs, CT scan, MRI scans and CT myelograms (C4) | - Single level anterior cervical discectomy with/without fusion(T3)  
- Standard anterolateral approach to the cervical spine (T3)  
- Use of fluoroscopy or plain radiographs to confirm spinal level (T3)  
- Radical and subtotal excision of the cervical disc, PLL, central and unco- vertebral osteophytes (T3)  
- Protection and full decompression of the spinal cord and spinal nerve roots (T3)  
- Interbody fusion using autologous bone with or without interbody cages (T3) |
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<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
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| **Management of the head injured patient** | - Pathophysiology of raised intracranial pressure & space occupying hematomas (K4)  
- Applied surgical anatomy (K4)  
- Principles of peri-operative care (K4)  
- Indications for surgery & appropriate surgical approaches (K4)  
- Indications for open and endoscopic closure of traumatic CSF fistulae (K4)  
- Complications of surgery and their management (K4) | - Competence in all aspects of peri-operative management of head-injured patients (C4)  
- Ability to diagnose & confirm brain death (C4) | - Craniotomy for supra and infratentorial extradural, subdural and intracerebral hematomas (T4)  
- Lobectomy for hemorrhagic contusion (T4)  
- Vault cranioplasty using in-situ/preformed prostheses (T4)  
- Decompressive bifrontal craniotomy with extensive durotomy (T3)  
- Subfrontal extradural or subdural repair of anterior fossa fractures (T3) |
| **Aneurysmal subarachnoid hemorrhage** | - Pathophysiology of SAH (K4)  
- Prevention and management of delayed cerebral ischemia, cerebral vasospasm and hydrocephalus (K4)  
- Relative indications for endovascular & surgical interventions(K4) | - Clinical assessment of patients with aneurysmal SAH (C4)  
- Non operative management of patients undergoing endovascular coiling (C4)  
- Management of delayed cerebral ischemia (C4) | - External ventricular drainage (T4)  
- Lumbar subarachnoid drainage (T4)  
- Ventriculoperitoneal shunting (T4)  
- Revision of ventriculoperitoneal shunt (T4)  
- Craniotomy for intracerebral hematoma (T4) |
| **Intracranial aneurysms** | - Aetiology, epidemiology & natural history of unruptured/ruptured intracranial aneurysms (K4)  
- Pathophysiology & general management of subarachnoid hemorrhage (K4)  
- Angiographic & microsurgical anatomy of the cerebral circulation (K3)  
- Indications for surgical management of intracranial aneurysms by clipping, trapping, microsurgical reconstruction and microvascular bypass (K3)  
- Complications of surgery and their management (K4) | - Assessment, counselling & pre-operative preparation of patients with ruptured and unruptured aneurysms (C4)  
- Interpretation of CT, MR and catheter angiography (C4) | - Standard pterional and subfrontal approaches (T4)  
- Clipping of anterior circulation aneurysm (T2) |
| **Intracranial vascular malformations** | - Pathogenesis, aetiology, epidemiology and natural history of intracranial vascular malformations including AVMs, A-V fistula, cavernomas & venous malformations (K4)  
- Pathophysiology and general management of intracranial hemorrhage (K4)  
- Angiographic and microsurgical anatomy of the cerebral circulation (K3)  
- Indications for embolization and radiosurgery (K3)  
- Indications for surgical management of malformations (K3)  
- Complications of surgery & their management, including hyperperfusion syndromes (K4) | - The assessment, counselling and pre-operative preparation of patients with vascular malformations (C4)  
- Interpretation of CT, MR and catheter angiography (C4) | - Image-guided craniotomy and exposure of supra-SSStentorial AVM (T3)  
- Microsurgical resection of superficial gyral or sulcal AVM (T2) |
<table>
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<th>Topic</th>
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<th>Technical Skills</th>
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| Occlusive cerebrovascular disease | - The epidemiology, natural history and pathophysiology of extra- and intracranial atherosclerotic occlusive disease (K3)  
- The epidemiology, natural history and pathophysiology of non-atherosclerotic occlusive diseases (K3)  
- Optimal medical management of occlusive and thrombo-embolic cerebrovascular disease (K3)  
- Imaging of the acutely ischaemic brain using CT and MRI (K3)  
- Principles of non-invasive and invasive imaging of the extra and intracranial vasculature using CT, MRI and catheter angiography (K3)  
