

GOALS AND OBJECTIVES OF ROTATIONS

ACGME General Competencies:

The residency program must require its residents to obtain competence in the six areas listed below to the level expected of a new practitioner. Toward this end, programs must define the specific knowledge, skills, behaviors, and attitudes required, and provide educational experiences as needed in order for their residents to demonstrate the following:

1. Patient care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health with specific reference to neurosurgical conditions. At a minimum residents are expected to:

- a) Gather and understand essential patient information in a timely manner.
- b) Generate an appropriate differential diagnosis.
- c) Implement an effective plan of management.
- d) Prioritize and stabilize multiple patients simultaneously.
- e) Competently perform neurosurgical operative procedures.
- f) Manage complications.
- g) Analyze Outcomes.
- h) Counsel and educate patients and families.
- i) Provide health care services aimed at preventing health problems and maintaining health.
- j) Work with health care professionals to provide patient-focused care.

2. Medical Knowledge: Residents must demonstrate knowledge about established and evolving biomedical, clinical, and cognate sciences, with specific reference to basic and clinical neurosciences, as well as the application of this knowledge to patient care.

Among other things, residents are expected to:

- a) Generate a differential diagnosis and properly sequence critical actions for patient care, including management complications, morbidity and mortality.
- b) Synthesize and properly utilize acquired patient data.
- c) Identify neurosurgical emergencies.
- d) Know how to access current medical information.
- e) Understand how to treat neurosurgical conditions.
- f) Incorporate evidence-based principles.

3. Practice-based learning and improvement that involves the investigation and evaluation of care for their patients, the appraisal and assimilation of scientific evidence, and improvements in patient care. At a minimum, residents are expected to:

- a) Analyze and assess their practice experience and perform practice-based improvement.
- b) Locate, appraise and utilize scientific evidence related to their patients' health problems.
- c) Apply knowledge of study design and statistical methods to critically appraise the medical literature.
- d) Utilize information technology to enhance their education and improve patient care.
- e) Facilitate the learning of students and other health care professionals.

4. Residents must be able to demonstrate **interpersonal and communication skills** that result in the effective exchange of information and collaboration with patients, their families, and other health professionals. At a minimum, residents are expected to:

- a) Develop an effective therapeutic relationship with patients and their families, with respect for diversity and cultural, ethnic, spiritual, emotional, and age-specific differences.
- b) Demonstrate effective participation in and leadership of the health care team.
- c) Develop effective written communication skills.
- d) Maintain relevant and legible medical records.
- e) Effectively communicate with out-of-hospital personnel as well as non-medical personnel.
- f) Involve patients in medical decisions.
- g) Strengthen listening and non-verbal communication skills.

5. Professionalism, as manifested through a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to patients of diverse backgrounds. At a minimum, residents are expected to:

- a) Treat patients/family/staff/ paraprofessional personnel with respect.
- b) Demonstrate sensitivity to patient's pain, emotional state, and gender/ethnicity issues.
- c) Discuss death honestly, sensitively, patiently, and compassionately.
- d) Exemplify integrity.
- e) Accept responsibility/accountability.
- f) Demonstrate reliability.
- g) Maintain calm, even temperament.
- h) Exhibit self-awareness and knowledge of limits.
- i) Respond to the comments of other team members, patients, families, and peers openly and responsibly.

6. Systems-based practice, as manifested by actions that demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care.

At a minimum, residents are expected to:

- a) Understand, access, appropriately utilize, and evaluate the effectiveness of the resources, providers, and systems necessary to provide optimal neurosurgical care.
- b) Understand different medical practice models and delivery systems and how to best utilize them to care for the individual patient.
- c) Practice cost-effective health care and resource allocation that does not compromise quality of care.
- d) Advocate, coordinate, and facilitate patient care.
- e) Understand principles of and advance practices for patient safety at the institutional and individual level.

