Curriculum

Surgical Education and Training Program in Neurosurgery

Consultation Draft

NEUROSURGICAL SOCIETY OF AUSTRALASIA
founded 1940

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1 Introduction

1.1 Overview

The overall objective of the Surgical Education and Training Program in Neurosurgery (**SET Program**) is to produce competent independent specialist neurosurgeons with the experience, knowledge, skills, and attributes necessary to provide the communities, health systems and professions they serve with the highest standard of safe, ethical, and comprehensive care and leadership.

The SET Program is one step in the continuum for the training, education, and practice of a neurosurgeon. It is designed to build on the knowledge, skills and professional qualities developed in other steps prior to the SET Program and to prepare graduates for practice as a neurosurgeon after training.

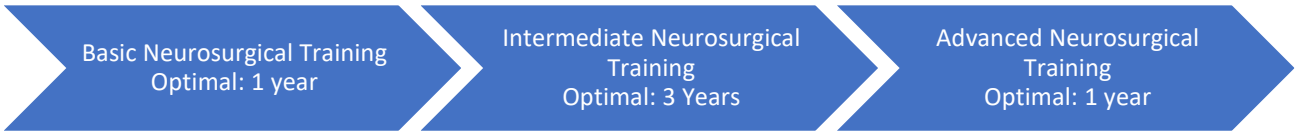
The main steps in the continuum can be summarised as follows:

The Curriculum has been developed by the Neurosurgical Society of Australasia (**NSA**) and the SET Program Board of Neurosurgery (**Board**) and must be read in conjunction with the SET Program Regulations and Royal Australasian College of Surgeons (**RACS**) regulations and policies which provide detailed guidance regarding the delivery of the SET Program, structure, and training requirements.

1.2 Structure of the SET Program

The SET Program is structured on a three-level sequential curriculum to facilitate the cumulative acquisition of the experience, knowledge, skills, and attributes aligned with the overall objective.

The optimal time required to achieve the SET Program graduate outcomes is 5 years. While 5 years is the optimal training time, the SET Program has a flexible structure which allows trainees to progress at different rates according to their ability to achieve the training requirements and graduate outcomes. The SET Program also allows for flexible training and interruption, to accommodate individual circumstances as detailed in the SET Program Regulations. As such, the SET Program can be completed in a minimum of 5 years full-time equivalent but can also extend to a maximum of 9 calendar years from commencement of training, subject to satisfactory progression through the levels in the timeframes outlined in the SET Program Regulations. The maximum training times do not include periods of approved interruption from the SET Program for parental responsibilities, carer responsibilities or health reasons.



The first level of the SET Program is Basic Neurosurgical Training, which is focused on the basic neurosurgical foundational skills. The minimum training time for Basic Neurosurgical Training is one full-time equivalent training year. The maximum training time for completion of Basic Neurosurgical Training is 2 calendar years from commencement of training.

The second level of the SET Program is Intermediate Neurosurgical Training where the trainee's involvement should be increasing in complexity. The trainee should be assuming more responsibility and building on the foundational experience, knowledge, skills, and attributes towards the required level of competence. The minimum training time for Intermediate Neurosurgical Training is 3 full-time equivalent training years from completion of Basic Neurosurgical Training. The maximum training time for completion of Intermediate Neurosurgical Training is 8 calendar years from commencement of training.

The third level of the SET Program is Advanced Neurosurgical Training where the trainee should be functioning with full emergency competence, operating as the primary surgeon in core neurosurgical procedures and acquiring the foundation for subspecialist practice. The minimum training time for Advanced Neurosurgical Training is one full-time equivalent training year from completion of Intermediate Neurosurgical Training. The maximum training time for completion of Advanced Neurosurgical Training is 9 calendar years from commencement of training.

If a trainee has completed the maximum training time for their training level and has not been approved for progression to the next training level, or completed the maximum time for completion of the SET Program and has not complete all training requirements, the trainee will be dismissed from the SET Program in accordance with the SET Program Regulations.

1.3 Structure of the Curriculum

To achieve the SET Program objectives, this curriculum articulates graduate outcomes in the RACS competency areas which include eight professional competencies and two technical competencies.

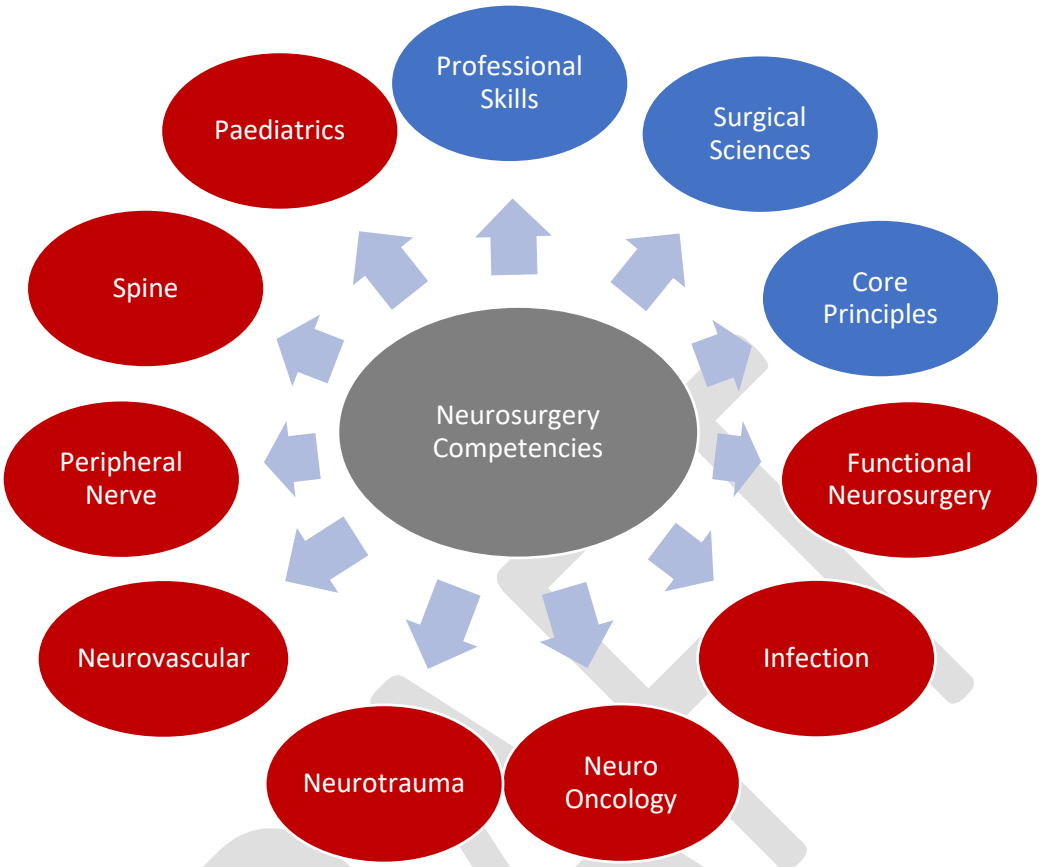
The professional competencies are:

- Collaboration and Teamwork
- Communication
- Cultural Competence and Cultural Safety
- Health Advocacy
- Judgement and Clinical Decision Making
- Leadership and Management
- Professionalism
- Scholarship and Teaching

The technical competencies are:

- Medical Expertise
- Technical Expertise

The eight professional competencies and two technical competencies have been integrated into specific learning outcomes for different training levels within the following curriculum modules.



Neurosurgery is a rapidly changing field and although the curriculum aims to provide a comprehensive, relevant, and current curriculum, there may be instances when major changes or new advances in neurosurgery require the trainee to develop competencies not encompassed by the curriculum.

The trainee is expected to develop independent learning skills and the curriculum should facilitate the development of those skills. The curriculum should guide, but not limit, the trainee's ongoing education.

The learning outcomes are delivered by a number of learning methods and modalities including structured educational programs, skills courses, self-directed learning and workplace hands on service learning and exploration.

To assess the accomplishment of the learning outcomes multiple assessment tools and performance-based standards are applied to determine the degree of progression towards the competencies and the suitability of the trainee to continue training.

To evaluate the effectiveness of achieving the overall objective evaluation mechanisms are applied to provide direction on potential improvements to the curriculum, training activities and learning methods and opportunities.

For procedural expertise, the following levels of competence in a graduating trainee are used:

Observe	Not competent to perform the procedure but has adequate knowledge of the steps through direct observation
Assist	Has adequate knowledge of the steps through direct involvement and is competent to perform parts of the procedure under supervision
Supervised	Competent to perform the whole procedure under supervision
Independent	Competent to perform the whole procedure independently

1.4 Teaching and Learning

The SET Program employs a range of teaching and learning approaches, mapped to the curriculum content to meet the SET Program graduate outcomes.

Clinical training posts facilitate workplace hands-on service learning and exploration in a range of training environments providing the opportunity for the trainee to develop, with supervision, the requisite experience, knowledge, skills, and attributes necessary to become a competent independent specialist neurosurgeon.

Teaching and learning may occur in any witnessed encounter with patients, in environments, such as:

- Accident and emergency departments
- Intensive care units
- Consulting rooms
- Consultative clinics
- Operating rooms
- Outpatient departments
- Wards and ward rounds

As part of the training post accreditation for the SET Program, training units are also required to provide trainees with the opportunity to participate in the following workplace activities:

- Consultant led tutorials focused on neurosurgery topics
- Journal Club meetings
- Neuropathology multi-disciplinary meetings
- Neuro-radiological multi-disciplinary meetings
- Morbidity and mortality and audit activities
- Neurosurgical research

1.5 Assessment Approach

The assessments contain a range of methods, including both summative and formative. The design and content of assessment tools are vitally important not only to evaluate the knowledge and skill of the trainee but also to support the development of constructive feedback for consolidation, learning, and improvement.

The eight professional competencies and two technical competencies have been integrated into specific learning outcomes in 11 curriculum modules as detailed in this Curriculum. The assessments contain a range of assessments, including both summative and formative to cover all competencies.

1.5.1 Professional Performance Assessment Report

Active Clinical Terms are assessed using the Professional Performance Assessment Report (**PPA Report**), which is completed by the Supervisor, with information provided by other members of the health care team who interact with the trainee.

The PPA Report is a summative assessment of learning, conducted at the conclusion of each Clinical Term (approximate three months), to provide trainees with feedback on their performance in all the RACS competencies. The PPA Report provides feedback to reinforce satisfactory performance and remediate identified areas of concern. The PPA Report provides evidence of whether trainees have met the standards required as part of the SET Program.

For each assessment area within the PPA Report, guidelines of what would be considered the minimum acceptable standard of performance are provided. The guidelines provide some common examples and are not exhaustive. Unsatisfactory performance includes all unethical or improper conduct and also includes honest mistakes, errors of judgement and poor standards in service delivery.

1.5.2 Direct Observation of Procedural Skills

The Neurosurgical Direct Observation of Procedural Skills Assessments (**DOPS**) are designed to assess both knowledge and technical proficiency in discrete procedural skills. The procedure must be performed by the trainee and observed by a Surgical Supervisor or Surgical Trainer approved by the Training Board (**Assessors**).

The trainee should initiate a DOPS when they feel they have a reasonable chance of demonstrating safe and efficient independent practice.

The Assessor, in completing the DOPS, is confirming that the trainee can perform all of the principal procedure independently and in a consistently safe and effective manner, based on their direct observations of the trainee performing the procedure.

1.5.3 Clinical Case Logbook

Appropriately supervised operative experience obtained during the SET Program, including good case mixes and caseloads, are essential learning opportunities for trainees to acquire the necessary technical skills and expertise to practice as an independent neurosurgical consultant.

Trainees must maintain an operative experience log of all procedures that they participate in as part of the SET Program during active Clinical Terms. A logbook summary report (**Logbook Report**) in the format

prescribed must be submitted by all trainees at the end of each six-month clinical training period and must be verified by the Supervisor as an accurate record. This information is assessed against minimum case requirements to determined suitability of the experience to meet the standards in the SET Program.

1.5.4 Research Requirements

The SET Program contains three research requirements (project, presentation, and publication), designed to ensure that trainees have exposure to research and are research literate, which is an essential part of advancing the specialty and improving health outcomes.

The research requirements are designed to ensure that trainees understand research methodology including qualitative, quantitative, bio-statistical, and epidemiological research methods. Trainees must be able to demonstrate the ability to undertake research, present the findings orally, and in written form, in a peer reviewed environment.

The research project must be a substantive project relevant to neurosurgery resulting in a meaningful outcome. The trainee must have been substantially or wholly involved in the continuum of activities associated with the research project but is not required to have performed all the work themselves (e.g., laboratory work; statistical analysis). The research project must be supervised, and trainees are offered support from the NSA Research Committee, including funding for some direct costs associated with their research through NSA awarded grants.

1.5.5 Examinations

The Fellowship Examination in Neurosurgery (**Fellowship Examination**) is a summative assessment which must be satisfactorily completed during the Advanced Neurosurgical Training period. The Fellowship Examination is comprised of written and clinical/viva components.

The required standard for the Fellowship Examination is a level of competency equivalent to that of a consultant neurosurgeon in his or her first year of independent practice. The surgical competencies espoused by the RACS and in this curriculum are used as a guideline for the examiners, who follow agreed marking guidelines and the predetermined standard.

There are also formative examinations during training. These include a Practice Examination designed to assist trainees in their preparation for the written component of the Fellowship Examination, and clinical and surgical anatomy MCQ examinations on neurosurgical topics designed to assist trainees in ensuring that their basic science knowledge relevant to neurosurgery is maintained throughout training, all of which help trainees and supervisors to identify a trainee's strengths and weaknesses and target areas for improvement.

1.5.6 Skills Courses and Seminars

The SET Program contains the following compulsory assessed skills courses and training seminars. Trainees are required to attend and engage in each of these and satisfy minimum standards:

- Early Management of Severe Trauma Course (**EMST**)
- Care of the Critically Ill Surgical Patient Course (**CCrISP**)
- Neurosurgical Training Seminars including the following topics: Spine, Neurovascular, Neurotrauma, Paediatrics, Functional Neurosurgery, Skull Base Surgery, Neuro-oncology and Professional Skills

2 Graduate Outcomes

The overall objective of the SET Program is to produce competent independent specialist neurosurgeons with the experience, knowledge, skills, and attributes necessary to provide the communities, health systems and professions they serve with the highest standard of safe, ethical, and comprehensive care and leadership.

The defined graduate outcomes for the SET Program are summarised as follows, with more detail encompassed in the individual curriculum modules and learning outcomes. The graduate outcomes are mapped against the assessments required as part of the SET Program.