- Principles of regional cerebral blood flow and metabolism measurement & imaging using CT and MRI perfusion techniques; SPECT & PET scanning (K2)  
- Indications for carotid endarterectomy (K2)  
- Indications for endovascular intervention including intra-arterial (K2) thrombolysis; carotid angioplasty and stenting; intracranial angioplasty  
- Principles of cerebral revascularisation by indirect synangiosis, low-flow EC-IC anastomosis and high flow EC-IC bypass grafting (K2) | - Assessment, counselling & pre-operative preparation of patients undergoing surgery for occlusive cerebrovascular disease with ruptured and unruptured aneurysms (C4)  
- Interpretation of CT, MR and catheter angiography (C3) | N/A |
| Adult hydrocephalus | - The pathophysiology of CSF circulation (K4)  
- Applied surgical anatomy of the ventricular system (K4)  
- Indications for external ventricular drainage, shunting, lumbar CSF drainage & shunting, ventriculo-cisternostomy (K4)  
- Surgical complications and their management (K4) | - The assessment, counselling and pre-operative preparation of patients with hydrocephalus (C4)  
- Interpretation of pressure studies and CSF infusion studies (C4)  
- Interpretation of CT and MRI scans and identification of shunt malfunction (C4) | Competence in all aspects of primary and revisional shunt surgery including:  
- Use of -D image-guidance or ultrasound for difficult ventricular cannulation (T4)  
- Intra-operative testing of shunt function  
  Selection of appropriate shunts (T4)  
- Management of peri-operative ventricular hemorrhage Lumbo-peritoneal shunt (T4)  
- Third ventriculo-cisternostomy (T2) |
| Paediatric hydrocephalus | - The pathophysiology of CSF circulation (K4)  
- Applied surgical anatomy of the ventricular system (K4)  
- Indications for external ventricular drainage, lumbar CSF drainage and shunting, ventriculo-cisternostomy (K4)  
- Indications for VP and VA shunting (K4)  
- Principles of shunt function and selection (K4)  
- Surgical complications and their management (K4) | - Assessment of the ill child with hydrocephalus, impaired consciousness and sepsis (C4)  
- Differential diagnosis of shunt malfunction (C4)  
- Interpretation of CT scans in shunted children (C4) | - Insertion, tapping & draining from CSF reservoir (T4)  
- External ventricular drainage including externalisation of VP shunts (T4)  
- Ventriculo-peritoneal shunting (T3) |
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<th>Topic</th>
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| **Anterior and middle fossa skull base tumours** | - Indications for selected approach in relation to pathology & surgical goals (K4)  
- Applied microsurgical anatomy of the anterior and middle cranial fossae (K4)  
- Principles of intra-operative management of patients undergoing resection of anterior and middle fossa tumours including olfactory groove, planum sphenoidale, parasellar and sphenoid wing and falcine meningiomas (K4)  
- Complications of surgery and their management (K4) | - The assessment, counselling and pre-operative preparation of patients with anterior and middle fossa tumors (C4)  
- Interpretation of CT and MRI scans (C4) | - Standard pterional and subfrontal approaches including: Pterional resection & basal drilling - Subfrontal approach to the optic nerve, chiasm and internal carotid arteries - Sylvian fissure splitting and exposure of the MCA bifurcation - CSF drainage by chiasmatic cisternal suction, intra-operative ventricular puncture and lamina terminalis fenestration (T4)  
- Bi-Frontal/Frontal & parietal parafalcine approaches (T4)  
- Microsurgical resection of superficial skull base meningioma (T4)  
- Anterior interhemispheric, fronto-orbital, zygomatic and temporo-zygomatic approaches (T2) |
| **Transphenoidal surgery** | - Pathophysiology of hypothalamic-pituitary axis  
- Indications for surgery (K4)  
- Selection of surgical approaches: sublabial, transnasal & endoscopic (K3)  
- Applied surgical anatomy of the skull base (K3)  
- Principles of peri-operative care (K4)  
- Complications of surgery and their management (K4) | - The assessment, counselling and pre-operative preparation of patients with pituitary, sellar and parasellar tumors (C4)  
- Interpretation of CT & MRI scans (C4) | - Microsurgical transphenoidal approach (T3)  
- Transphenoidal resection of non-functioning macroadenoma (T2) |
| **Midline tumors** | - Indications for surgery (K4)  
- Applied surgical anatomy of midline structures (K4)  
- Selection of surgical approaches including principles of endoscopic biopsy and/or resection (K4)  