Cerebrovascular/endovascular neurosurgery:

Patient Care

NS 1-2:

1. Perform a comprehensive neurological history and clinical examination.
2. Perform a comprehensive systemic evaluation.
3. Adapt comprehensive evaluation to specific pertinent positives and negatives with regard to ischemic and hemorrhagic stroke.
4. Demonstrate an understanding of urgency and the ability to prioritize during emergent aspects of hemorrhagic and ischemic disease states.
5. Demonstrate the ability to manage cardiac and pulmonary complications following cerebrovascular illness and therapy, and review the need for specialty and subspecialty consultations.
6. Apply the principles of perioperative care following common endovascular and surgical procedures directed at cerebrovascular disease.
7. Demonstrate the ability to be vigilant in the clinical detection of subtle neurological change during the acute and subacute phases of illness.
8. Demonstrate the ability to place an arterial catheter, central venous catheter, and pulmonary artery catheter. Perform placement of a ventricular catheter via a burr hole or twist-drill craniotomy.
9. Perform lumbar puncture and cerebrospinal fluid (CSF) reservoir tapping.
10. Define the proper placement of a craniotomy flap in the planned surgical evacuation of hematoma. This should be performed using both topographical as well as stereotactic-assisted navigation techniques.
11. Assist in the opening, exposure, and closure of cervical carotid procedures.
12. Assist during pterional craniotomy for vascular disease.
13. Assist in the performance of intracranial hematoma evacuation.

NS 3-4:

1. Perform pterional craniotomy for vascular disease.
2. Demonstrate the ability to make independent management decisions regarding ischemic and hemorrhagic stroke states.
3. Supervise care delivered by PGY1 and junior resident physicians for cerebrovascular patients.
4. Demonstrate efficient prioritization skills for clinical assessment of multiple simultaneous problems in the same or different patients. Display a clear sense of prioritization regarding timing and urgency of medical and surgical intervention for ischemic and hemorrhagic stroke states. Recognize the impact of systemic conditions on prioritization and timing issues.
5. Correctly interpret and respond to changes in patient status related to systemic and neurological parameters.
6. Implement patient-care protocols regarding perioperative management.

7. Display independence in making decisions regarding the critical care of cerebrovascular patients. Recognize the need for reporting to senior resident and attending staff such decisions.
8. Demonstrate the ability to obtain appropriate medical and surgical consultation.
9. Display skills in prioritization of diagnostic interventions, including the choice and sequence of studies in the setting of ischemic and hemorrhagic states.
10. Interpret invasive and noninvasive diagnostic imaging studies in relationship to cerebrovascular disease.
11. Formulate preliminary and surgical planning.
12. Perform frameless navigation procedures.
13. Perform routine and complicated twist drill or burr-hole procedures for the drainage of the ventricular system or intracranial hematomas.
14. Perform exposure of the cervical carotid artery for endarterectomy or proximal arterial control.
15. Observe and assist in the performance of plaque removal and arterial closure during carotid endarterectomy.
16. Practice microsurgical techniques in the laboratory setting.
17. Demonstrate a mature understanding of the planning and performance of pterional craniotomy for intracranial vascular pathology. Perform pterional craniotomy with initiation of microsurgical clinical skills. Observe the microsurgical dissection of the Sylvian fissure and basal cisterns for vascular pathology.
18. Perform the surgical approach to vascular structures via a craniotomy other than pterional.
19. Supervise and assist junior residents in burr-hole and twist-drill procedures for ventricular access or intracranial pressure monitoring.

NS 5-6:

1. Review fundamental concepts of cerebrovascular disease during conferences and clinical rounds with the house staff and medical student.
2. Demonstrate a mature clinical judgment related to the spectrum of problems encountered in hemorrhagic and ischemic stroke states.
3. Formulate independent plans for patient assessment and management, including prioritization in cerebrovascular disease while maintaining a clear reporting relationship with faculty.
4. Supervise house staff and medical student team in daily patient assessment and care.
5. Identify the indications and controversies of endovascular catheter procedures, perioperative management, and follow-up. Implement and supervise patient care protocols related to these procedures.
6. Display a mature and detailed understanding of indications, principles, and interpretation of the full spectrum of neurodiagnostic armamentarium. Formulate independent management plans based on sophisticated interpretation of diagnostic studies for concise presentation to faculty.
8. Demonstrate a mature understanding of surgical strategies and approaches to common and unusual vascular disease.

9. Apply the principles of intraoperative anesthetic management, proximal and distal control, temporary arterial occlusion, brain protective strategies, and intraoperative localization as applied to vascular disease.
10. Complete the planning, positioning, and execution of pterional craniotomy for common vascular disease.
11. Perform microsurgical dissection of the Sylvian fissure and exposure of the basal cisterns for vascular disease.
12. Perform microsurgical exposure and clipping of intracranial aneurysm.
13. Complete the planning, positioning, and execution of non-pterional craniotomy for intracranial vascular disease.
14. Assist in the microsurgical management of highly complex cerebrovascular disease.
15. Plan and execute the craniotomy for the evacuation of intracranial hematomas.
16. Supervise other house staff in meeting their surgical objectives.
17. Describe the exposure and treatment of intraspinal vascular lesions. Assist in such operations.