Graduate Outcomes **Collaboration and Teamwork**	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Maintains harmonious working relationships	✓							
Adopts a multidisciplinary team approach to patient care, respecting the contributions and beliefs of colleagues	✓							
Ensures the timely exchange of necessary and relevant patient information	✓							
Delegates appropriate responsibilities to team members according to the skills of the person	✓							
Provides appropriate collegial and emotional support to team members	✓							
Formulates and offers a second opinion, and refers patients to other professionals when appropriate	✓				✓	✓		
Complies with patient safety measures	✓			✓	✓	✓		
Takes responsibility for the performance of the team and continuity of patient care	✓			✓	✓			
Anticipates potential areas of conflict and intervenes when appropriate	✓							
Graduate Outcomes **Communication**	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Reconciles disparate or conflicting information pertinent to decision making, patient management and treatment from multiple sources within appropriate timeframes	✓			✓	✓			
Communicates in a respectful, effective, and timely manner all necessary and relevant clinical information and decisions to members of the health care team	✓							

Communicates appropriate information to patients, families, and carers, including potentialities, benefits and risks of treatment options, in a manner which encourages their participation in informed decision-making	✓					✓		
Demonstrates empathy and makes time for patients, families, and carers to ask questions and clarify the diagnosis and treatment plan	✓							
Modifies communication to appropriately accommodate cultural and linguistic sensitivities	✓					✓		

Graduate Outcomes **Cultural Competence and Cultural Safety**	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Promotes cultural competence and cultural safety and care to achieve equitable healthcare outcomes	✓							
Understands the special status of Aboriginal and Torres Strait Islander peoples in Australia, and Māori in Aotearoa New Zealand as Indigenous people and integrates this into patient care	✓					✓		
Leads a safe and inclusive environment that considers cultural and social determinants of health for patients, families, and carers	✓							
Promotes an inclusive and safe workplace by working in partnership with colleagues from different backgrounds, organisations, and communities	✓							
Demonstrates self-awareness of biases and how these can impact interactions	✓							
Leads an environment where team members feel safe to speak up against damaging behaviours and unprofessional conduct, including discrimination, bullying and harassment	✓							

Graduate Outcomes **Health Advocacy**	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Advocates for patients in a constructive and appropriate manner with effective outcomes	✓							
Supports patients in caring for themselves and empowering them to improve and maintain their own health	✓							
Advocates for more equitable health resources to improve outcomes for patients, including those from rural, regional, and remote areas	✓							
Demonstrates commitment to the sustainability and efficiency of the healthcare system	✓							
Leads an environment of caring for the wellbeing of colleagues	✓							

Graduate Outcomes Judgement and Clinical Decision Making	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Selects appropriate medical investigations applying an evidence-based approach and accurately appraises and interprets results	✓			✓	✓	✓		✓
Makes informed and timely decisions regarding assessment, diagnosis, preoperative preparation, surgical management and postoperative follow up of patients	✓			✓	✓	✓		✓
Applies an evidence-based approach when considering where surgery is indicated and where conservative treatment is the best option of the patient	✓					✓		✓
Creates management plans for procedures, anticipating risks and benefits, incorporating individual patients' circumstances, values, and goals of care	✓							✓
Discusses and takes into account the patient's circumstances, expectations, risks and comorbidities	✓					✓		
Utilises a variety of decision making styles, choosing the appropriate method for the situation	✓							
Organises patients according to priority, balancing complex competing needs in emergency and elective situations	✓							
Plans ahead, identify risks and manages complications and changes effectively	✓							
Continually reviews the suitability of decisions and actions and makes adjustments as required	✓							

Graduate Outcomes Leadership and Management	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Understands when to lead, manage or follow, and takes direction when there are others who are better equipped to lead or manage a situation	✓							
Demonstrates leadership behaviours that inspire others and create a safe working environment	✓							
Speaks up against damaging behaviours and unprofessional conduct including discrimination, bullying and harassment	✓							
Remains calm and in control in high pressure situations	✓							
Complies with quality and safety standards, accepted principles of surgery, codes of professional conduct and protocols	✓							
Applies an efficient, organised, and reliable approach to admissions, ward rounds, bed management, operating lists and clerical duties	✓							

Graduate Outcomes Professionalism	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Demonstrates awareness and insight into their own limitations, mistakes and learning	✓							
Makes appropriate changes to practice as areas of improvement are identified	✓							
Maintains compliance with standards of ethics, probity, and confidentiality in all professional interactions	✓							
Applies effective strategies to maintain personal, mental and physical health and wellbeing to optimise performance	✓							
Makes decisions without influence of inducement, profit or personal gain	✓							
Takes responsibility to ensure an honest and open agreement of informed financial consent	✓							

Graduate Outcomes Scholarship and Teaching	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Assumes responsibility for self-directed learning, including seeking out opportunities for professional development and maintenance of knowledge and skills	✓					✓		
Applies a critically reflective approach to neurosurgery, regularly carrying out self and peer reviewed audits	✓						✓	
Supervises the teaching and assessment of junior colleagues	✓							
Adopts effective methods for communicating feedback to others	✓							
Understands research methodology including qualitative, quantitative, bio-statistical, and epidemiological research methods							✓	
Demonstrates the ability to undertake research and present findings from research in a peer reviewed environment							✓	
Demonstrates the ability write a scientific paper in a peer reviewed environment							✓	

Graduate Outcomes Medical Expertise	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Demonstrates a commitment to high-quality patient care with complete clinical assessments and management plans	✓	✓						✓
Demonstrates core surgical sciences knowledge required for the practice of neurosurgery, including anatomy, neurophysiology, neuroradiology, neuropsychology and neuropharmacology	✓	✓		✓	✓	✓		✓
Integrates and applies surgical knowledge, clinical skills and professional behaviour in the provision of patient care	✓	✓						✓
Maintains currency of knowledge through participation in self-directed learning	✓					✓		

Graduate Outcomes Technical Expertise	PPA Report	DOPS Assessment	Clinical Case Logbook	CCrISP Course	EMST Course	Training Seminars	Research Requirements	Fellowship Exam
Competently assess and manages neurosurgical patients, pre- and post-operatively, in emergency and elective settings in the specialty practice areas	✓	✓				✓		✓
Obtains informed consent prior to surgery in emergency and elective settings	✓	✓						✓
Demonstrates competence in the operative management of neurosurgical patients in the specialty practice areas, including the procedural knowledge, dexterity, and technical skills to safely and effectively perform procedures	✓	✓						✓
Approaches and carries out procedures with due attention to the safety of patient, self and others	✓	✓						✓
Reliably identifies and respond to post-operative complications	✓	✓						✓
Practices within their defined scope of practice	✓							
Critically analyses their own clinical performance for continuous improvement	✓							

3 Professional Skills

The professional skills learning outcomes, informed by the RACS Professional Skills Curriculum, apply equally across all training levels. While they have not been specifically stated in each individual specialty practice curriculum module to prevent repetition throughout the curriculum, they are applicable to all. In some instances, specialty practice curriculum modules provide selected examples of how professional skills learning outcomes apply specifically to that area of practice.

3.1 Collaboration and Teamwork

- Maintains harmonious working relationships
- Adopts a multidisciplinary team approach to patient care, respecting the contributions and beliefs of colleagues
- Ensures the timely exchange of necessary and relevant patient information
- Delegates appropriate responsibilities to team members according to the skills of the person
- Provides appropriate collegial and emotional support to team members
- Formulates and offers a second opinion, and refers patients to other professionals when appropriate
- Complies with patient safety measures
- Takes responsibility for the performance of the team and continuity of patient care
- Anticipates potential areas of conflict and intervenes when appropriate.

3.2 Communication

- Reconciles disparate or conflicting information pertinent to decision making, patient management and treatment from multiple sources within appropriate timeframes
- Communicates in a respectful, effective, and timely manner all necessary and relevant clinical information and decisions to members of the health care team
- Communicates appropriate information to patients, families, and carers, including potentialities, benefits and risks of treatment options in a manner which encourages their participation in informed decision-making
- Demonstrates empathy and makes time for patients, families, and carers to ask questions and clarify the diagnosis and treatment plan
- Modifies communication to appropriately accommodate cultural and linguistic sensitivities.

3.3 Cultural Competence and Cultural Safety

- Promotes cultural competence and cultural safety and care to achieve equitable healthcare outcomes
- Understands the special status of Aboriginal and Torres Strait Islander peoples in Australia, and Māori in Aotearoa New Zealand as Indigenous people and integrates this into patient care
- Leads a safe and inclusive environment that considers cultural and social determinants of health for patients, families, and carers
- Promotes an inclusive and safe workplace by working in partnership with colleagues from different backgrounds, organisations, and communities
- Demonstrates self-awareness of biases and how these can impact interactions

- Leads an environment where team members feel safe to speak up against damaging behaviours and unprofessional conduct including discrimination, bullying and harassment.

3.4 Health Advocacy

- Advocates for patients in a constructive and appropriate manner with effective outcomes
- Supports patients in caring for themselves and empowering them to improve and maintain their own health
- Advocates for more equitable health resources to improve outcomes for patients, including those from rural, regional, and remote areas
- Demonstrates commitment to the sustainability and efficiency of the healthcare system
- Leads an environment of caring for the wellbeing of colleagues.

3.5 Judgement and Clinical Decision Making

- Selects appropriate medical investigations applying an evidence-based approach and accurately appraises and interprets results
- Makes informed and timely decisions regarding assessment, diagnosis, preoperative preparation, surgical management and postoperative follow up of patients
- Applies an evidence-based approach when considering where surgery is indicated and where conservative treatment is the best option of the patient
- Creates management plans for procedures, anticipating risks and benefits, incorporating individual patients' circumstances, values, and goals of care
- Discusses and takes into account the patient's circumstances, expectations, risks and comorbidities
- Utilises a variety of decision making styles, choosing an appropriate method for the situation
- Organises patients according to priority, balancing complex competing needs in emergency and elective situations
- Plans ahead, identify risks and manages complications and changes effectively
- Continually reviews the suitability of decisions and actions and makes adjustments as required.

3.6 Leadership and Management

- Understands when to lead, manage or follow, and takes direction when there are others who are better equipped to lead or manage a situation
- Demonstrates leadership behaviours that inspire others and create a safe working environment
- Speaks up against damaging behaviours and unprofessional conduct, including discrimination, bullying and harassment
- Remains calm and in control in high pressure situations
- Complies with quality and safety standards, accepted principles of surgery, codes of professional conduct and protocols
- Applies an efficient, organised, and reliable approach to admissions, ward rounds, bed management, operating lists and clerical duties.

3.7 Professionalism

- Demonstrates awareness and insight into their own limitations, mistakes and learning

- Makes appropriate changes to practice as areas of improvement are identified
- Maintains compliance with standards of ethics, probity, and confidentiality in all professional interactions
- Applies effective strategies to maintain personal, mental and physical health and wellbeing to optimise performance
- Makes decisions without influence of inducement, profit or personal gain
- Takes responsibility to ensure an honest and open agreement of informed financial consent.

3.8 Scholarship and Teaching

- Assumes responsibility for self-directed learning, including seeking out opportunities for professional development and maintenance of knowledge and skills
- Applies a critically reflective approach to neurosurgery, regularly carrying out self and peer reviewed audit
- Supervises the teaching and assessment of junior colleagues
- Adopts effective methods for communicating feedback to others
- Understands research methodology including qualitative, quantitative, bio-statistical, and epidemiological research methods
- Demonstrates the ability to undertake research and present findings from research in a peer reviewed environment
- Demonstrates the ability write a scientific paper in a peer reviewed environment.

4 Surgical Sciences

The Surgical Sciences learning outcomes apply equally across all training levels. While they have not been specifically stated in each individual specialty practice curriculum module, to prevent repetition throughout the curriculum, they are applicable to all. In some instances, specialty practice curriculum modules provide selected examples of how Surgical Sciences learning outcomes apply to that specific area of practice.

4.1 Medical Expertise

- Demonstrate core surgical sciences knowledge required for the practice of neurosurgery, including anatomy, neurophysiology, neuroradiology, neuropsychology and neuropharmacology
- Integrate and applies surgical knowledge, clinical skills and professional behaviour in the provision of patient care
- Maintain currency of knowledge through participation in self-directed learning.

4.2 Anatomy

- Describe the development of the nervous system - neuroembryology
- Describe the cellular components of the nervous system - histology
- Describe the gross anatomy of the cranium and brain
- Describe the gross anatomy of the scalp, the skull and associated muscles
- Describe the gross anatomy of the dura, its reflections and venous spaces
- Describe the cranial nerves and their nuclei
- Describe the CSF filled spaces
- Describe the arterial supply and venous drainage of the cranium and brain

- Describe the gross anatomy of the vertebral column, the spinal cord and associated structures
- Describe the gross anatomy of the peripheral somatic nervous system
- Describe the gross anatomy of the autonomic nervous system
- Describe the radiological anatomy of the cranium, vertebral column and the central nervous system
- Describe the motor, somatic, visual and auditory pathways

4.3 Neurophysiology

- Describe the principles of:
  - Electroencephalography
  - Somatosensory, motor and brainstem evoked potential monitoring
- Describe peripheral neuropathies and entrapment neuropathies including:
  - The structure and function of peripheral nerves
  - Nerve conduction studies
- Describe disorders of the neuromuscular junction including the:
  - Structure and function of smooth and striated muscle
  - Role and uses of electromyography
- Discuss the indications for, and the limitations of, common neurophysiological diagnostic studies
- Interpret the results of neurophysiological diagnostic studies including:
  - Electroencephalograms (EEGs)
  - Evoked potentials (EPs)
  - Nerve conduction studies (NCS)
  - Electromyography (EMG)

4.4 Neuroradiology

- Describe the principles of neuroradiological imaging of the nervous system, using:
  - X-rays
  - Ultrasound
  - Computerised tomography (CT) of the brain, skull, and spine
  - Basic magnetic resonance imaging (MRI) and advance MRI including, functional MERI (fMRI), Diffusion-weighted imaging (DWI) and Spectroscopy
  - Positron emission tomography (PET)
  - Nuclear medicine
  - Other developing technologies
- Discuss the use of isotopes and contrast in imaging, including potential side effects (e.g., allergic reactions) and other safety issues
- Interpret the following:
  - Plain radiographs of the skull/spine
  - CT scans, especially for acute spinal disorders, cranial trauma, hydrocephalus, intracranial tumours, and spontaneous intracranial haemorrhage
  - MRI scans, especially for acute spinal disorders, cranial trauma, hydrocephalus, and intracranial tumours
  - Angiographic images [CTA, Magnetic resonance angiography (MRA) and Digital subtraction angiography (DSA)

4.5 Neuropsychology

- Describe the principles of neuropsychological assessment and the application of the Mental Health Act
- Describe common neuropsychological problems associated with the conditions listed below, including their management:
    - Head injury
    - Subarachnoid haemorrhage
    - Hydrocephalus
    - Structural lesions of the frontal and temporal lobes
    - Disorders of the limbic system
- Perform a bed-side assessment of cognition and memory
- Identify patients requiring additional neuropsychological assessment and select appropriate referral pathways for further psychological or psychiatric assessment
- Discuss management of an at risk patient who has discharged themselves against medical advice

4.6 Neuropharmacology

- Discuss the principles of neuropharmacology, including:
    - Receptor and ion channel function
    - Neuropeptides and neurotransmitters
    - The principles of pharmacological neuroprotection
- Discuss the safe prescribing of drugs used in the treatment of surgical conditions/diseases
- Describe the pharmacology of the following agents, including their mechanisms of action, pharmacodynamics, and common drug interactions:
    - Anaesthetic agents
    - Analgesics
    - Muscle relaxants
    - Barbiturates
    - Anticonvulsants
    - Anti-inflammatories
    - Corticosteroids
    - Anticoagulants
    - Procoagulants
- Describe the aitiology, pathophysiology and clinical manifestations of chronic pain and chronic pain syndromes
- Discuss the multidisciplinary approach to pain management
- Describe the indications for involvement of, and/or referral to, an acute pain service in the care of surgical patients
- Demonstrate appropriate peri-operative prescribing for surgical patients, for treatment and prophylaxis, both pre- and post-surgically
- Identify and manage common adverse events arising from the use of pharmacological agents used in the surgical patient
- Demonstrate a multidisciplinary approach to pain management, when required, by involving an acute pain service in the care of the surgical patient and/or referring the surgical patient to an acute pain service

5 Core Principles

The learning outcomes for the Core Principles apply equally across all training levels. While they have not been specifically stated in each individual specialty practice curriculum module, to prevent repetition throughout the curriculum, they are applicable to all. In some instances, specialty practice curriculum modules provide selected examples of how the Core Principles learning outcomes apply to that specific area of practice.