- Principles of intra-operative management of patients undergoing resection of midline sellar, para-sellar, pineal and third ventricular tumors including colloid cysts (K4)  
- Complications of surgery and their management (K4) | - The assessment, counselling and pre-operative preparation of patients with midline tumours tumours (C4)  
- Interpretation of CT and MRI scans (C4) | - Transfrontal, transcortical approach to the lateral and third ventricle (T3)  
- Microsurgical resection of lateral intraventricular tumor (T2)  
- Transfrontal endoscopic biopsy (T3) |
| **Malignant posterior fossa tumours** | - Indications for surgery (K4)  
- Selection of surgical approaches (K4)  
- Applied surgical anatomy (K4)  
- Principles of peri-operative care (K4)  
- Complications of surgery and their management (K4) | - The assessment, counselling and pre-operative preparation of patients with posterior fossa malignant tumors (C4)  
- Interpretation of CT and MRI scans (C4) | Competence in midline, paramedian and retrosigmoid posterior fossa craniotomies including:  
- Safe patient positioning in the prone and semi-prone positions - exposure of the lateral and sigmoid sinuses - exposure and decompression of the foramen magnum - use of cisternal CSF drainage - safe use of fixed retractors - exposure and resection of superficial, lateral and midline intrinsic cerebellar tumours and metastases (T4) |
<table>
<thead>
<tr>
<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
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</table>
| Cerebellopontine angle tumors | - Relative indications for surgery, radiosurgery & conservative management (K4)  
- Principles of intra-operative management of patients undergoing resection of CP angle tumours including vestibular schwannomas and meningomas (K4)  
- Principles and application of cranial nerve & brainstem monitoring (K3)  
- Applied microsurgical anatomy of the CP angle, brainstem & lower cranial nerves (K4)  
- Relative indications for retrosigmoid, middle fossa, and translabyrinthine approaches with respect to hearing preservation, tumor size & position (K3) | - Assessment, counselling and pre-operative preparation of patients with CP angle tumors (C4)  
- Interpretation of CT & MRI scans (C4) | - Retrosigmoid approach (T4)  
- Subarachnoid dissection and exposure of the tumor and lower cranial nerves (T3)  
- Subtotal microsurgical resection of acoustic neuroma (T2) |
| Management of intracerebral abscess & subdural empyema | - The aetiology and pathophysiology of intracranial sepsis (K4)  
- Indications for burr hole drainage, ventricular drainage and craniotomy in the management of intracranial sepsis (K4)  
- Indications for combined otorhinological procedures (K4)  
- Applied surgical anatomy (K4)  
- Principles of peri-operative care (K4)  
- Surgical complications (K4) | - Assessment, counselling and pre-operative preparation of patients with intracranial sepsis (C4)  
- Interpretation of CT & MRI scans (C4)  
- Management of anti-microbial therapy (C3) | - Burr hole drainage of intracerebral abscess (T4)  
- Ventricular drainage (T4)  
- Craniotomy for subdural empyema, including frontal and parietal parafalcine approaches (T4)  
- Craniotomy and resection of frontal, temporal and cerebellar abscess (T4)  
- Anterior and middle fossa extradural and subdural duroplasty (T3) |
| Movement disorders | - The aetiology and pathophysiology of movement disorders (K3)  
- Indications for medical, minimally-invasive & surgical management (K2)  
- Complications of surgery and their management (K4) | Surgical aspects of the multi-disciplinary assessment of patients with movement disorders (C3) | N/A |
| Chronic pain | - The aetiology and pathophysiology of chronic pain syndromes (K3)  
- Indications for medical, minimally-invasive & surgical management (K3)  
- Complications of surgery and their management (K3) | - Surgical aspects of the multi-disciplinary assessment of chronic pain patients (C3)  
- Pre-op counselling & preparation (C4) | N/A |
| Trigeminal neuralgia | - Aetiology, epidemiology & natural history of trigeminal neuralgia (K4)  
- Differential diagnosis and management of related cranio-facial pain syndromes (K4)  
- Medical management of cranio-facial pain (K4)  
- Surface anatomy of the trigeminal nerve & microsurgical anatomy of CP angle (K4)  
- Indications for surgical management of trigeminal neuralgia by peripheral neurectomy, percutaneous rhizotomy, radiofrequency rhizotomy, microvascular decompression (K4)  
- Complications of surgery and their management (K4) | - Assessment, counselling & pre-operative preparation of patients with trigeminal neuralgia (C4)  