Medical Knowledge

NS 1-2:

1. Describe the anatomy of the extracranial and intracranial vessels, including the carotid, vertebral, and spinal arteries.
2. Describe the location of key perforating arteries involving the anterior and posterior circulation, their target distribution, and the consequence of occlusion or injury.
3. Review the anatomy of the venous circulation as it pertains to the central nervous system.
4. Identify the classic syndromes of vessel occlusion of the following:
 - a. internal carotid artery
 - b. middle cerebral artery
 - c. anterior cerebral artery
 - d. recurrent artery of Heubner
 - e. anterior choroidal artery
 - f. vertebral artery
 - g. posterior inferior cerebellar artery (PICA)
 - h. lower and upper basilar trunk
5. Identify the classic brain stem ischemic syndromes.
6. Explain the concepts of cerebral blood flow, cerebral autoregulation (hemodynamic and metabolic), ischemic thresholds, intracranial pressure, and cerebral perfusion pressure. Describe the impact of intracranial hypertension with and without mass lesion on cerebral blood flow.
7. Recognize the common causes of brain ischemic states including:
 - a. cardiac embolism
 - b. embolism from proximal vasculature
 - c. large vessel occlusion
 - d. intracranial conducting vessel occlusion

- e. small vessel disease
8. Associate computed tomography (CT) and magnetic resonance (MR) evidence of ischemic injury with likely anatomic substrate.
9. Describe the epidemiology, physiology, and underlying pathophysiology of ischemic brain injury, including concepts of critical therapeutic window.
10. Recognize the common causes of intracranial and intraspinal hemorrhage including:
 - a. aneurysmal disease
 - b. vascular malformations
 - c. hypertension
 - d. vasculopathies
 - e. degenerative diseases
 - f. hemorrhagic arterial infarction
 - g. venous infarction.
11. Relate typical imaging characteristics of central nervous system hemorrhagic lesions to probable causes.
12. Categorize common causes of intracranial hemorrhage, subarachnoid hemorrhage, and ischemic stroke.
13. Explain the principles of fluid and electrolyte resuscitation and maintenance, respiratory physiology, cardiac physiology, and nutritional physiology, as applied to the neurological patient following ischemic or hemorrhagic stroke. Integrate this knowledge with the specific issues of the perioperative period.
14. Recognize the need for laboratory evaluation for systemic illness.
15. List the appropriate diagnostic neuro-imaging studies utilized to evaluate ischemic and hemorrhagic stroke.
16. Recognize the typical clinical course of patients with ischemic and hemorrhagic stroke, including peak risk intervals for edema, vasospasm, re-bleeding, etc.
17. Identify the periods of high vulnerability to systemic complications of cerebrovascular illness, including deep venous thrombosis, pulmonary embolism, bacterial pneumonia, aspiration, congestive heart failure, etc.
18. Explain the principles of augmentation of cerebral blood flow during cerebral vasospasm.
19. Discuss the principles and indications for medical, endovascular, and surgical interventions for ischemic and hemorrhagic stroke.
20. Relate the principles of timing of medical, endovascular, and surgical intervention in these same disease states.
21. Explain the principles, indications for, and complications of barbiturate coma.
22. Recognize the principles and interpretation of normal and common abnormal findings on skull, chest, and abdominal x-rays in the Critical Care Unit.
23. Describe the fundamentals of CT scanning, including the typical appearance of acute, subacute, and chronic blood, calcification, ventricular anatomy, and mass effect.
24. Describe the typical CT appearance of hemorrhagic and ischemic stroke. Provide a detailed explanation for the typical delay between the onset of stroke and appearance of confirmatory CT findings.