5.1 Assessment and management

- Describe the general approach to the assessment and management of the surgical patient, pre- and post-operatively, in emergency and elective settings
- Consider and discuss alternatives to surgery including non-operative care and the presence or absence of advanced health care directives
- Discuss the importance of effective communication, with patients, families/carers, and healthcare colleagues, in the above-mentioned settings
- Discuss the effects and potential harm of smoking, alcohol, and other drugs on clinical presentations
- Discuss multidisciplinary planning for high-risk surgical patients
- Discuss issues associated with the surgical care of the paediatric patient
- Obtain a targeted history and perform a focused examination
- Demonstrate clinical decision making e.g., perform a differential diagnosis, order investigations, propose and initiate comprehensive surgical/non-surgical management plans
- Assess the patient and manage any pre-operative issues prior to surgery (re: patient optimisation)
- Coordinate multidisciplinary planning for high-risk surgical patients
- Obtain informed consent prior to surgery in emergency and elective settings
- Undertake appropriate prescribing across all stages of patient care
- Prepare timely and complete clinical records and communications
- Recognise issues associated with the surgical care of the paediatric patient
- Communicate using a patient-centred and culturally appropriate approach, demonstrate compassion, provide emotional support, and address challenging communication issues effectively (e.g., breaking bad news)
- Demonstrate effective interactive clinical communication and collegiate collaboration to optimise patient care (e.g., teamwork, planning and audit participation)

5.2 Pre-operative

- Describe the pre-operative assessment and management of the surgical patient including:
    - History and examination
    - Risk assessment e.g., risk factors for surgery, scoring systems
    - Alternatives to surgery including non-operative care
    - Homeostasis and thermoregulation
    - Cardiorespiratory physiology
    - Endocrine disorders e.g., diabetes
    - Fluid homeostasis and renal failure
    - Laboratory testing and imaging
    - Preoperative prescribing and pre-medications and thromboprophylaxis
    - The pathophysiology of sepsis and septic shock, including their pathophysiology, prevention, and prophylaxis
    - The principles of day surgery

- Assess and manage the surgical patient in the pre-operative period, and:
    - Obtain a targeted history and perform a focused examination from a medical and surgical perspective
    - Interpret pre-operative investigations
    - Manage co-morbidities and any identified surgical risks
    - Provide advice on smoking cessation etc. to reduce perioperative risk
    - Perform appropriate peri-operative prescribing including premedication

5.3 Intraoperative care

- Discuss the WHO Surgical Safety Checklist including time out and team huddle
- Discuss patient positioning and pressure care
- Discuss the avoidance of nerve injuries
- Discuss safety in theatre including:
    - Sharps safety and injuries
    - Diathermy use
    - Radiation use and risks
    - Safe tourniquet use
- Discuss managing infection risks, including surgery in hepatitis and HIV carriers
- Discuss anaesthesia (local, regional, general)
- Discuss monitoring (invasive and non-invasive)
- Discuss the prevention of venous thrombosis
- Discuss fluid balance and homeostasis
- Deliver appropriate intraoperative care, and:
    - Perform intraoperative care safely
    - Ensure correct patient positioning
    - Avoid nerve injuries
    - Manage sharps injuries
    - Prevent diathermy injury
    - Manage infection risk
    - Manage thromboprophylaxis and bleeding (see below)
    - Fluid balance and homeostasis

5.4 Post-operative care

- Describe post-operative care including:
    - Postoperative monitoring
    - Cardiorespiratory physiology
    - Fluid balance and homeostasis
    - Endocrine disorders including diabetes
    - Renal failure
    - The pathophysiology of blood loss, sepsis, Systemic Inflammatory Response Syndrome (SIRS), shock, and multi-organ dysfunction syndrome
    - Common post-operative complications
    - Postoperative analgesia
- Demonstrate appropriate post-operative care and:
    - Prepare operative and post-operative care records
    - Assess and monitor the patient's condition post-operatively
    - Recognise, prevent, and treat post-operative complications

- Manage post-operative analgesia
- Manage fluid and electrolyte balance
- Discuss limits of care
- Detect impending organ failure and undertake initial management
- Identify indications for dialysis

5.5 Perioperative care

- Describe the assessment, management, and care of the critically ill surgical patient
- Discuss the rationale for admission of the surgical patient to a High-Dependency Unit (HDU) or an Intensive Care Unit (ICU)
- Discuss the general principles of airway management, and the management of the emergency critical airway
- Describe resuscitation of the surgical patient
- Discuss the recognition and management of the deteriorating patient, including use of the Medical Emergency Team (MET) assessment and response system
- Discuss the metabolic response to injury, as well as nutrition and malnutrition (and excess) effects, including its effects on disease processes and healing
- Discuss nutritional assessment, management, and planning including:
  - Screening of nutritional status
  - Post-operative, enteral and parenteral nutrition
- Discuss haemostasis and blood products including the:
  - Components of blood, haemostasis, and the clotting cascade
  - Pathophysiology of impaired haemostasis e.g., liver disease, massive haemorrhage, haemophilia
  - Administration of blood products (and alternatives) and patient safety
- Discuss coagulation, deep vein thrombosis and embolism, including:
  - The clotting mechanism (Virchow Triad) and the effect of surgery and trauma on coagulation
  - Tests for suspected thromboembolic disease and disorders of coagulation e.g., thrombophilia
  - The role of Ventilation (V) Perfusion (Q) (V/Q) scanning, CT pulmonary angiography, D-dimer,
  - The treatment of venous thrombosis, pulmonary embolism (and the role of pulmonary embolectomy) and anticoagulation and thrombolysis
  - Prophylaxis of thromboembolism and Deep Vein Thrombosis (DVT) risk classification, management, and DVT prevention (mechanical and pharmacological)
- Describe the normal immune response to injury and the aetiology, pathophysiology, and clinical presentation of infections
- Discuss common pathogens in surgical patients, including blood-borne viruses
- Discuss the following:
  - Sepsis and septic shock
  - Asepsis and antisepsis, including hand hygiene and the principles of disinfection and sterilisation
  - Hospital-acquired infections
  - Multi-resistant organisms
- Describe the mechanism of action of common classes of antibiotics including antibiotic prophylaxis and treatment, and antibiotic sensitivities, side-effects, and resistance
- Discuss metabolic and endocrine disorders relating to the perioperative management of the surgical patient, including the:
  - Pathophysiology of thyroid hormone conditions and any surgical risks

    - Causes and effects of hyponatraemia hypercalcaemia/ hypocalcaemia, and hyperkalaemia/hypokalaemia
    - Causes and consequences of steroid insufficiency and corticosteroid therapy complications
    - Complications of diabetes
- Discuss delirium including its epidemiology, causes, clinical features, prognosis, and its impact on patients, families, and carers
- Assess, manage, and care for the critically ill surgical patient and refer appropriately to a High Dependency Unit (HDU) or Intensive Care Unit (ICU)
- Recognise airway distress and manage the emergency critical airway
- Manage resuscitation of the surgical patient
- Recognise and manage the deteriorating patient, and use MET services appropriately
- Assess and plan preoperative nutritional management and arrange access to suitable artificial nutritional support (preferably via a Nutrition and Dietetics Team), including use of dietary supplements, enteral nutrition and parenteral nutrition as required
- Recognise conditions likely to lead to a bleeding diathesis and:
    - Identify abnormal bleeding during surgery
    - Use blood products appropriately
    - Manage any complications of blood product transfusion
- Manage coagulation, deep vein thrombosis and embolism and:
    - Identify at risk patients and initiate prophylaxis when required
    - Diagnose pulmonary embolism/DVT
    - Interpret and act on results from duplex scanning, venography, and D-dimer measurement
- Initiate and monitor treatment of venous thrombosis and pulmonary embolism
- Prescribe antibiotics appropriately throughout the perioperative period, for treatment and prophylaxis of infection
- Collect a history and perform an examination in patients with metabolic, endocrine and/or electrolyte disorders and investigate and manage patients in the perioperative period with:
    - Thyrotoxicosis and hypothyroidism
    - Hypercalcaemia and hypocalcaemia
    - Hyponatraemia
    - Hyperkalaemia and hypokalaemia
    - Diabetes
    - Conditions requiring steroid therapy
- Prevent, recognise, and manage delirium in the surgical patient and:
    - Assess cognitive impairment
    - Differentiate between delirium and dementia
    - Identify delirium triggers and appropriate non-pharmacological and pharmacological management options
    - Explain delirium to patients and families

6 Specialty Practice: Functional Neurosurgery

6.1 Procedures

Procedures	Graduate Level of Competence
Epilepsy: Corticectomy/Lobectomy	Independent
Epilepsy: Disconnective surgery for epilepsy	Assist
Epilepsy: Electrode Insertion	Supervised
Epilepsy: Lesionectomy	Independent
Epilepsy: Vagal Nerve Stimulator	Supervised
Movement Disorders: Deep Brain Stimulator	Supervised
Pain: DREZ Lesions	Supervised
Pain: Opioid/Baclofen Infusion Pump	Independent
Pain: Spinal Cord Stimulator	Independent
Pain: Trigeminal Microvascular Decompression	Independent
Pain: Trigeminal Percutaneous Rhizotomy	Independent

6.2 Epilepsy

Basic Training

Knowledge

- Discuss the classification, epidemiology, aetiology, pathophysiology, and clinical presentation of seizures
- Discuss the pharmacological management of epilepsy, including the controversies associated with prophylactic antiseizure medication
- Discuss the clinical manifestations and investigations that may be used to distinguish between epileptic and non-epileptic seizures (pseudoseizures)
- Discuss the epidemiology of post-traumatic epilepsy
- Discuss the issues regarding epilepsy and pregnancy
- Describe the formal recommendations for patients with seizures and obtaining a driver's license
- Discuss the risk of seizure for patients after neurosurgical interventions

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with a suspected seizure
- Observe and describe a patient's seizure semiology
- Advise and counsel patients who have experienced a seizure

Intermediate Training

Knowledge

- Discuss the impacts of seizures upon quality of life and life expectancy

- Discuss the role of curative versus palliative surgical procedures for epilepsy

Skills

- Interpret the results of investigations for patients having seizures

Advanced Training

Knowledge

- Discuss the role of neuromodulation for the management of epilepsy
- Discuss the anatomy, surgical technique outcomes and risks of temporal lobectomy
- Describe the indications, benefits and risks of invasive monitoring for patients with epilepsy
- Describe strategies for pre-operative and intraoperative brain mapping and the technique of awake surgery
- Discuss the unique features of assessment and surgical management of epilepsy in children as compared to adults
- Discuss emerging techniques to manage epilepsy

Skills

- Perform a corticectomy/lobectomy
- Assist in performing disconnective surgery for epilepsy
- Perform under supervision electrode insertion
- Perform a lesionectomy
- Perform under supervision insertion of a vagal nerve stimulator

6.3 Movement Disorders

Basic Training

Knowledge

- Discuss the epidemiology, aetiology, pathophysiology, clinical presentation and natural history and medical management of movement disorders including:
  - Parkinson's Disease
  - Essential tremor
  - Dystonic syndromes
  - Tourette syndrome

Intermediate Training

Knowledge

- Discuss the impact of implanted neuromodulation devices upon imaging and surgery

Skills
• Perform an image coregistration
Advanced Training
Knowledge

• Describe the role of the following targets in stereotactic interventions:
  ○ Subthalamic nucleus (STN)
  ○ Globus pallidus internus (GPi)
  ○ Ventralis intermedius (Vim)
  ○ Posterior subthalmic area (PSA)
• Discuss the differences between lesioning and neuromodulation approaches in movement disorder surgery
• Briefly discuss the advantages and disadvantages of methods of lesion production, including thermocoagulation, Gamma knife and focused ultrasound
• Discuss the potential complications associated with deep brain stimulation
• Discuss the role of magnetic resonance imaging (MRI) guided high frequency ultrasound lesioning in movement disorders

Skills
• Perform under supervision deep brain stimulator surgery

6.4 Pain

Basic Training
Knowledge
• Describe the anatomy, aetiology, physiology, clinical features and natural history of common pain syndromes • Discuss the predictors of chronic post-surgical pain • Explain the rationale for multidisciplinary management of pain disorders • Describe the major classes of medications commonly used for pain treatment and their mode of action, risks and benefits • Discuss the medical management of trigeminal neuralgia • Describe the clinical syndrome, differential diagnosis and management of hemifacial spasm and glossopharyngeal neuralgia • Discuss the benefits and risks of spinal and peripheral nerve injections and radiofrequency procedures
Skills
• Obtain a targeted history, perform a focused examination, order and interpret appropriate imaging for patients presenting with pain • Collaborate with pain medicine physicians in the management of patients with complex pain

Intermediate Training
Knowledge
• Describe commonly used pain and disability assessment scales • Discuss the benefits and risks of intrathecal drug administration
Advanced Training
Knowledge
• Discuss the indications for spinal cord ablative procedures in the management of pain • Discuss the role of neuromodulation in the management of pain • Discuss the advantages and disadvantages of Microvascular Decompression (MVD) versus percutaneous procedures in the management of trigeminal neuralgia • Discuss the role of radiosurgery in the management of trigeminal neuralgia • Discuss the role of intra operative monitoring during MVD • Describe the detailed surgical anatomy of the glossopharyngeal and vagus nerves • Describe the indication, preoperative assessment, techniques of spinal cord stimulation • Discuss the role of peripheral nerve stimulation in the management of pain • Discuss the role of ablative brain and brainstem procedures in the management of cancer pain • Recognise and evaluate malfunctions of intraspinal drug administration systems • Describe the techniques of spinal cord ablative procedures such as dorsal root entry zone (DREZ) lesions, cordotomy and myelotomy
Skills
• Perform under supervision the DREZ lesioning procedure • Perform the insertion of an Opioid/Baclofen Infusion Pump • Perform the insertion of a spinal cord stimulator • Perform Trigeminal Microvascular Decompression • Perform Trigeminal Percutaneous Rhizotomy

7 Specialty Practice: Infection

7.1 Procedures

Procedures	Graduate Level of Competence
Cerebral abscess aspiration, biopsy or excision	Independent
Craniotomy or burr hole drainage of extra-axial cranial infection	Independent
Insertion of a ventricular drain	Independent
Lumbar puncture	Independent
Revision of a CSF shunt	Independent
Stereotactic needle biopsy	Independent
Wound debridement including removal of an infected bone flap	Independent

7.2 Primary CNS Infections

Basic Training

Knowledge

- Discuss the aetiology, microbiology and pathogenesis of the following CNS infections:
  - Bacterial
  - Viral
  - Fungal and parasitic
- Describe the clinical presentation of patients with a CNS infection, and their radiological features
- Outline the components and function of the human immune system
- Discuss the principles of medical management of CNS infections, surveillance and monitoring

Skills

- Obtain a targeted history, perform a focused examination and select, order and interpret investigations for patients presenting with a suspected CNS infection
- Initiate medical treatment for CNS infections, where appropriate
- Perform the insertion of a ventricular drain
- Perform a lumbar puncture

Intermediate Training

Knowledge

- Discuss the indications, risks and benefits of surgical intervention for a CNS infection
- Discuss the various causes of immune compromise
- Describe the neurological complications of patients who are immuno-compromised and the role of biopsy