- Interpretation of posterior fossa CT & MRI scans (C4) | - Retrosigmoid microsurgical approach to the CP angle and trigeminal nerve (T3)  
- Trigeminal microvascular decompression (T2)  
- Percutaneous trigeminal rhizotomy (T2) |
| Epilepsy | - The aetiology & pathophysiology of idiopathic & lesional epilepsy (K4)  
- Indications for medical and surgical management (K3) | - Surgical aspects of the multi-disciplinary assessment of epilepsy patients (C4)  
- Interpretation of CT, MRI & SPECT scans (C4)  
- Pre-op counselling & preparation (C4) | - Image-guided resection of cortical lesions (T3)  
- Vagal nerve stimulation (T3) |
<table>
<thead>
<tr>
<th>Topic</th>
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<th>Clinical Skills</th>
<th>Technical Skills</th>
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</table>
| Cervical spine fracture-subluxation | - Pathophysiology of spinal cord injury (K4)  
- Classification of cervical spinal fracture dislocations (K4)  
- Biomechanics of spinal instability (K4)  
- Indications for halo traction and external stabilization (K4)  
- Indications for and principles of open reduction and stabilization (K4) | - Clinical assessment of the spinal injury patient (C4)  
- Management of spinal shock (C4)  
- Interpretation of plain radiology, CT & MRI scans (C4)  
- Liaison with spinal injury units (C4)  
- Counselling and pre-operative preparation of spinal injury patients (C4) | Application of cranial-cervical traction (T4) |
| Thoraco-lumbar fractures | - Pathophysiology of spinal cord injury (K4)  
- Classification of thoracolumbar fracture dislocations (K4)  
- Biomechanics of spinal instability (K4)  
- Indications for open reduction and stabilization (K4) | - Clinical assessment of the spinal injury patient (C4)  
- Management of spinal shock (C4)  
- Interpretation of plain radiology, CT & MRI scans (C4)  
- Liaison with spinal injury units (C4)  
- Counselling and pre-operative preparation of spinal injury patients (C4) | Posterior reduction of thoracolumbar fractures by pedicle screw instrumentation and ligamentotaxis (T2) |
| Malignant spinal cord compression | - Pathophysiology of spinal cord compression (K4)  
- Classification, aetiology & natural history of vertebral metastases (K4)  
- Spinal instability associated with vertebral malignancy (K4)  
- Indications for percutaneous and open spinal biopsy (K4)  
- Role of primary radiotherapy/adjuvant radiotherapy/chemotherapy (K4)  
- Indications for spinal decompression with and without instrumented spinal stabilization (K4) | - Clinical assessment of patients with malignant spinal cord compression (C4)  
- Interpretation of plain radiology, CT & MRI scans (C4)  
- Liaison with medical oncologists & radiotherapist (C4)  
- Counselling and pre-operative preparation of patients with malignant spinal cord compression (C4) | - Decompressive thoracic and lumbar laminectomy with extradural tumor resection (T4)  
- Posterior pedicle screw stabilization (T3)  
- Anterior cervical corporectomy with anterior column re-construction and anterior cervical plating (T3) |
| Intradural extradural tumors | - Classification, natural history and basic molecular biology of intradural spinal tumors (K4)  
- Pathophysiology of spinal cord compression (K4)  
- Indications for surgery (K4)  
- Selection of surgical approaches (K4)  
- Applied surgical anatomy (K4)  
- Principles of peri-operative care (K4)  
- Complications of surgery and their management (K4) | - Assessment, counselling and pre-operative preparation of patients with intradural spinal tumors (C4)  
- Interpretation of spinal MRI scans (C4) | - Microsurgical excision of posterior and postero-lateral intradural extramedullary tumors (T4)  
- Microsurgical excision of anterior intradural extramedullary tumours (T2) |
| Intramedullary spinal cord tumours | - Classification, natural history & pathology of intramedullary spinal cord tumours (K4)  
- Indications for biopsy, subtotal and radical excision (K4)  
- Role of adjuvant treatment (K4)  
- Applied surgical anatomy of spine and spinal cord (K4)  
- Selection of surgical approaches (K4)  
- Principles of intra-operative management of patients undergoing resection of intramedullary tumours (K4)  
- Complications of surgery and their management (K4) | - Assessment, counselling & pre-operative preparation of patients with intramedullary spinal cord tumors (C4)  
- Interpretation of spinal MRI scans (C4) | - Microsurgical biopsy of intramedullary spinal cord tumor (T3)  
- Subtotal microsurgical resection of intramedullary tumor (T2)  
- Duroplasty (T4) |