Skills

- Collaborate with infectious diseases and microbiology colleagues to optimise care for patients with Central Nervous System (CNS) infection
- Formulate and implement a comprehensive management plan for patients with CNS infection
- Perform surgery for patients with CNS infection:
  - Stereotactic aspiration or biopsy
  - Open aspiration/excision cerebral abscess
  - Drainage of subdural empyema
  - Craniotomy or burr hole drainage of extra-axial cranial infection

Advanced Training

Knowledge

- Discuss the features of subdural empyema and its management
- Discuss long-term sequelae of CNS infections
- Compare and contrast aspiration and surgical excision of intracerebral abscess

• Discuss prion diseases affecting the human CNS, including clinical features, diagnostic features, the role of biopsy, management and infection control

7.3 Post operative and post traumatic infections

Basic Training
Knowledge

• Discuss the aetiology, microbiology and pathogenesis of:
  ○ Post traumatic wound infections
  ○ Post operative wound infections
  ○ Shunt infections

Intermediate Training
Knowledge
• Discuss the evidence regarding the use of prophylactic antibiotics during cranial surgery and for cranial trauma • Discuss the evidence for various measures to decrease operative infections.
Skills
• Perform a revision of a CSF shunt • Perform a wound debridement including removal of an infected bone flap
Advanced Training
Knowledge
• Discuss the management options for an infected shunt

8 Specialty Practice: Neuro Oncology

8.1 Procedures

Procedures	Graduate Level of Competence
Glioma: High grade - Debulking	Independent
Glioma: Low grade - Debulking	Independent
Haemangioblastoma	Independent
Intraventricular tumours: Colloid Cyst	Independent
Intraventricular tumours: Endoscopic Biopsy	Independent
Lymphoma: Stereotactic tumour biopsy	Independent

Meningioma	Independent
Metastatic brain tumours	Independent
Pituitary Tumour - Trans-cranial	Independent
Pituitary Tumour - Trans-sphenoidal	Independent
Skull Base: Acoustic Neuroma/vestibular Schwannoma	Supervised
Skull Base: CPA tumours	Independent
Skull Base: Tumour Excision Skull Base Approach	Independent
Tumours of the scalp and skull vault: Bony Skull Tumour	Independent
Ventricular Tumour/Cyst	Independent

8.2 Tumours of the scalp and skull vault

Basic Training

Knowledge

- List the classification of tumours that occur at the skull vault and scalp
- Describe epidemiology, clinical presentation and natural history of scalp and skull tumours

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with a tumours of the scalp and skull

Intermediate Training

Knowledge

- Describe the histopathological features of scalp and skull tumours
- Describe the differential diagnosis of lytic and sclerotic skull lesions

Skills

- Interpret the results of investigations for patients with benign and malignant scalp and skull tumours
- Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with tumours of the scalp and skull vault

Advanced Training

Knowledge

- Describe the comparative risks and benefits of surgical and non-surgical management options for patients with skull vault and scalp tumours

Skills

- Manage patients with skull vault and scalp tumours, including postoperative complications
- Perform surgery for a bony skull tumour

8.3 Basic sciences of neoplasia

Basic Training
Knowledge
• Describe the nature of cell division and the cell cycle and identify the abnormalities of the cell cycle in neoplasia • Define tumour invasion and angiogenesis and describe the underlying mechanisms and discuss the significance of each tumour progression for common CNS neoplasms • Define "tumour markers" and their use in clinical practice • Discuss the blood brain barrier, the CNS immune system, its unique characteristics and response to brain tumours • Discuss the consequences of disruption of the blood brain barrier and the mechanisms by which it may occur • Describe factors secreted by tumours which modulate the immune response and cause immunodeficiency and the mechanisms by which they do this • Describe the mechanisms of action of commonly used medications for patients with CNS tumours and the effect on the immune system, in particular, glucocorticoids and anticonvulsants
Intermediate Training
Knowledge
• Describe the impact of tumour invasion and tumour biology on the accuracy of biopsy of CNS tumours • Describe commonly used histopathological markers of cell kinetics and their significance
Advanced Training
Knowledge
• Describe imaging techniques that examine cell kinetics of brain tumours

8.4 Classification and epidemiology of cerebral tumours

Basic Training
Knowledge
• Discuss brain tumour classification systems and the current WHO framework as it relates to brain tumour treatment

Intermediate Training
Knowledge
• Summarise the epidemiology, incidence and risk factors for common CNS neoplasms including predisposing conditions (such as the phakomatoses or other genetic syndromes)
Advanced Training
Knowledge
• Identify histopathological features of common tumour types and grades, including gliomas, meningiomas, metastases, pineal region tumours, acoustic neuroma, pituitary tumours and craniopharyngioma • Develop an understanding of the relationship between histopathological features and molecular changes in formation of an integrated diagnosis

8.5 Gliomas

Basic Training
Knowledge
• Discuss the cortical and sub-cortical anatomy as it relates to neuro-oncology • Describe the clinical presentation of a patient with glioma with consideration of grade and location
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients with suspected gliomas
Intermediate Training
Knowledge
• Discuss the use of advanced imaging and intraoperative localisation techniques relevant to tumour surgery • Describe the gross, histopathological and molecular features of gliomas • List the natural history and prognosis of gliomas • Describe the common types of adjuvant therapy for gliomas, including dosing regimens, complications, and the indications for them
Skills
• Interpret the results of investigations in patients presenting with gliomas. • Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with gliomas

- Collaborate with neuro-oncology and palliative care colleagues to optimise the surgical or non-surgical care for patients with gliomas

Advanced Training

Knowledge

- Describe the role of surgery and adjuvant therapy for gliomas and the efficacy/effect on natural history
- Discuss the indications for re-operation in recurrent glioma
- Describe, differentiate and compare the different techniques for glioma excision
- Describe the clinical management of uncommon glial and mixed glial/neuronal tumours
- Critically evaluate the emerging adjuvant therapies for glioma
- Discuss controversies in the management of glioma including surgical management and adjuvant therapy of low grade gliomas, extent of surgical resection and biopsy vs. excision and timing of adjuvant therapy
- Critically evaluate the controversial issues including the role of surgery in the management of brainstem glioma

Skills

- Collaborate with members of the Multidisciplinary Team (MDT) to develop and implement a comprehensive management plan for patients with gliomas
- Manage patients with glioma, including postoperative complications
- Perform surgery for high grade gliomas
- Perform surgery for low grade gliomas
- Perform stereotactic tumour biopsy

8.6 Intraventricular tumours

Basic Training

Knowledge

- List the tumours that may appear within the ventricular system by location and their natural history
- Describe the clinical presentation of masses within the ventricular system
- Discuss the mechanisms of development of hydrocephalus in intraventricular tumours
- Describe the principles of management of acute ventricular obstruction

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients with an intraventricular tumour

Intermediate Training
Knowledge

• Describe the gross, histopathological and molecular features of intraventricular tumours
• Describe the distinguishing radiological features of tumours of the:
  ○ Fourth Ventricle
  ○ Third Ventricle
  ○ Lateral Ventricule

Skills
• Interpret results of investigations in patients presenting with intraventricular tumours • Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with intraventricular tumours • Collaborate with neuro-oncology and Palliative care colleagues to optimise the care for patients with intraventricular tumours
Advanced Training
Knowledge
• Discuss grading and molecular features of ependymomas and medulloblastomas and their significance for management • Describe role of surgery for treatment of medulloblastoma and ependymoma of posterior fossa • Discuss the management of incidental lesions of the ventricular system • Describe surgical approaches, including advantages and disadvantages, to tumours of the ventricular system
Skills
• Develop and implement a comprehensive management plan for patients with intraventricular tumours • Manage patients with intraventricular tumours, including postoperative complications • Perform surgery for a colloid cyst or ventricular tumour • Perform an endoscopic biopsy of a ventricular tumour

8.7 Metastatic brain tumours

Basic Training
Knowledge
• Discuss tumours that metastasise to the CNS • Describe the clinical presentation of patients with metastatic disease to the central nervous system • Describe current theories of metastatic spread of tumours to the CNS

Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for a patient with metastatic disease of the central nervous system
Intermediate Training
Knowledge
• Describe the gross, histopathological and molecular features of cerebral metastases • Describe the radiological features of cerebral metastases and their differential diagnosis • Describe the common types of therapy for patients with metastatic disease of the central nervous system
Skills
• Interpret investigations in patients presenting with metastatic disease of the central nervous system • Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with cerebral metastases • Collaborate with neuro-oncology and palliative care colleagues to optimise the surgical and non-surgical care for patients with cerebral metastases
Advanced Training
Knowledge
• Discuss the role of surgery for solitary and multiple intracerebral metastases • Discuss adjuvant treatments for cerebral metastases
Skills
• Collaborate with members of an MDT to develop and implement a comprehensive management plan for patients with metastases • Perform surgery for cerebral metastases

8.8 Meningioma

Basic Training
Knowledge
• Describe the common locations of meningioma and the expected presentation of each • Discuss epidemiology of meningioma • Define the cell of origin and cytogenetics of meningioma and theories of tumourigenesis

Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with meningioma
Intermediate Training
Knowledge
• Discuss the clinical significance of pathological sub types of meningiomas • Discuss the features of meningioma related to prognosis such as extent of surgical resection (Simpson classification), markers of proliferation, histological grade and molecular features • Discuss surgical goals in the treatment of meningiomas and general principles of surgery • Discuss the presentation, epidemiology, pathology and management of solitary fibrous tumour
Skills
• Interpret investigations in a patient presenting with meningioma • Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with cerebral metastases • Collaborate with neuro-oncology and palliative care colleagues to optimise the care for patients with cerebral metastases
Advanced Training
Knowledge
• Discuss the role of radiation treatment in the management of meningiomas • Discuss the management of meningiomas related to the dural venous sinuses • Discuss the difficulties associated with managing a recurrent meningioma • Discuss role of pre-operative embolisation in the surgical management of meningiomas
Skills
• Collaborate with members of an MDT to develop and implement a comprehensive management plan for patients with meningiomas • Manage patients with meningioma, including postoperative complications • Perform surgery for meningioma

8.9 Epidermoids, dermoids and teratoma

Basic Training
Knowledge
• Define and differentiate epidermoid, dermoid and teratoma • Describe common locations of epidermoid and dermoid and the epidemiology of both • List the clinical features, natural history and prognosis of epidermoids, dermoids and teratomas

Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with an epidermoid, dermoid and teratoma
Intermediate Training
Knowledge
• Identify the macroscopic and microscopic features of epidermoid, dermoid and teratoma • Identify the radiological features of epidermoid, dermoid and teratoma • Differentiate mature, immature and malignant teratoma
Skills
• Interpret the results of investigations for patients with an epidermoid, dermoid and teratoma
Advanced Training
Knowledge
• Discuss the options for surgical and non-surgical management of dermoids and epidermoids • Describe the indications for and types of adjuvant therapy for teratomas • Describe the indications for resections of epidermoids, dermoids or teratoma
Skills
• Formulate and implement a comprehensive management plan for patients with epidermoids, dermoids or teratomas • Collaborate with members of an MDT to develop and implement a comprehensive management plan for patients with teratomas • Coordinate with medical and radiation oncology colleagues to optimise management of patients with teratomas

8.10 Pineal region tumours

Basic Training
Knowledge
• Discuss the incidence, classification, and clinical presentation of pineal region tumours • Describe embryology and anatomy of pineal region tumours, particularly the vascular supply and adjacent important structures
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with pineal region tumours

- Collaborate with neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with pineal region tumours
- Collaborate with neuro-oncology colleagues to optimise the care for patients with pineal region tumours

Intermediate Training

Knowledge

- Discuss the significance of pineal region tumour markers, age, gender and ethnic origin on diagnosis and prognosis

Skills

- Interpret the results of investigations for patients with pineal region tumours

Advanced Training

Knowledge

- Discuss the surgical indications for pineal region tumours
- Describe the role of adjuvant therapy for pineal regions tumours
- Contrast the appropriate management of parenchymal and germ cell pineal tumours
- Describe the surgical approaches to pineal region tumours, their advantages and disadvantages, including procedural steps

Skills

- Collaborate with members of a MDT to develop and implement a comprehensive management plan for patients with pineal region tumours

8.11 Haemangioblastoma

Basic Training

Knowledge

- Describe the epidemiology, clinical presentation and natural history of haemangioblastoma
- Describe the epidemiology, clinical features and natural history of von Hippel Lindau syndrome

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients with suspected haemangioblastoma

Intermediate Training
Knowledge
• Describe the gross and microscopic features of haemangioblastoma • Identify radiological features of haemangioblastoma
Skills
• Interpret the results of investigations for patients with haemangioblastoma
Advanced Training
Knowledge
• Describe the indications for and types of adjuvant therapy for haemangioblastoma • Describe surveillance and genetic counselling for patients with von Hippel Lindau disease
Skills
• Collaborate with other medical specialists and health professionals to develop and implement a comprehensive management plan for patients with haemangioblastoma • Perform surgery for haemangioblastoma

8.12 Pituitary and parasellar tumours

Basic Training
Knowledge
• Describe the classification, epidemiology and the clinical presentation of pituitary or parasellar tumours • Describe pituitary/hypothalamic emergencies, including apoplexy, diabetes insipidus and Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH), their causes and emergency management • Describe the postoperative care of patients who have had pituitary region surgery • Discuss the embryology, epidemiology, clinical presentation and natural history of craniopharyngioma and Rathke's cleft cyst
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients with suspected pituitary or parasellar tumours • Perform a full endocrinological assessment and demonstrate the medical management of common endocrinopathies • Perform and discuss the results of visual testing in patients with pituitary or parasellar tumours

Intermediate Training
Knowledge
• Describe the gross and microscopic features of pituitary or parasellar tumours • Demonstrate the radiological features of pituitary region masses • Describe the complications and long term risks of endocrinopathies associated with pituitary tumours, both with and without treatment • Discuss the management of Cerebrospinal Fluid (CSF) leak following pituitary region surgery
Skills
• Interpret results of investigations for patients with pituitary or parasellar tumours • Formulate and implement a comprehensive management plan for patients with pituitary region tumours • Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with pituitary and parasellar tumours • Collaborate with ophthalmology, endocrinology, and oncology colleagues to optimise the care for patients with pituitary and parasellar tumours
Advanced Training
Knowledge
• Discuss the indications for surgery and various surgical approaches in management of pituitary region tumours • Discuss adjuvant treatment for pituitary tumours and craniopharyngioma • Discuss pituitary region lesions and their management in relation to the treatment of fertility and pregnancy
Skills
• Perform transsphenoidal surgery for a pituitary tumour • Perform transcranial surgery for a pituitary or parasellar tumour

8.13 Tumours of the orbit

Basic Training
Knowledge
• List common neurosurgical tumours that may involve the orbit and their clinical presentations
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients with tumours that involve the orbit

Intermediate Training
Knowledge
• Describe the gross and microscopic pathological features of neurosurgical tumours which may involve the orbit • List the clinical features, natural history and prognosis of tumours and pseudo tumours which occur in the orbit
Skills
• Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with tumours of the orbit • Collaborate with ophthalmology, endocrinology, and oncology colleagues to optimise the care for patients with tumours of the orbit
Advanced Training
Knowledge
• Discuss the role for adjuvant therapy for orbital tumours • Discuss surgical approaches to orbital lesions and their complications
Skills
• Formulate and implement a comprehensive management plan for patients with an orbital tumour

8.14 Lymphoma

Basic Training
Knowledge
• Discuss the classifications of CNS lymphoma • Discuss the relationship between lymphoma and associated conditions e.g. immunosuppression • Describe the clinical and radiological features, natural history and prognosis of CNS lymphoma
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with CNS lymphoma
Intermediate Training
Knowledge
• Describe the classification and pathological features of cerebral lymphoma

Skills
• Interpret results of investigations of CNS lymphoma
Advanced Training
Knowledge
• Discuss the role of surgery in CNS lymphoma • Discuss the effect of steroids in CNS lymphoma • Discuss non-surgical treatments for the management of CNS lymphoma
Skills
• Collaborate with members of an MDT to develop and implement a comprehensive management plan for patients with CNS lymphoma • Perform a stereotactic tumour biopsy

8.15 CNS Tumours: Radiotherapy, chemotherapy and other adjuvant treatment

Basic Training
Knowledge
• Describe ionizing radiation, its effect on normal and neoplastic tissue, the concept of fractionation, and compare types commonly used in medical applications • Discuss the basic principles of systemic therapies, common applications and complications
Intermediate Training
Knowledge
• Describe indications for radiation therapy for treatment of brain tumours • List the commonly used systemic therapies for brain tumours, their mechanism of action and side effects
Advanced Training
Knowledge
• Discuss the clinical presentation, investigation, differential diagnosis and management of radionecrosis

8.16 Skull Base Tumours including Schwannoma and Chordoma

Basic Training

Knowledge

- Outline the diagnostic criteria of Neurofibromatosis I and II, its incidence, genetic characteristics
- Discuss the embryogenesis of chordoma
- Discuss location, epidemiology, clinical and radiological features and natural history of chordoma
- Describe the anatomy of the cerebellopontine angle (CPA) and tumours that arise there
- Describe the epidemiology, clinical presentation, pathological features, radiological features and natural history of vestibular schwannoma
- Describe the House-Brackmann grading scale of facial nerve weakness

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with skull base tumours including schwannoma and chordoma

Intermediate Training

Knowledge

- Describe the long-term risks and complications of the neurophakomatoses and the neoplasms associated with them
- Discuss the genetic testing and prenatal diagnosis available for neurophakomatoses
- Describe the pathological and radiological features of chordoma
- Discuss the radiological features of CPA tumours
- Describe otological investigations required for CPA tumours

Skills

- Interpret the results of investigations in patients presenting with neurophakomatoses
- Order molecular investigation for neurophakomatoses, as appropriate
- Interpret the results of investigations for patients with chordoma
- Interpret the results of investigations for patients with CPA tumours
- Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients with skull base tumours
- Collaborate with ophthalmology, ENT, and oncology colleagues to optimise the care for patients with skull base tumours

Advanced Training

Knowledge

- Identify the macroscopic and microscopic differences between neurofibromas and schwannomas
- Discuss the indications for surgical and non-surgical treatment of neurofibroma in patients with neurofibromatosis

- Describe biochemistry and function of neurofibromatosis I protein (neurofibromin) and Neurofibromatosis II protein (schwannoma/merlin)
- Discuss the appropriate investigation and differential diagnosis of a sacral mass
- Discuss the therapeutic options in the management of skull base tumours including chordoma
- Discuss the role of stereotactic radiosurgery and other adjuvant treatment for management of skull base and CPA tumours
- Describe in detail the surgical anatomy, risks and indications of different approaches for CPA tumours
- Discuss the management of a patient with facial paresis
- Discuss the uses and indications for intraoperative monitoring during skull base and CPA surgery
- Discuss the issues relating to the management of patients with bilateral vestibular schwannomas
- Describe the on-going investigations, monitoring and genetic counselling for patients with Neurofibromatosis II protein (NP-2)

Skills

- Refer patients with neurofibromatosis for genetic counselling
- Collaborate with other medical specialists and health professionals to develop and implement a comprehensive management plan for patients with neurophakomatoses
- Collaborate with members of an MDT to develop and implement a comprehensive management plan for patients with skull base tumours including chordoma
- Develop and implement a comprehensive management plan for patients with a CPA tumours
- Perform surgery for a CPA tumour
- Perform with supervision surgery for a vestibular schwannoma/acoustic neuroma
- Perform surgery for tumour excision with skull base approach
- Manage patients with skull base and CPA tumours, including postoperative complications

9 Specialty Practice: Neurotrauma

9.1 Procedures

Procedures	Graduate Level of Competence
Acute Subdural Haematoma	Independent
Chronic Subdural Haematoma	Independent
Cranioplasty	Independent
Decompressive Craniectomy	Independent
External Ventricular Drain/ ICP Monitor	Independent
Extradural Haematoma	Independent
Intracerebral Haematoma/Contusions	Independent
Repair for CSF leak	Independent
Trauma craniotomy for intracranial haemorrhage	Independent
Laminectomy for spinal cord compression	Independent
Decompression, correction, fixation of a traumatic spine injury	Independent

9.2 Cranial Trauma

Basic Training

Knowledge

- Discuss the principles of initial resuscitation and assessment of multi-trauma
- Discuss the principles of resuscitation of multiple system trauma patients, including appropriate fluid resuscitation
- Discuss the aetiology, pathophysiology, classification, clinical presentation and management of cranial trauma and traumatic brain injury
- Discuss pathophysiology, assessment and management protocols for raised intracranial pressure
- Discuss the risk factors for and management of post traumatic seizures
- Describe clinical and radiological determinants of outcome of traumatic brain injury
- Discuss the criteria for brain death and organ donation

Skills

- Assess a patient with multi-system trauma, using a systematic approach
- Perform surgery for an acute subdural haematoma
- Perform surgery for a chronic subdural haematoma
- Perform surgery for an extradural haematoma
- Perform a trauma craniotomy for intracranial haemorrhage
- Perform the insertion of an ICP monitor and external ventricular drain

Intermediate Training

Knowledge

- Discuss the principles of neuroprotection in trauma
- Discuss the pathophysiology and management of coagulopathy after head injury
- Describe surgical options including approaches and timing for treatment of CSF fistulae

Skills

- Select and interpret investigations for penetrating head injuries

Advanced Training

Knowledge

- Discuss the options for cranioplasty
- Discuss the principles of trauma care systems
- Discuss the evidence for decompressive craniectomy in the management of severe closed head injury

Skills

- Perform the repair for CSF leak

- Perform cranioplasty
- Perform a decompressive craniectomy

9.3 Spinal Trauma

Basic Training

Knowledge

- Describe the clinical features and pathophysiology of spinal cord injury including:
  - Complete and incomplete injury
  - Anterior cord injury
  - Central cord injury
  - Brown-Sequard injury
  - Cruciate paralysis
  - Conus syndrome
  - Cauda equina syndrome
  - Sacral sparing
- Describe the early management of spine and spinal cord injured patients including immobilisation, traction, reduction and appropriate imaging
- Differentiate spinal shock from other etiologies of shock
- Discuss the medical management spinal cord injured patients including blood pressure management, bowel and bladder, pressure areas and DVT prophylaxis
- Discuss the definitions of spinal stability
- Describe the eponymous fractures in the cervical spine
- Describe the indications for spinal immobilisation and/or investigation in trauma patients
- Describe the appropriate investigations required for trauma patients considered at risk of having spinal injury

Skills

- Identify the normal anatomical features of plain x-rays, CT scans and MRI scans of the cervical, thoracic and lumbar regions
- Identify the expected age-related changes not indicative of significant spinal injury in elderly patients on plain cervical x-rays, CT scans and MRI scans of the cervical, thoracic and lumbar regions
- Demonstrate the correct technique for cervical immobilisation for endotracheal intubation in the context of emergency trauma

Intermediate Training

Knowledge

- Classify fractures, dislocations, and ligament injuries of the craniocervical region, subaxial cervical spine, thoracic, thoracolumbar junction, lumbar and sacral spine
- Discuss the indications for, and timing of, surgical management of spinal instability
- Discuss the indications and timing of surgery for neurological compromise
- Discuss (briefly) the concept of grading schemes for spinal cord injury and myelopathy

- Discuss the late complications of spinal cord injury
- Discuss the indications, uses and relative effectiveness of common spinal orthoses
- Discuss the management principles for penetrating wounds to the spine
- Discuss non-operative and operative treatment options for fractures and dislocations affecting the atlas and axis
- Compare and contrast the indications for non-operative treatment, anterior approaches and posterior operative approaches for the treatment of fractures and dislocations of the subaxial cervical spine
- Describe in detail the indications for, risks and complications, and alternative techniques for cervical spinal traction
- Describe the application of cervical traction and subsequent management of a patient in traction

Skills

- Apply common external spinal orthoses

Advanced Training

Knowledge

- Discuss the implications for the management of trauma in the presence of ankylosing spondylitis
- Discuss the impact of underlying bone disease such as rheumatoid arthritis, osteoporosis, Paget's disease and metabolic bone disease
- Discuss the pathogenesis, clinical presentation and management options for post traumatic syringomyelia
- Discuss the indications and techniques for complex internal fixation for spinal trauma
- Discuss current theories of spinal cord regeneration
- Discuss the controversies surrounding the management of compression fractures
- Describe the controversies surrounding the management of odontoid fractures
- Discuss the controversies surrounding, and the evidence relating to, the use of steroids in spinal injury
- Discuss the controversies, risks and indications of dynamic radiological investigations in acute spinal trauma
- Discuss the controversies surrounding kyphoplasty and vertebroplasty and their indications
- Discuss the controversies regarding the diagnosis, management and prognosis of chronic musculoligamentous spinal injuries (including "whiplash")

Skills

- Demonstrate the placement and management of cranial traction devices for reduction and immobilisation of the unstable cervical spine
- Demonstrate the application and management of a halo-thoracic brace
- Demonstrate the application and management of cervical traction for instability
- Perform a laminectomy for spinal cord compression
- Perform decompression, correction and fixation of a traumatic spine injury

9.4 Concussion

Basic Training
Knowledge
• Discuss the pathophysiology, clinical presentation, assessment and natural history of concussion, including persistent post-concussive symptoms • Describe the potential complications associated with repetitive head injury • Discuss the guidelines for return to sport, school, driving and other activities after sustaining a concussion
Skills
• Obtain a targeted history, perform a focused examination and select, order and interpret investigations for patients presenting with suspected concussion • Formulate a comprehensive management plan for patients with concussion including return to sport, school, driving and other activities
Intermediate Training
Knowledge
• Discuss the utility of imaging in concussion

9.5 Trauma in the Regional, Rural and Remote Context

Basic Training
Knowledge
• Discuss the principles for managing head injury in remote locations • Discuss factors that adversely influence the outcome for trauma patients in rural and remote settings • Discuss retrieval systems available for the safe transfer of patients to trauma centres
Skills
• Utilise telemedicine to support care for patients in rural and remote settings
Intermediate Training
Knowledge
• Determine when onsite surgery by local surgeons is required, in rural and remote settings

Skills
• Provide advice to the local surgeons and/or the retrieval team on early management, including indications for retrieval or onsite surgery

10 Specialty Practice: Neurovascular

10.1 Procedures

Procedures	Graduate Level of Competence
Aneurysm - Clipping: Anterior circulation	Independent
AVM Excision	Independent
Carotid Endarterectomy	Assist
Cavernoma Excision	Independent
Decompressive craniectomy for cerebral ischaemia	Independent
Endovascular Procedure	Assist
Non-traumatic intracerebral haemorrhage evacuation	Independent

10.2 Cerebral Aneurysms and Non-Traumatic Subarachnoid Haemorrhage

Basic Training
Knowledge
• Discuss the aetiology, pathophysiology, and clinical presentation of non-traumatic subarachnoid haemorrhage (SAH) • Describe the radiological features of SAH and grading systems • Discuss risk factors associated with the formation, growth and rupture of cerebral aneurysms • Discuss clinical grading scales for aneurysmal SAH • Discuss the natural history of unruptured and ruptured cerebral aneurysms • Describe the complications of SAH and cerebral aneurysm rupture
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with suspected SAH • Develop a comprehensive non-surgical management plan for patients with a SAH • Recognise and respond to complications of SAH, including vasospasm and hydrocephalus • Formulate a comprehensive management plan for patients with a ruptured cerebral aneurysm • Collaborate with neurointerventional colleagues and intensive care physicians to optimise care for patients with SAH

Intermediate Training
Knowledge
• Discuss the microsurgical anatomy in relation to common cerebral aneurysms • Discuss the pathophysiology and treatment of delayed ischaemic deficit following SAH • Describe the common interventional neuroradiology techniques used to treat cerebral aneurysms, their indications and potential complications
Skills
• Select, order and interpret preoperative investigations for patients with non-traumatic SAH • Correctly position a patient undergoing surgery for a cerebral aneurysm • Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for the patients having surgery for SAH • Formulate a management plan for patients with an unruptured cerebral aneurysm, with consideration of natural history data, aneurysm and patient factors
Advanced Training
Knowledge
• Discuss the factors considered in determining the mode and timing of treatment (surgical or endovascular) in patients with a ruptured or unruptured cerebral aneurysm • Describe the common approaches, and key surgical steps, to safely repair a cerebral aneurysm • Explain the treatment of intraoperative aneurysm rupture, the use of temporary clipping, and neuroprotection in aneurysm surgery
Skills
• Perform the clipping of an anterior circulation aneurysm • Assist with performing an endovascular procedure

10.3 Cerebral and Spinal Vascular Malformations

Basic Training
Knowledge

• Discuss the epidemiology, aetiology and clinical presentation and natural history of:
  ○ Dural arteriovenous fistulas and carotid cavernous fistulas
  ○ Angiographically occult vascular malformations
  ○ Cerebral arteriovenous malformations (AVMs)
  ○ Spinal vascular malformations

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with suspected:
  - Dural arteriovenous fistulas and carotid cavernous fistulas
  - Angiographically occult vascular malformations
  - Cerebral AVMs
  - Spinal vascular malformations

Intermediate Training

Knowledge

- Discuss the pathophysiology, angiographic anatomy and grading of:
  - Dural arteriovenous fistulas and carotid cavernous fistulas
  - Angiographically occult vascular malformations
  - Cerebral AVMs
  - Spinal vascular malformations
- Discuss the risk of haemorrhage, including the impact of angiographic, demographic and clinical factors, from:
  - Dural arteriovenous fistulas and carotid cavernous fistulas
  - Angiographically occult vascular malformations
  - Cerebral AVMs
  - Spinal vascular malformations

Skills

- Interpret investigations for:
  - Dural arteriovenous fistulas and carotid cavernous fistulas
  - Angiographically occult vascular malformations
  - Cerebral AVMs
  - Spinal vascular malformations
- Collaborate with neurointerventional colleagues and intensive care physicians to optimise care for patients with cerebral and spinal vascular malformations
- Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for patients having surgery for cerebral and spinal vascular malformations

Advanced Training

Knowledge

- Describe the comparative risks and benefits of management options for patients with:
  - Dural arteriovenous fistulas and carotid cavernous fistulas
  - Angiographically occult vascular malformations
  - Cerebral AVMs
  - Spinal vascular malformations
- Discuss perioperative management of patients with cerebral AVMs and spinal vascular malformations

Skills
• Formulate comprehensive management plans for patients with cerebral and spinal vascular malformations, taking into consideration patient and angiographic factors • Perform an AVM excision • Perform a cavernoma excision • Manage patients with cerebral and spinal vascular malformations, including postoperative complications

10.4 Cerebral Ischaemia and Haemorrhagic Stroke

Basic Training
Knowledge

• Discuss the epidemiology, aetiology, pathophysiology, clinical presentation and natural history of:
  ○ Cerebral and spinal ischaemia
  ○ Haemorrhagic stroke
• Discuss the use and limitations of radiological modalities for the examination of cerebral and spinal ischaemia and haemorrhage
• Describe the pharmacological and medical management of ischaemic and haemorrhagic stroke, including endovascular clot retrieval and intravenous and intraarterial stroke management