<table>
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<th>Topic</th>
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<th>Clinical Skills</th>
<th>Technical Skills</th>
</tr>
</thead>
</table>
| **Lumbar radiculopaties**          | - Indications for operative management of lumbar radiculopathies (K4)  
                                     - Applied surgical anatomy of the lumbar spine with particular reference to degenerative neural compression and morphological variations in vertebral anatomy (K4)  
                                     - Selection of minimally-invasive approaches (K4)  
                                     - Principles of peri-operative care (K4)  
                                     - Complications of surgery (K4) | - Assessment, counselling & pre-operative preparation of patients with lumbar radiculopathies (C4)  
                                     - Interpretation of plain radiographs, CT scan, MRI scans and CT myelograms (C4) | - Lumbar microdiscectomy (T4)  
                                     - Microsurgical lateral recess decompression (T4)  
                                     - Posterior decompression (laminotomy, hemilaminectomy etc) (T4)  
                                     - Revisional lumbar microsurgical discectomy with & without decompression (T4)  
                                     - Microsurgical lumbar discectomy for central disc protrusion with cauda equina compression (T4) |
| **Compressive cervical myeloradiculopathies** | - Indications for operative management of cervical radiculopathies (K4)  
                                     - Applied surgical anatomy of the cervical spinal column, spinal cord, nerve roots & vertebral arteries (K4)  
                                     - Selection of surgical approaches (K4)  
                                     - Principles of peri-operative care (K4)  
                                     - Complications of surgery (K4) | - The assessment, counselling and pre-operative preparation of patients with cervical myeloradiculopathies (C4)  
                                     - Interpretation of plain radiographs, CT scan, MRI scans and CT myelograms (C4) | - Single and multi-level anterior cervical discectomy with and without fusion (T4)  
                                     - Anterior cervical plating (T4)  
                                     - Posterior cervical microforaminotomy & microdiscectomy (T3)  
                                     - Posterior cervical decompression (laminotomy, hemilaminectomy etc (T4) |
| **Rheumatoid disease**             | - The pathology and natural history of rheumatoid spondylopathy (K3)  
                                     - Indications for operative management of atlanto-axial subluxation, cranial settling and related disorders (K3)  
                                     - Applied surgical anatomy of the craniocervical junction (K3)  
                                     - Selection of surgical approaches (K3)  
                                     - Principles of peri-operative care (K4)  
                                     - Complications of surgery (K4) | - Assessment, counselling & pre-operative preparation of patients with cervical myeloradiculopathies (C4)  
                                     - Interpretation of plain radiographs, CT scan, MRI scans and CT myelograms and D spinal reconstructions (C4) | Atlanto-axial wiring for reducible atlanto-axial subluxation (T4) |
| **Hindbrain herniation**           | - The pathogenesis and natural history of hindbrain herniation, craniovertebral stenosis, syringomyelia and syringobulbia (K4)  
                                     - Indications for foramen magnum decompression (K4)  
                                     - Applied surgical anatomy of the craniocervical junction (K4)  
                                     - Selection of surgical approaches (K4)  
                                     - Principles of peri-operative care (K4)  
                                     - Complications of surgery (K4) | - Assessment, counselling & pre-operative preparation of patients with hind brain anomalies (C4)  
                                     - Interpretation of plain radiographs, CT scan, MRI scans and CT myelograms and D spinal reconstructions (C4) | Foramen magnum decompression (T3) |
| **Spinal epidural abscess**        | - The aetiology and pathophysiology of spinal sepsis (K4)  
                                     - Indications for drainage of spinal epidural abscess by laminectomy and multiple laminotomies (K4)  
                                     - Applied surgical anatomy (K4)  
                                     - Principles of peri-operative care (K4)  
                                     - Surgical complications and their management (K4)  
                                     - Principles of peri-operative care (K4) | - The assessment, counselling and pre-operative preparation of patients with spinal sepsis (C4)  
                                     - Interpretation of spinal CT and MRI scans (C4)  
                                     - Management of anti-microbial therapy (C3) | Drainage of spinal epidural abscess by laminectomy and/or multiple laminotomies (T4) |
<table>
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<tr>
<th>Topic</th>
<th>Knowledge</th>
<th>Clinical Skills</th>
<th>Technical Skills</th>
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</table>
| Vertebral osteomyelitis and discitis | - The aetiology and pathophysiology of vertebral osteomyelitis and discitis, including pyogenic, tuberculous and atypical infections (K4)  
- Indications for percutaneous and open biopsy (K4)  
- Indications for spinal stabilization (K4)  
- Principles of peri-operative care (K4)  
- Surgical complications and their management (K4) | - Assessment, counselling and pre-operative preparation of patients with spinal sepsis (C4)  
- Interpretation of spinal CT and MRI scans (C4)  
- Management of anti-microbial therapy (C3) | Transpedicular and open vertebral and disc biopsy (T2) |
| Carpal tunnel compression | - Presentation, differential diagnosis and management of carpal tunnel syndrome (K4)  
- Interpretation of nerve conduction studies (K4)  
- Indications for surgery (K4)  
- Applied surgical anatomy (K4) | - Assessment and counselling of patients with carpal tunnel syndrome (C4) | Carpal tunnel decompression (T4) |
| Ulnar neuropathy | - Presentation, differential diagnosis and management of ulnar neuropathies (K4)  
- Interpretation of nerve conduction studies (K4)  
- Indications for surgery (K4)  
- Applied surgical anatomy (K4) | - Assessment and counselling of patients with an ulnar neuropathy (C4) | Cubital ulnar nerve decompression with and without transposition (T4) |
| Peripheral nerve sheath tumors | - Pathology of peripheral nerve sheath tumors (K4)  
- Indications for complete and subtotal resection of tumors (K4)  
- Applied surgical anatomy of the major peripheral nerves | - Assessment and counselling of patients with peripheral nerve sheath tumors (C4) | Microsurgical excision of peripheral nerve sheath tumor (T3) |
| Pediatric head and spinal injury | - Pathophysiology of raised intracranial pressure in children following head injury (K4)  
- Prevention and treatment of secondary insults relating to transfer and emergency surgery in head-injured children (K4)  
- Medical management and intensive care in pediatric head injury (K4)  
- Pathophysiology, legal and social aspects of non-accidental injury in children (K4)  
- Management of perinatal trauma, growing fractures and penetrating injuries in children (K4)  
- Indications for decompressive craniectomy in management of intractable increases in ICP (K4)  
- Rehabilitation after mild, moderate and severe head injuries (K3)  
- Diagnosis and certification of brain death in children (K4)  
- Classification, assessment, investigation and management of pediatric spinal injuries (including SCIWORA) (K4) | - Assessment and clinical management of children with head and spinal injuries (C4) | - Insertion of ICP monitor (T4)  
- Insertion of ventriculostomy (T4)  
- Cranietomy for traumatic intracranial hematoma (T4)  
- Repair of depressed skull fracture (T3) |
| Pediatric intracranial vascular disorders | - Epidemiology, natural history, pathophysiology and clinical features of subarachnoid hemorrhage, hemorrhagic stroke and ischemia stroke in children secondary to intracranial aneurysms, arteriovenous malformations and fistulae, cavernomas, arterial dissection, moyamoya disease and venous sinuses thrombosis (K4)  
- Surgical and endovascular strategies for the management of acute intracranial vascular disorders in children (K4) | - The assessment and clinical management of children presenting with spontaneous intracranial hemorrhage and acute cerebral ischemia (C4) | Emergency operative management of spontaneous intracerebral hemorrhage (T4) |
## Schedule of Surgeries

<table>
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<tr>
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<th>Procedure</th>
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<td>Adult Trauma &amp; Infection</td>
<td>Craniotomy for extradural hematoma</td>