Skills

• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with suspected:
  ○ Cerebral and spinal ischaemia
  ○ Haemorrhagic stroke
• Develop a comprehensive non-surgical management plan for patients with cerebral and spinal ischaemia and haemorrhage, including limits of care and best supportive care
• Collaborate with neurologists, neurointerventional colleagues and intensive care physicians to optimise management of patients with cerebral ischaemia and haemorrhagic stroke

Intermediate Training
Knowledge
• Describe the epidemiology, aetiology, pathophysiology, clinical presentation and natural history of steno-occlusive arterial diseases • Describe the epidemiology, aetiology, pathophysiology, clinical presentation and natural history of clinical syndromes associated with steno-occlusive arterial diseases
Skills
• Select, order and interpret investigations for patients with suspected: ○ Intracranial venous occlusive diseases

○ Steno-occlusive arterial diseases • Formulate a comprehensive management plans for patients with: ○ Haemorrhagic stroke ○ Spontaneous intracerebral haemhorrhage • Perform a non-traumatic intracerebral haemorrhage evacuation • Perform a decompressive craniectomy for cerebral ischaemia • Manage patients with cerebral ischaemia haemorrhagic stroke, including postoperative complications
Advanced Training
Knowledge
• Discuss the indications and comparative risks and benefits of the management options for patients with cerebrovascular occlusive disease including: ○ Pharmacological/medical ○ Neurointerventional procedures ○ Surgery • Discuss the indications and comparative risks and benefits of the treatment modalities available for patients with venous occlusive disease
Skills
• Assist in performing a carotid endarterectomy • Manage patients with cerebrovascular occlusive disease, including postoperative complications

11 Specialty Practice: Peripheral Nerves

11.1 Procedures

Procedures	Graduate Level of Competence
Brachial Plexus Dissection	Supervised
Carpal Tunnel	Independent
Common peroneal (fibular) Neurolysis	Independent
Endoscopic Sympathectomy	Supervised
Muscle biopsy	Independent
Nerve Repair	Supervised
Neurectomy	Independent
Peripheral Nerve Tumour	Independent
Sural Nerve Biopsy	Independent
Ulnar Neurolysis	Independent

11.2 Autonomic Peripheral Nervous System Disorders

Basic Training
Knowledge
• Discuss the clinical features of a patient with hyperhidrosis or facial flushing
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with autonomic nervous system disorders
Intermediate Training
Knowledge
• Describe the various conditions for which sympathectomy may be indicated • Discuss the risks and complications of sympathectomy
Skills
• Develop a comprehensive management plan for patients presenting with autonomic nervous system disorders • Perform under supervision an endoscopic sympathectomy
Advanced Training
Knowledge
• Describe the anatomical and surgical details of endoscopic thoracic sympathectomy

11.3 Peripheral Nerve Neoplasms

Basic Training
Knowledge
• Describe the epidemiology, aetiology, pathophysiology, clinical presentation and natural history of peripheral nerve tumours • Describe the classification of peripheral nerve tumours and their relationship to syndromic disorders
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with a peripheral nerve tumour

Intermediate Training
Knowledge
• Identify the diagnostic radiological features of peripheral nerve tumours • Describe the different neurophakomatoses including the genetic and clinical features of each
Skills
• Interpret investigations for patients presenting with a peripheral nerve tumour
Advanced Training
Knowledge
• Discuss the indications and comparative risks and benefits of non-surgical and surgical management options for patients with benign or malignant peripheral nerve tumours
Skills
• Develop a comprehensive non-surgical management plan for patients with peripheral nerve tumours • Perform the resection of a benign peripheral nerve tumour

11.4 Peripheral Nerve Entrapment Neuropathies

Basic Training
Knowledge
• Discuss the aetiology, pathophysiology, and clinical presentation of common entrapment neuropathies • Describe Wallerian degeneration and nerve regeneration in peripheral neuropathies • Discuss the physiology of electromyography (EMG) and nerve conduction studies in entrapment neuropathy • Outline the clinical signs that differentiate a peripheral neuropathy from spinal radiculopathy
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with entrapment neuropathies
Intermediate Training
Knowledge
• Discuss the operative and non-operative management options for patients with entrapment neuropathies, including indications, timing and risks

- Describe the use of electrophysiological studies in entrapment neuropathies, including key findings and limitations

Skills

- Develop a comprehensive management plan for patients with entrapment neuropathies
- Perform a carpal tunnel decompression

Advanced Training

Knowledge

- Discuss diagnostic features, symptoms and signs of uncommon entrapment neuropathies
- Describe the uses and limitations of intra-operative electrophysiological nerve evaluation
- Describe the neurophysiological findings in various entrapment neuropathies
- Outline the indications for ulnar nerve transposition

Skills

- Interpret EMG and nerve conduction studies for the common entrapment neuropathies
- Perform an ulnar neurolysis
- Perform decompression of the common peroneal nerve

11.5 Peripheral Nerve Injuries

Basic Training

Knowledge

- Discuss the classification of peripheral nerve injury
- Discuss the physiology of electromyography (EMG) and nerve conduction studies for peripheral nerve injuries

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with a peripheral nerve injury

Intermediate Training

Knowledge

- Describe a stretch injury, missile injury, laceration and avulsion injury and their definitions
- Discuss the operative and non-operative management options for patients with peripheral nerve injuries, including indications, timing and risks
- Describe the use of electrophysiological studies in peripheral nerve injuries, including timing, key findings and limitations

Skills
• Develop a comprehensive management plan for patients with a peripheral nerve injury
Advanced Training
Knowledge
• Describe the features, indications and limitations of neurolysis, nerve repair, nerve transfer, and nerve graft in peripheral nerve injury • Describe the features and limitations of tendon and muscle transfer in nerve injuries • Describe the uses and limitations of intra-operative electrophysiological nerve evaluation
Skills
• Perform and interpret intraoperative neurophysiological studies, including nerve action potential recordings • Perform a neurectomy • Perform under supervision dissection of the brachial plexus • Perform under supervision nerve repair

11.6 Non Entrapment Peripheral Neuropathies

Basic Training
Knowledge
• Discuss the aetiology, pathophysiology, and clinical presentation of non-entrapment peripheral neuropathies • Discuss the physiology of electromyography (EMG) and nerve conduction studies in non-entrapment peripheral neuropathy
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with non-entrapment peripheral neuropathies • Perform a muscle biopsy • Perform a sural nerve biopsy
Intermediate Training
Knowledge
• Discuss the natural history and medical management of non-entrapment peripheral neuropathies
Skills
• Interpret investigations for patients presenting with non-entrapment peripheral neuropathies

12 Specialty Practice: Spine

12.1 Procedures

Procedures	Graduate Level of Competence
Cervical and Thoracic Degenerative Conditions: Anterior cervical decompression and fusion/arthroplasty	Independent
Cervical and Thoracic Degenerative Conditions: Anterior or Lateral Lumbar Interbody Fusion or Disc Arthroplasty	Independent
Cervical and Thoracic Degenerative Conditions: C1/2 or Occipitocervical Fixation and Fusion	Assist
Cervical and Thoracic Degenerative Conditions: Posterior Cervical Decompression	Independent
Cervical and Thoracic Degenerative Conditions: Posterior Cervical Foraminotomy	Independent
Cervical and Thoracic Degenerative Conditions: Posterior Thoracic Decompression	Independent
Congenital and developmental: Foramen Magnum Decompression for Chiari malformations	Independent
Lumbar Degenerative Conditions: Anterior to lateral lumbar interbody fusion or disc arthroplasty	Independent
Lumbar Degenerative Conditions: Lumbar vertebrectomy	Supervised
Lumbar Degenerative Conditions: Posterior Lumbar Decompression	Independent
Lumbar Degenerative Conditions: Posterior Lumbar Fixation and Fusion	Independent
Neoplasia: Excision Extradural Spinal Neoplasm or Lesion	Independent
Neoplasia: Excision Intradural Extramedullary Spinal Cord Neoplasm	Independent
Neoplasia: Excision Intramedullary Spinal Cord Neoplasm	Supervised
Spinal Vascular Malformations: Spinal cavernous malformation	Assist
Spinal Vascular Malformations: Spinal Dural Arteriovenous Fistula	Supervised
Spine Trauma: Decompression and Fusion/Arthroplasty	Independent
Spine Trauma: Posterior Cervical or Thoracic Fixation and Fusion	Independent
Spinal Trauma: C1/2 or Occipitocervical Fixation and Fusion	Assist
Spine Trauma: Thoracic or lumbar vertebrectomy	Supervised

12.2 General

Basic Training
Knowledge
• Describe the clinical assessment and differential diagnosis spinal pain • Describe the pathological changes that occur in the intervertebral disc and other anatomical elements of the spine with age, their natural history and their impact on load bearing capacity

- Describe normal anatomical features of the vertebral column on imaging studies
- Describe the normal blood supply and venous drainage of the spinal cord and vertebral column
- Define the anatomical relationship of the spinal nerve roots to the disc spaces in the cervical, thoracic and lumbar spine
- Describe the anatomy of the spinal cord and cauda equina, including the relationship of neurological level and vertebral level and internal architecture
- Describe the anterior and lateral relationships to the vertebral column
- Discuss the preoperative work-up of a patient scheduled for surgery, including management of comorbidities, medications and other patient factors

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with spinal conditions
- Obtain informed consent from a patient requiring spinal surgery
- Lead a "time out" procedure prior to commencement of spinal surgery, in addition to communicating with anaesthestist and theatre staff regarding specific patient requirements and anticipated problems
- Demonstrate correct preparation for surgery, including patient review, patient positioning, surgical site preparation, draping, appropriate to procedure
- Plan and anticipate for surgery in terms of ensuring availability of prostheses and equipment
- Set up the operating microscope and have a functional knowledge of diathermy and suction equipment
- Demonstrate a sound working knowledge of stereotaxy, including preoperative data management, planning, registration and intraoperative navigation

Intermediate Training

Knowledge

- Describe anatomical variations that may contribute to degenerative change in the vertebral column or influence surgical decision making
- Identify comorbidities and other patient factors which have implications for prognosis, treatment outcomes and surgical decision making in relation to spinal surgery
- Discuss the management of postoperative complications of spinal surgery, including hematoma, infection, and new neurologic deficit
- Describe the management options for intraoperative and postoperative cerebrospinal fluid leaks
- Discuss the technical principles and utility of imaging modalities used for patients with spine disease, including intraoperative stereotaxy
- Discuss the role of other health professionals in the rehabilitation of patients with spinal disorders

Skills

- Demonstrate a reproducible and accurate technique for radiological confirmation of the correct spinal level

Advanced Training
Knowledge
• Discuss the management options for patients in whom spinal surgery has failed to relieve symptoms • Describe the indications for, technical principles, and limitations of intraoperative spinal cord monitoring
Skills
• Manage intraoperative and postoperative cerebrospinal fluid leaks

12.3 Metabolic and Inflammatory Conditions

Basic Training
Knowledge

• Describe the composition, structure, and metabolism of normal bone, including its regulators
• Outline the epidemiology, pathophysiology, clinical presentation, natural history, radiological features, and laboratory diagnosis of:
  ○ Inflammatory arthritis, including rheumatoid arthritis, sero-negative rheumatoid arthritis, and other sero-negative arthritis (psoriatic arthritis, reactive arthritis, inflammatory bowel disease)
  ○ Ankylosing arthritis, ossification of the posterior longitudinal ligament (OPLL), ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis (DISH)
  ○ Crystal arthritis, including gout, pseudogout
• Outline the epidemiology, pathophysiology, clinical presentation, natural history, radiological features, laboratory diagnosis and medical management of:
  ○ Osteoporosis
  ○ Osteomalacia, Pagets Disease and other disorders of bone metabolism
• Outline the general principles of non-surgical management:
  ○ Inflammatory arthritis
  ○ Ankylosing arthritis
  ○ Crystal arthritis
• Discuss any specific disease-related perioperative considerations for patients with metabolic and inflammatory conditions undergoing spinal surgery

Skills
• Obtain a targeted history, perform a focused examination and select, order and interpret investigations for patients presenting with metabolic and inflammatory conditions

Intermediate Training
Knowledge

• Discuss specific concerns to be considered in a trauma patient with:
  ○ Ankylosing spondylitis or DISH
  ○ Rheumatoid arthritis
• Discuss the impact of osteoporosis and other diseases that affect bone quality on surgical decision making

Skills
• Formulate and implement comprehensive management plan for a patient with a metabolic and/or inflammatory condition • Collaborate with other medical specialties and health professionals to optimise care of patients with metabolic and inflammatory conditions undergoing surgery
Advanced Training
Knowledge
• Discuss management options for symptomatic osteoporotic vertebral fractures • Discuss the surgical management of rheumatoid cervical disease • Discuss the surgical management of ankylosing conditions of the spine

12.4 Neoplasia

Basic Training
Knowledge

• Discuss the classification, clinical presentation and radiological features of patients presenting with a:
  ○ Vertebral neoplasm
  ○ Extradural neoplasm
  ○ Intradural extramedullary neoplasm
  ○ Intramedullary neoplasm
• Discuss the appropriate radiological and other investigations for patients with spinal neoplasia
• Discuss the indications for, and broad treatment goals for surgery in patients with a spinal neoplasm

Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with a suspected spinal neoplasm

Intermediate Training

Knowledge

- Discuss the principles of radiation therapy in the context of malignant spinal neoplasia
- Discuss the role of spinal angiography and preoperative embolisation in the management of spinal malignancy
- Describe the differential diagnosis and most common types of spinal tumours, including their pathology and natural history, in the following categories:
    - Vertebral – primary and metastatic
    - Extradural
    - Intradural extramedullary
    - Intramedullary
- Discuss the framework for decision making and management of patients with common spinal tumours in the following categories:
    - Vertebral – primary and metastatic
    - Extradural
    - Intradural extramedullary
    - Intramedullary

Skills

- Interpret the results of investigations for patients with spinal neoplasia
- Collaborate with radiation and medical oncology, pathology, and neurointerventional colleagues to optimise care for patients with spinal neoplasia
- Collaborate with the neuroanaethetist, and where necessary neurophysiologists, to optimise the intraoperative environment for patients having surgery for a spinal neoplasm

Advanced Training

Knowledge

- Discuss the key procedural steps and surgical strategies, for surgery on spinal tumours in the following categories:
    - Vertebral – primary and metastatic
    - Extradural
    - Intradural extramedullary
    - Intramedullary
- Discuss the pathological significance and management options for Tarlov cysts, arachnoid cysts, and other non-neoplastic cysts of the spine

Skills

- Formulate and implement a comprehensive management plan for patients with spinal neoplasia
- Perform surgery for patients with an:
    - Extradural spinal neoplasm or lesion
    - Intradural extramedullary spinal cord neoplasm
- Perform with supervision
    - Intramedullary spinal cord neoplasm

12.5 Infection

Basic Training
Knowledge
• Discuss the aetiology, microbiology and pathogenesis of spinal infections • Describe the clinical presentation of patients with a spinal infection, and their radiological features
Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with a suspected spinal infection
Intermediate Training
Knowledge
• Discuss the indications, risks and benefits of surgical intervention for a patient with a spinal infection • Discuss the principles of medical management of spinal infections, surveillance and monitoring • Discuss factors contributing to post operative spinal infections • Describe the evidence for the use of prophylactic antibiotics in spinal surgery
Skills
• Collaborate with infectious diseases and microbiology colleagues to optimise care for patients with spinal infection • Formulate and implement a comprehensive management plan for patients with a spinal infection • Surgically manage a patient with a spinal infection
Advanced Training
Knowledge
• Discuss management options for patients with an infected spinal prosthesis / internal fixation device

12.6 Congenital and developmental

Basic Training
Knowledge
• Describe the normal embryological development of the spine and spinal cord • Discuss the embryology and anatomy of major forms of spinal dysraphism

- Describe the clinical features of spinal dysraphism presentation at different ages (neonatal, childhood and adulthood)

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with congenital and developmental conditions of the spine

Intermediate Training

Knowledge

- Discuss the pathophysiology, clinical presentation, and management options in the treatment of Chiari malformations and syringomyelia
- Describe the indications for surgery and surgical strategies in patients with spinal dysraphism

Skills

- Interpret the results of investigations for patients with congenital and developmental conditions of the spine
- Collaborate with paediatricians and other health professionals to develop and implement a comprehensive management plan for patients with congenital and developmental conditions of the spine

Advanced Training

Knowledge

- Describe the surgical procedure for closure of a neonatal myelomeningocele or resection of a lipomyelomeningocele
- Describe the management options for incontinence secondary to neonatal spinal dysraphism
- Describe the surgical and non-surgical options available for the management of chronic spasticity secondary to spinal cord pathology

Skills

- Perform a foramen magnum decompression for Chiari malformations

12.7 Spinal Vascular Malformations

Basic Training

Knowledge

- Discuss the epidemiology, aetiology, clinical presentation and natural history of spinal vascular malformations

Skills
• Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with suspected spinal vascular malformations
Intermediate Training
Knowledge
• Discuss the pathophysiology, angiographic anatomy and grading of spinal vascular malformations
Skills
• Interpret the results of investigations for patients with spinal vascular malformations • Collaborate with neurointerventional colleagues to optimise care for patients with cerebral and spinal vascular malformations • Collaborate with the neuroanaethetist to optimise the intraoperative and perioperative environment for patients having surgery for cerebral and spinal vascular malformations
Advanced Training
Knowledge
• Describe the comparative risks and benefits of management options for patients with spinal vascular malformations • Discuss perioperative management of patients with spinal vascular malformations
Skills
• Formulate a comprehensive management plan for patients with spinal vascular malformations, taking into consideration patient and angiographic factors • Perform under supervision surgery for a spinal dural arteriovenous fistula • Assist with performing surgery for a patient with spinal cavernous malformation • Manage patients with spinal vascular malformations including postoperative complications

12.8 Spinal biomechanics, stabilisation and fusion

Basic Training
Knowledge
• Discuss the biomechanically relevant anatomy and material properties of the spine and associated elements including regional characteristics • Describe the forms of deformity and instability commonly seen due to age-related degenerative changes • Discuss commonly used definitions and classification schemes used for spinal deformity and instability • Discuss the biology of bone healing • Describe the general indications and different types for spinal stabilisation and fusion

- Discuss the utility of various forms of spinal bracing

Intermediate Training

Knowledge

- Discuss the techniques and principles of bone grafting and harvesting in spinal surgery
- Discuss bone graft substrates and the materials available for spinal fusion
- Discuss the role of non-surgical management of spinal instability
- Define factors which affect bone union following spinal fusion

Advanced Training

Knowledge

- Discuss additional measures to enhance fusion
- Discuss the aetiology, natural history and classification of various forms of scoliosis and spinal deformity and their management principles
- Discuss the radiological features, and basic parameters relevant to spinal deformity and balance
- Describe the range of common fixation systems and their biomechanical features
- Discuss the literature regarding arthrodesis versus arthroplasty in the cervical and lumbar spine
- Discuss strategies to enhance internal fixation integrity in the presence of osteoporosis
- Discuss management of adult spinal deformities

12.9 Cervical and Thoracic Degenerative Conditions

Basic Training

Knowledge

- Discuss the pathophysiology, natural history, clinical presentation, and radiological features of cervical and thoracic degenerative spinal pathologies including:
  - Cervical and thoracic myelopathy
  - Cervical and thoracic radiculopathy
  - Axial Neck Pain
- Discuss the differential diagnosis of cervical myelopathy and radiculopathy
- Discuss appropriate radiological investigations and diagnostic interventions for symptomatic degenerative cervical and thoracic spine pathology
- Discuss the non-operative management of patients with symptomatic degenerative cervical and thoracic spinal conditions including:
  - Cervical and thoracic myelopathy
  - Cervical and thoracic radiculopathy
  - Axial Neck Pain
- Discuss the indications for surgical management of cervical radiculopathy

Skills

- Obtain a targeted history, perform a focused examination, and select and order investigations for patients presenting with symptomatic degenerative cervical and thoracic spine pathologies

Intermediate Training

Knowledge

- Discuss the controversies surrounding the management of asymptomatic radiological cord compression from degenerative disease
- Describe the approach to the anterior cervical column, the anatomical relationships to this approach and specific risks and complications
- Describe the spectrum of surgical strategies for the management of cervical radiculopathy, including their indications, benefits and risks
- Describe the spectrum of surgical strategies available to treat cervical myelopathy, their indications, benefits, and risks
- Describe how deformity or instability is considered within the range of factors influencing surgical strategies in cervical and thoracic degenerative pathologies

Skills

- Interpret the results of investigations for patients with symptomatic degenerative cervical and thoracic spine pathologies
- Formulate and implement a comprehensive management plan for patients with symptomatic degenerative cervical and thoracic spine pathologies
- Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative management of patients undergoing spinal surgery for a cervical or thoracic degenerative condition
- Collaborate with surgical colleagues to facilitate exposure of the spinal column where necessary
- Perform:
    - Posterior cervical decompression
    - Posterior cervical foraminotomy
    - Anterior cervical decompression and fusion/arthroplasty

Advanced Training

Knowledge

- Describe indications and surgical strategies for the management of thoracic myelopathy and radiculopathy
- Discuss the management of degenerative conditions of C1/2 articulation
- Discuss the diagnosis and management of symptomatic Ossification of the Posterior Longitudinal Ligament (OPPL), including indications, risks and limitations of the different surgical approaches

Skills

- Perform a posterior thoracic decompression
- Perform an anterior or lateral lumber interbody fusion or disc arthroplasty
- Assist in performing an occipitocervical or C1/2 internal fixation and fusion

12.10 Lumbar Degenerative Conditions

Basic Training

Knowledge

- Discuss the pathophysiology, natural history, clinical presentation, and radiological features of degenerative spinal pathologies including:
  - Lumbar intervertebral disc pathology
  - Lumbar spinal canal stenosis
  - Axial back pain
- Discuss appropriate radiological investigations and diagnostic interventions for symptomatic degenerative lumbar spine pathology
- Discuss the non-operative management of patients with symptomatic degenerative spinal conditions including:
  - Lumbar intervertebral disc pathology
  - Lumbar spinal canal stenosis
  - Axial back pain
- Discuss the importance and relative urgencies of the various compressive syndromes, especially cauda equina syndrome

Skills

- Obtain a targeted history, perform a focused examination, and select and order investigations for patients presenting with symptomatic degenerative lumbar spine pathology
- Manage patients following surgery for lumbar degenerative pathologies, including postoperative complications

Intermediate Training

Knowledge

- Describe the differential diagnosis of a lumbar radiculopathy or neurogenic claudication with detailed reference to the spectrum of pathologies, their historical and clinical features, and means of differentiating them
- Discuss the indications for operative treatment of lumbar radiculopathy or symptomatic lumbar spinal canal stenosis
- Discuss spondylolisthesis in the lumbar spine in terms of its classification, natural history, and pathophysiology
- Discuss the non-operative management of patients with symptomatic and asymptomatic spondylolisthesis
- Describe the anatomical landmarks, technique and complication avoidance strategies for the insertion of lumbar pedicle screws

Skills

- Perform a posterior lumbar decompression
- Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative management of patients undergoing spinal surgery for a lumbar degenerative condition

- Collaborate with surgical colleagues to facilitate exposure of the spinal column where necessary
- Perform methods of decompression of the spinal canal, including unilateral and bilateral laminotomy techniques
-

Advanced Training

Knowledge

- Discuss the current literature evidence in relation to the role of surgery for:
  - Lumbar radiculopathy
  - Lumbar spinal canal stenosis
  - Axial back pain
  - Degenerative Spondylolisthesis
  - Isthmic Spondylolisthesis
- Describe the range of surgical strategies that are used to treat lumbar radiculopathy or symptomatic lumbar spinal canal stenosis
- Describe how deformity or instability is considered within the range of factors influencing surgical strategies in lumbar degenerative pathologies
- Discuss surgical strategies and technical considerations in revision surgery for lumbar degenerative spine pathologies
- Discuss different surgical strategies used for patients with spondylolisthesis
- Describe the procedural steps for an extraspinal approach to the lateral aspect of the intervertebral foramen

Skills

- Perform a posterior lumbar fixation and fusion
- Perform under supervision a lumbar vertebrectomy
- Perform an anterior to lateral lumbar interbody fusion or disc arthroplasty

12.11 Spinal Trauma

Basic Training

Knowledge

- Describe the mechanism of injury and clinical presentation of traumatic injuries to the:
  - Craniocervical junction and occipital condyles
  - Atlantoaxial spine
  - Subaxial cervical spine
  - Thoracic and lumbar spine
  - Sacrum
- Describe the classification and morphological features of traumatic injuries to the:
  - Craniocervical junction and occipital condyles
  - Atlantoaxial spine
  - Subaxial cervical spine
  - Thoracic and lumbar spine
  - Sacrum

- Outline patterns of spinal cord injury
- Discuss the appropriate radiological and other investigations for traumatic spinal injuries
- Discuss the prehospital and early trauma care of patients with spinal injury

Skills

- Obtain a targeted history, perform a focused examination and select and order investigations for patients presenting with spinal trauma
- Apply appropriate bracing for patients with spinal trauma

Intermediate Training

Knowledge

- Discuss the framework for decision making and management of patients with spinal trauma
- Discuss the unique features and management of spinal trauma in the paediatric population

Skills

- Interpret the results of investigations for spinal trauma
- Collaborate with the neuroanaesthetist and intensive care physicians to optimise the intraoperative and perioperative management of patients undergoing spinal surgery for spinal trauma
- Collaborate with spinal rehabilitation physicians and other health professionals in the management of patients with spinal trauma
- Apply and manage traction for patients with cervical subluxation/dislocation
- Perform an anterior cervical decompression and fusion/arthroplasty

Advanced Training

Knowledge

- Describe evidence supporting early surgical care of patients with spinal cord injury (neuroprotective strategy)
- Describe the procedural steps and surgical strategies for surgery for common traumatic injuries to the:
    - Craniocervical junction and occipital condyles
    - Atlantoaxial spine
    - Subaxial cervical spine
    - Thoracic and lumbar spine
    - Sacrum
- Discuss the management of cervical subluxation and dislocation
- Discuss the controversies surrounding the management of central cord syndrome
- Discuss acute and delayed complications of spinal cord injury and their management
- Discuss the role of rehabilitation in the management of spinal cord injury
- Discuss surgical options for the management of traumatic spinal injuries

Skills

• Apply and manage a halo thoracic brace
• Perform decompression, correction and fixation of a traumatic spine injury
• Perform:
  ○ Posterior cervical or thoracic fixation and fusion
  ○ Posterior lumbar fixation and fusion
• Perform with supervision:
  ○ Thoracic or lumbar vertebrectomy
• Assist with performing a C1/2 or occipitocervical fixation and fusion

13 Specialty Practice: Paediatrics

13.1 Procedures

Procedures	Graduate Level of Competence
Craniosynostosis: Craniotomy for craniofacial procedure	Independent
Functional: Surgical procedures for management of epilepsy, pain and movement disorders	Assist
Hydrocephalus: Endoscopic third ventriculostomy	Independent
Hydrocephalus: Insertion of ventricular reservoir	Independent
Hydrocephalus: Ventriculo-Peritoneal Shunt insertion or revision	Independent
Infection: Drainage of an intracranial abscess	Independent
Neural tube defects including spinal dysraphism: Closure of neural tube defects	Supervised
• Neural tube defects including spinal dysraphism: De-tethering of closed spinal dysraphism	Assist
Paediatric trauma including spine trauma: Craniotomy for trauma	Independent
Paediatric tumours: Endoscopic biopsy	Assist
Paediatric tumours: Posterior fossa approach for Chiari decompression or tumour	Independent
Paediatric tumours: Stereotactic biopsy of midline lesions	Assist

13.2 Neurological Evaluation

Intermediate Training
Knowledge
• Describe the normal milestones for neurological development in neonates, infants and children

Skills
• Perform an age appropriate neurological evaluation
Advanced Training
Knowledge
• Describe the key stages of embryology with relevance to paediatric neurosurgical conditions

13.3 Neural tube defects including spinal dysraphism

Basic Training
Skills
• Obtain a targeted history for risk factors for spinal dysraphism
Intermediate Training
Knowledge
• Describe the spectrum of cranial and spinal dysraphism; embryology, aetiology, risk factors, clinical presentation and management • Discuss the significance of neurocutaneous stigmata in infants
Skills
• Perform a physical examination to determine the spinal level of neurological deficit in an infant • Perform the closure of open spinal dysraphism under supervision • Assist in the de-tethering of closed spinal dysraphism • Collaborate through the MDT with other medical specialties and health professionals to develop and implement a comprehensive management plan
Advanced Training
Skills
• Describe the embryology, aetiology, risk factors, clinical presentation and management of encephalocele

13.4 Craniovertebral junction anomalies

Intermediate Training
Knowledge
• Outline the development of craniocervical congenital anomalies
Skills
• Position a paediatric patient for surgery
Advanced Training
Knowledge
• Describe the anatomy and the anatomical variations of the ventral craniocervical junction in neonates and infants • Discuss the differential diagnosis of craniovertebral anomalies, acquired and congenital
Skills
• Select, order and interpret investigations for paediatric patients presenting with Craniovertebral junction anomalies

13.5 Hydrocephalus

Basic Training
Knowledge
• Discuss the CSF pathway, embryology and physiology of CSF dynamics • Discuss the anatomy relevant to the performance of CSF diversion procedures (Ventriculo peritoneal, ventriculoatrial, ventriculopleural) • Discuss the aetiology and classification of hydrocephalus
Intermediate Training
Knowledge
• Compare and contrast the presentation and management of hydrocephalus in neonates, infants and children > 2 years of age • Describe the various investigations and/or imaging available in the diagnosis of CSF disorders • Discuss the indications, benefits and risks of Endoscopic Third Ventriculostomy (EVT) for management of hydrocephalus • Describe treatment options for Idiopathic Intracranial Hypertension (IIH) • Describe the potential complications of shunt surgery and shunt infections • Describe current Shunt hardware options

Skills
• Obtain a targeted history and perform a focused physical examination for a paediatric patient presenting with macrocephaly or hydrocephalus • Select, order and interpret age appropriate investigations for paediatric patients presenting with hydrocephalus • Formulate and implement a comprehensive management plan for a paediatric patient presenting with hydrocephalus • Obtain a targeted history and perform a focused physical examination for a neonate presenting with Intraventricular Hemorrhage (IVH) • Select, order and interpret investigations for a neonate with IVH • Formulate and implement a comprehensive management plan for a neonate with IVH • Perform an insertion of Rickham reservoir and CSF aspiration in a neonate with intraventricular haemorrhage (IVH) • Perform the insertion of a Ventriculoperitoneal shunt • Perform an endoscopic third ventriculostomy • Manage a patient presenting with a shunt infection
Advanced Training
Knowledge
• Describe pathophysiological changes that underlie hydrocephalus and IIH • Differentiate between communicating hydrocephalus, BESS, subdural hygroma and subdural haematoma
Skills
• Demonstrate landmarks and perform ventricular tap in a neonate with IVH • Formulate a management plan for hydrocephalus secondary to IVH