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<td>Craniotomy for subdural hematoma</td>
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<td>Craniotomy for subdural empyema</td>
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<td>Craniotomy/burr hole for abscess</td>
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<td>Supratentorial intrinsic tumors</td>
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<td>Infratentorial intrinsic tumors</td>
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<td>Transphenoidal Procedures</td>
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<td>Retrosigmoid approach for CPA</td>
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<td>Adult CSF</td>
<td>Insertion of ventriculoperitoneal shunt</td>
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<td>Revision of ventriculoperitoneal shunt</td>
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<td>Craniotomy for Cavernoma</td>
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<td>Craniotomy for Supratentorial intracerebral hematoma</td>
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<td>Pediatric Oncology</td>
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<td>Craniotomy for Infratentorial ICH</td>
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<td>Pediatric Spine</td>
<td>Dysraphism</td>
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Residents are required to present a research through final year thesis and for this purpose, workshops are held as follows:
- Research methodology (3 days)
- Literature review & Refworks (1 day)
- SPSS (Basic Statistics)

The goal of these workshops is to understand and able to apply the following:
- Using electronic databases such as Medline & Internet to conduct literature searches and to locate information
- Critically appraise/evaluate relevant literature, reviews and new techniques/technologies
- Use word processors, databases, spreadsheets & statistical packages to produce statistical analysis & research papers
- Conduct a literature review
- Develop an hypothesis to be tested
- Choose an appropriate research methodology and design a research study
- Write a grant application to fund a research project.
- Apply for ethics committee approval for a clinical or laboratory based study
- Collect, collate and interpret data
- Apply basic statistical analysis to clinical data
- Develop an outline structure for a research paper
- Write a literature review for a research paper
- Apply the developed outline to write a research paper
- Searching the literature and data-bases purposefully
- Appraising critically relevant articles and reports
- Interpreting findings and consider their applications to other contexts
- Know how to select and draw on clinical evidence to inform practice

- Be able to define the following terms
  - Clinical significance
  - Statistically significant / insignificant
  - Variability
  - Biological variability

- Understand the following methods of and terms associated with data collection:
  - Epidemiological studies
  - Randomized controlled & crossover clinical trials
  - Randomized controlled laboratory study

- Recognize and understand the following concepts of problems associated with data:
  - Bias: confounding - measurement - sampling
  - Randomization
  - Stratification
  - Blindness (masking)
  - Relevance of sample size to the ultimate
  - Outcome of the statistical analysis

- Understand and apply the following statistical terms:
  - Probability & probability distribution models
  - Regression and correlation analysis
  - Risk – sensitivity analysis, particularly;
  - Exposure odds ratio
  - Number needed to treat
  - Significance testing
  - Meta-analysis

- Getting Research skills:
  - Choosing a topic for research
  - Having a detailed literature review for this purpose
  - Designing a research as per standard methodology
  - Choosing a mentor on the related field
  - Finalize the research proposal and get both scientific and ethical approval
  - The research proposal will consist of at least of Title page, Specific Aims
  - Introduction/Background and Significance
  - Objectives and Hypothesis
  - Research Design and Methodology
  - References / Bibliography
  - Conduct the research through data gathering, survey, or any standard tool
  - Analyze the data
  - Present the data on a thesis as per DRTP thesis guidelines.
Each thesis must be arranged in the following order:
- Title Page (Sample A). Do not place a page number on this page.
- Dedication. Do not place a page number on this page.
- Acknowledgements and/or Preface. Do not place a page number on this page.