13.6 Arachnoid Cysts

Intermediate Training
Knowledge
• Define arachnoid cysts – epidemiology, etiology, locations, and mechanisms of expansion • Discuss the typical modes of presentation of a patient with an arachnoid cyst • Compare and contrast the radiological features of arachnoid cysts and their differentials • Outline the indications for which surgical treatment of arachnoid cysts would be appropriate
Advanced Training
Knowledge
• Describe the surgical options for treating arachnoid cysts

13.7 Craniosynostosis

Basic Training

Knowledge

- Discuss normal skull growth including sutural and appositional growth
- Describe the cranial sutures and fontanelles and their normal closure times
- Describe variations in head shapes seen in craniosynostosis, including but not limited to:
    - Scaphocephaly
    - Anterior plagiocephaly
    - Trigonocephaly
    - Posterior plagiocephaly
    - Brachycephaly
- Discuss the risk of raised ICP in craniosynsostosis
- Describe the rates of craniosynostosis in each of the single suture and syndromic craniosynostoses

Skills

- Identify the cranial sutures and fontanelles on radiological imaging
- Perform an examination of head shape to diagnose craniosynostosis
- Obtain a targeted age appropriate clinical history and perform a targeted physical examination for paediatric patients presenting with suspected raised ICP

Intermediate Training

Knowledge

- Describe the pathophysiology involved in altered cranial bone growth including sutural fusion, deformation, and brain growth
- Describe the presentations, management and/or preventative strategies for deformational plagiocephaly
- Discuss syndromic craniosynostosis, clinical and physical presentations, known genetic mutations, investigation and management of each
- Outline the pathogenesis, management options of hydrocephalus in craniosynostosis and its complications
- Describe key surgical procedures for correction of craniosynostosis including:
    - Spring-assisted Cranioplasty
    - Suturectomy +/- moulding helmet therapy
    - Bifrontal Orbital advancement
    - Total cranial vault reconstruction
    - Cranial vault distraction
- Describe the pathogenesis of Chiari malformation in craniosynostosis

Skills

- Select, order and interpret imaging for patients presenting with craniosynostosis, with attention to optimal timing

- Demonstrate the clinical examination findings of posterior deformational plagiocephaly
- Demonstrate the clinical examination findings of head shapes in craniosynostosis
- Perform a craniotomy for a craniofacial procedure
- Interpret CT/MRI findings at the craniocervical junction in patients with craniosynostosis

Advanced Training

Knowledge

- Discuss the optimal timing of key surgical procedures in craniosynostosis
- Discuss the natural history, include modes, incidence and management of late presentations in untreated craniosynostosis

13.8 Paediatric trauma including spine trauma

Basic Training

Knowledge

- Discuss the unique characteristics of children (vs adults) as trauma patients, in common types and patterns of craniospinal injuries.
- Describe the primary management of trauma, including related issues unique to paediatric patients

Intermediate Training

Knowledge

- Discuss the paediatric imaging guidelines for mild to moderate paediatric head injury
- Define a growing skull fracture and discuss its management
- Describe red flags for child maltreatment/ non-accidental injury and discuss the injury patterns/presentations
- Describe the methods of performing cranioplasty in children of various ages
- Discuss the embryological development, and radiological appearance of the spine in infancy and childhood
- Describe the imaging modalities appropriate to investigate children with suspected spinal cord injury

Skills

- Obtain a targeted history and perform a focused physical examination of a child with a suspected spinal cord injury
- Perform an age appropriate neurological examination for a child with head injury

Advanced Training
Knowledge
• Discuss the long term effects of trauma in children and the varied roles of rehabilitation
Skills
• Perform craniotomy for trauma

13.9 Paediatric tumours

13.9.1 Clinical presentation and investigation of paediatric brain tumours

Basic Training
Knowledge
• Discuss the impact of tumours on acquisition of, or regression in, physical and developmental milestones
Intermediate Training
Knowledge
• Discuss the appropriate investigations of a suspected paediatric tumour, including indications for whole CNS axis imaging • Describe genetic / familial cancer syndromes • Describe additional assessments such as visual, endocrine, tumour markers, neurocutaneous stigmata
Skills
• Select, order and interpret appropriate investigations for a suspected paediatric CNS tumour • Obtain a targeted history and focused physical examination of a patient presenting with a familial cancer syndrome
Advanced Training
Knowledge

• Describe unique presentations, including:
  ○ Diencephalic syndrome
  ○ Bobble headed doll syndrome
  ○ Precocious puberty

13.9.2 Classification of paediatric brain tumours

Basic Training
Knowledge

• Classify tumours and likely pathologies on a regional basis, including:
  ○ Posterior fossa
  ○ Suprasellar
  ○ Pineal Region
  ○ Intraventricular
  ○ Hemispheric

Intermediate Training
Knowledge
• Discuss the current WHO classification of brain tumours with particular reference to paediatric tumours • Describe the spectrum of tumours presenting in neonates and infants • Describe the differential diagnosis and management of skull lesions
Advanced Training
Knowledge

• Discuss the molecular classification of paediatric tumours with particular reference to molecular subtyping of:
  ○ Medulloblastoma
  ○ Ependymoma
  ○ Pilocytic astrocytoma
• Discuss the use of molecular assessment for diagnosis of embryonal tumours

13.9.3 Posterior fossa tumours and their surgical management

Basic Training
Knowledge
• Describe the presentation, investigation and diagnosis of a posterior fossa tumour • Discuss the peri-operative management plan for hydrocephalus in the setting of posterior fossa tumours

Intermediate Training
Knowledge

• Discuss the clinical, radiological and diagnostic features of the following common posterior fossa tumours:
  ○ Medulloblastoma
  ○ Ependymoma
  ○ Juvenile Pilocytic Astrocytoma
  ○ Atypical Teratoid Rhabdoid Tumour (ATRT)

Skills
• Perform the placement of an EVD
Advanced Training
Knowledge
• Describe the common surgical approaches to posterior fossa tumours and the indications for each • Discuss posterior fossa syndrome, its three axes – neurobehavioural, motor and linguistic, and the management of the syndrome
Skills
• Perform a midline posterior fossa tumour surgical approach

13.9.4 Suprasellar tumours

Basic Training
Knowledge
• Describe the presentation of a suprasellar lesion including visual assessment, endocrinological and hypothalamic assessment
Intermediate Training
Knowledge

• Describe the following common tumour pathologies and the features that may distinguish them:
  ○ Glioma
  ○ Craniopharyngioma
  ○ Germ cell tumour

Advanced Training
Knowledge

• Discuss surgical decision making including the:
  ○ Need for tissue diagnosis vs radiological/ marker/medical diagnosis (NF)
  ○ Surgical approaches to the suprasellar region
  ○ Treatment intent – biopsy vs debulking vs Guided Tissue Regeneration (GTR)

13.9.5 Midline gliomas

Basic Training
Knowledge
• Define the clinical spectrum of H3K27M mutated gliomas
Intermediate Training
Knowledge
• Discuss role of biopsy for lesions of the brainstem/diencephalon
Skills
• Assist in a stereotactic biopsy of midline lesions
Advanced Training
Knowledge
• Describe the surgical technique of Biopsy of the brainstem/diencephalon

13.9.6 Pineal region tumours

Basic Training
Knowledge
• Describe the clinical presentation and radiological features of lesions in the pineal region

Intermediate Training
Knowledge
• Describe the tumour markers of relevance for pineal region lesions
Skills
• Select, order and Interpret investigations for pineal region lesions • Assist in an endoscopic biopsy
Advanced Training
Knowledge

• Discuss management strategies for pineal region tumours including:
  ○ Role of biopsy
  ○ Biopsy techniques
  ○ Growing teratoma syndrome

13.9.7 Developmental tumours

Basic Training
Knowledge

• Define the spectrum of developmental tumours below:
  ○ Dysembryoplastic Neuroepithelial Tumor (DNET)
  ○ Ganglioglioma
  ○ Desmoplastic Infantile Ganglioglioma (DIG)

Skills
• Obtain a targeted history and perform a focused physical examination for a child with a suspected developmental tumour
Intermediate Training
Knowledge
• Discuss management plans for developmental tumours, including observation vs biopsy vs resection

13.9.8

13.9.9 Spinal tumours

Basic Training
Knowledge

• Describe clinical presentations specific to paediatrics, for:
  ○ Motor / developmental regression
  ○ Scoliosis
  ○ Pain syndromes

Intermediate Training
Knowledge
• Discuss surgical considerations in the growing spine, for example, the role of laminoplasty • Discuss the role of biopsy of spinal cord lesions with reference to molecular analysis
Advanced Training
Knowledge
• Describe tumour lysis syndrome and its relevance in acute cord compression from paraspinal tumours in children

13.9.10 Adjuvant therapy in paediatric neuro-oncology

Basic Training
Knowledge
• Discuss the effect of radiation relative to age for the developing brain and spine
Intermediate Training
Knowledge
• Describe the benefits of proton beam therapy and the clinical application in paediatric CNS tumours
Skills
• Liaise with an MDT to develop and implement a comprehensive management plan for paediatric patients with CNS tumours

Advanced Training
Knowledge
• Discuss the principles of molecular targeted therapy/immunotherapy in paediatrics

13.10 Paediatric Vascular

Basic Training
Knowledge
• Describe the embryological development of the cerebrovascular system
Intermediate Training
Knowledge

• Describe the clinical presentation, natural history and management options for:
  ○ Paediatric cavernous malformations
  ○ Familial cerebral cavernous malformation
• Describe the pathophysiology of intracranial aneurysms in the paediatric population
• Describe the clinical and radiological features of:
  ○ Non-galenic paediatric dural arteriovenous fistulas
  ○ Sinus pericranii

Skills
• Obtain a targeted history and perform a physical examination for a paediatric patient with a suspected spontaneous intracranial haemorrhage • Formulate and implement a comprehensive management plan for a paediatric patient with a suspected spontaneous intracranial haemorrhage • Perform the insertion of an external ventricular drain in an infant
Advanced Training
Knowledge
• Describe the embryological development, presentation, management and outcomes of a neonate with a Vein of Galen malformation • Describe the clinical presentation, pathophysiology, classification and natural history of paediatric Moya Moya disease • Discuss the various surgical techniques in the management of Moya Moya disease in the paediatric population • Briefly describe syndromes associated with paediatric vascular malformations and known genetic vasculopathies

13.11 Paediatric Infection

Intermediate Training
Knowledge
• Describe common risk factors and infective agents that cause meningitis and intracranial infections in different age groups, as well as the relevant management options • Describe the typical presentations (in contrast to adults), imaging and microbes in children for spinal infections
Skills

• Assess a febrile patient post-operatively
• Obtain a targeted history and perform a focused physical examination of a paediatric patient with a suspected:
  ○ Intracranial infection
  ○ Spinal infection
• Formulate and implement a comprehensive management plan for paediatric patients presenting with:
  ○ An intracranial infection
  ○ A spinal infection
• Perform drainage of an intracranial abscess

13.12 Paediatric Functional

Basic Training
Knowledge
• Describe the different types of paediatric epilepsy syndromes and clinical presentation • Discuss the epidemiology, aetiology, pathophysiology, clinical presentation and natural history of cerebral palsy • Discuss the epidemiology, aetiology, pathophysiology, clinical presentation and natural history of paediatric movement disorders i.e. dystonia
Skills
• Obtain a targeted history, perform a focused examination and order appropriate investigations for a child presenting with a seizure
Intermediate Training
Knowledge
• Describe the embryological development of the temporal lobe and mesial temporal structures including amygdala and hippocampus • Discuss the indications and comparative risks and benefits of non-surgical and surgical treatment modalities available for a child presenting with epilepsy including medication refractory epilepsy

- Discuss the indications and comparative risks and benefits of procedural treatment modalities available for a child with:
  - Acute/chronic pain i.e. injections/infusions/pain pumps
  - Cerebral palsy i.e. injections/ infusions/ baclofen pumps
  - Dystonia

Skills

- Collaborate with a neurologist to develop and implement an initial management plan for a child with epilepsy
- Collaborate with neurologist and rehabilitation paediatrician to develop and implement an
- initial management plan for a child with cerebral palsy or movement disorder
- Select, order and interpret appropriate investigations to guide non-surgical and surgical management of epilepsy, pain and movement disorders
- Assist in performing surgical procedures for management of epilepsy, pain and movement disorders
- Formulate and implement a comprehensive management plan for any intraoperative and postoperative complications that may occur with surgical management of epilepsy, pain and movement disorders

Advanced Training

Knowledge

- Discuss the embryological basis for the development of cerebral heterotopias i.e. cortical dysplasia
- Describe the approaches and key surgical steps for safely performing a temporal lobectomy and amygdala-hippocampectomy
- Describe the surgical approaches and key surgical steps in the surgical management of epilepsy i.e. lesionectomy, corpus callostomy or hemispherotomy
- Describe the clinical indications and key surgical steps in performing safe:
  - Implantation of an intrathecal pump device for management of pain or movement disorder
  - Selective dorsal rhizotomies for management of spasticity in a child with cerebral palsy

13.13 Miscellaneous

Basic Training

Knowledge

- Describe issues in assessing and interpreting the clinical presentation and blood test results of neonates and infants
- Discuss blood and blood product administration in neonates, infants and children

Skills
• Obtain a targeted history, including antenatal, birth history, family history and history relevant to the presentation • Demonstrate blood volume estimation in relationship to age and size
Intermediate Training
Knowledge
• Interpret key variations in neuroradiological investigation findings in neonates and infants
Skills
• Collaborate with the neuroanaesthetist to optimise the intraoperative and perioperative environment for neonates and infants
Advanced Training
Knowledge
• Discuss obtaining consent for treatment of adolescents and young adults • Describe the surgical modifications required for neonates, infants, children, and adolescents

14 Glossary of Terms

Term	Definition
Anticipate	Expect a particular outcome and plan
Apply	Use, utilise, employ in a particular situation
Assess	Conduct an assessment of the patient, usually history and examination
Define	Precisely state the meaning of and identify essential qualities
Demonstrate	Show something and explain how it works
Describe	Give a detailed account in words of the characteristics and features
Determine	Ascertain or establish exactly by examination, research, or calculation
Develop	Design and plan something such as a management plan for a patient
Diagnose	Identify the nature of an illness or other problem by examination of the symptoms
Discuss	Identify issues and provide points for and/or against.
Evaluate	Determine the significance, worth, or condition of by appraisal and study
Explain	Relate cause and effect in more detail or revealing relevant facts
Facilitate	Make an action or process possible or easier
Formulate	Create or prepare something methodically
Identify	Establish or indicate who or what something is by examining the available information
Implement	Put a decision or plan into effect
Integrate	Combine two or more things so that they work together
Interpret	Understand the explain the meaning of information or actions
Investigate	Carry out a systematic or formal inquiry to discover and examine the facts to establish the truth
Leads	Takes the initiative in an action; an example for others to follow
List	Name, usually in the order of importance or frequency
Manage	Be in charge of something to achieve the outcome
Outline	Describe in general terms or give an outline covering essential features
Record	Document according to conventions
Perform	Carry out, accomplish or fulfil an action, task or function
Recognise	Identify or acknowledge the existence or validity of something
Select	Choose something from a group of things as being the best or most suitable