- Abstract (Sample B). Do not place a page number on this page.
- Table of Contents. Do not place a page number on this page.
- List of Tables, Figures, Illustrations/Maps/Slides, List of Supplemental Files such as multimedia files.
- List of abbreviations
  - Text of the Thesis. All pages from the first page of text through the bibliography or Vita, if included, are numbered consecutively in Arabic numerals, beginning with Arabic numeral “1” on the first page of the thesis text.
- Introduction
- Material and Methods
- Results
- Discussion
- Limitations
- Conclusion
- Appendix or Appendices. Continue text numbering with Arabic numerals.
- References. Vancouver or Harvard standard style.
- Publications (please insert the full text of your published paper if you have any)
- Curriculum Vita. Continue text numbering with Arabic numerals.

**Thesis Formatting and Layout Requirements:**

<table>
<thead>
<tr>
<th>Page Size</th>
<th>Page size should be standard A4 size (8.50 x 11.00).</th>
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</thead>
<tbody>
<tr>
<td>Margins</td>
<td>1 inch on all sides, including page numbers.</td>
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<tr>
<td>Page Nos.</td>
<td>Should be at least 1&quot; from the below margins edges of the page, as appears in this document.</td>
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<td>Spacing</td>
<td>Preliminary pages and text must be double-spaced or 1.5-spaced. Under certain conditions, quotations may be single spaced. Table of Contents and lists with lengthy entries may be single spaced with a double space between entries. References may be single spaced, with a double space between entries.</td>
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<tr>
<td>Page Alignment</td>
<td>Each new chapter/major section (i.e. Chapter 1 - 2, Appendix, Bibliography, Vita) must begin on a new page.</td>
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<tr>
<td>Pagination</td>
<td>All text page in the thesis is numbered.</td>
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<td></td>
<td>All text page numbers in the thesis must be centered under the text in the same location on each page and located at least one inch from the bottom of the page.</td>
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<td>Word Processing</td>
<td>Your final thesis must be correct in spelling and punctuation and presented in a consistent, structured format. A single, legible font must be used throughout the thesis, the only exceptions being in tables, figures, graphs, appendices, foot notes, and supplemental files. The font size should be 12-pt. Accuracy and consistency is required in format of the thesis.</td>
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<td>Pages carrying illustrative material must be given page numbers appropriate to their place in the document. Illustrative material may not be inserted after the document has been numbered and given numbers such as “10a.” All tables, figures, illustrations, and other types of examples included and referenced in the text of the thesis should be numbered for identification. There should be no duplication of these numbers; i.e., no two tables should be assigned the same number. Figures may be numbered in one of two ways: consecutively throughout the document (Table 1, Table 2, Table 3, etc.), or double-numbered so that illustrations’ numbers reflect their locations in the document (Fig 9.3 is the third figure in Chapter 9, or Fig A2 is the second figure in Appendix A.)</td>
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<td>Captions &amp; legends</td>
<td>To be placed on the same page with the figure, graph, table or illustration they describe. In order to fit both figure and caption on the same page, captions may be single-spaced, margins may be decreased to one inch, and figures may be reduced in size to fit. If the figures are reduced from their original size, then the page number must be added after the reduction so as not to alter its size. If there is no other way to manage the amount of material to be shown, the caption and figures should be side-by-side in continuous view. This method should only be used in the rare instance where all of the pertinent material will not fit on the same page. Figures, captions, and page numbers must be easily readable when the electronic document is viewed at 100 percent.</td>
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<td>Footnote Citations, References &amp; Bibliography</td>
<td>Each thesis must include a reference, or bibliography section. This section may be called “Bibliography” or “References”. The bibliography is the last required section of the thesis and the last section heading listed on the Table of Contents unless an optional Vita page is included. When a Vita page is included, the bibliography immediately precedes the Vita at the end of the thesis. The bibliography must indicate materials actually used, such as articles, chapters of books, websites, etc.</td>
</tr>
</tbody>
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Page 23 of 24
References

- The British Intercollegiate Surgical Curriculum (Neurosurgery syllabus - August 2010).
- The Saudi Commission for Health Specialties – Program of Neurosurgery -