25. Explain the fundamentals of MR imaging. Distinguish between normal and abnormal findings within the realm of cerebrovascular disease. Recognize the classic MR appearance of:
 - a. arteriovenous malformations
 - b. venous angiomas
 - c. cavernous malformations
 - d. aneurysms
26. List the indications for non-invasive vascular imaging, including ultrasound, magnetic resonance angiography (MRA), and CT angiography. Recite the limitations of non-invasive studies.
27. Describe the practical application of commonly employed non-invasive studies, such as transcranial Doppler, in the setting of cerebral vasospasm.
28. List the indications for catheter angiography. Interpret the findings of angiography in ischemic and hemorrhagic cerebrovascular conditions. Identify the key segments of the internal carotid artery including the upper cervical, petrous, cavernous, and supraclinoid components.
29. Recite the principles of localizing focal intracranial and spinal vascular pathology by the use of traditional topographic measurements and the application of stereotactic guidance.
30. Describe the surgical anatomy and the principles of exposure of the cervical carotid artery.
31. Describe the principles of pterional craniotomy, including scalp and bony anatomy, as well as the anatomy of the sphenoid ridge.
32. Explain the principles of cerebrovascular surgery detailed in the previous objectives to medical students and allied health personnel during conferences.

NS 3-4:

1. Recognize controversies regarding the basic neuroscience knowledge concepts mastered during junior residency.
2. Explain the principles of ischemic neuronal protection and salvage.
3. Review the principles of guideline development and outcome assessment related to the basic knowledge objectives achieved during junior residency.
4. Display an understanding of the principles of hypothesis development and testing, and statistical analysis as applied to clinical research trials, as well as the critique of scientific manuscripts.
5. Recognize areas of controversy related to management protocols in cerebrovascular patients achieved during junior residency.

NS 5-6:

1. Demonstrate a sophisticated understanding of current literature related to basic neuroscience knowledge objectives acquired as a junior and middle resident. Define scientific hypotheses in relationship to controversies and evolving knowledge regarding these same objectives and demonstrate the ability to interpret and adapt new knowledge to evolving patient-care paradigms.

2. Demonstrate a mature fundamental knowledge in clinical and teaching conferences, specialty conferences, and in publications and scientific presentations.
3. Understand the guidelines, protocols, and literature controversies regarding the diagnostic imaging modalities available in cerebrovascular disease.

Spinal neurosurgery:

Patient Care

NS 1-2:

1. Perform a complete history and physical examination on patients with spinal disorders.
2. Interpret plain x-rays, dynamic x-rays, myelograms, CT scans and MR scans of patients with spinal disorders.
3. Prepare patients for spinal surgery, including proper positioning, protection to pressure points, and placement of indicated arterial and central venous catheters, indwelling urinary catheters and anti-embolism devices.
4. Perform lumbar punctures and placement of lumbar drains.
5. Demonstrate the ability to place and manage cranial traction devices for reduction and immobilization of the unstable cervical spine.
6. Demonstrate the ability to place and manage a halo vest, including indications for placement and criteria for removal.
7. Demonstrate the ability to properly place the Mayfield head holder and other headrests.
8. Demonstrate the ability to harvest autologous bone graft from the calvarium and anterior or posterior iliac crest.
9. Perform dorsal exposure of the spinous processes, laminae, and facets of the cervical, thoracic, and lumbar spine.
10. Demonstrate the ability to close dorsal, ventral, and lateral spinal incisions.
11. Demonstrate proper postoperative wound care.
12. Demonstrate appropriate postoperative management of patients who have undergone spinal procedures.
13. Demonstrate the ability to perform, with supervision, a lumbar decompressive laminectomy for spinal stenosis.
14. Demonstrate the ability to excise, with supervision, a herniated lumbar disc.
15. Demonstrate the ability to perform a minimally invasive lumbar discectomy.
15. Demonstrate the appropriate use of the operating microscope.

NS 3-4:

1. Demonstrate the ability to prepare structural allografts for use in spinal surgery.
2. Determine the need for postoperative inpatient or outpatient rehabilitation in patients with spinal disorders.
3. Demonstrate the ability to perform a ventral exposure of the cervical spine followed by anterior cervical discectomy.
4. Demonstrate the ability to perform an anterior cervical interbody arthrodesis.
5. Demonstrate the ability to place anterior cervical instrumentation.
6. Demonstrate the ability to perform posterior cervical decompressive laminectomy.
7. Demonstrate the ability to perform posterior cervical foraminotomy with or without discectomy.
8. Demonstrate the ability to perform medial and lateral approaches to a far lateral lumbar disc herniation.

9. Demonstrate appropriate surgical technique in the management of recurrent lumbar disc herniations and recurrent lumbar stenosis.
10. Demonstrate the ability to perform posterior lumbar arthrodesis with or without the use of interbody instrumentation.
11. Demonstrate exposure of the cervical lateral masses, thoracic and lumbar transverse processes, and the sacral ala.
12. Demonstrate the ability to perform posterior/intertransverse arthrodesis in the cervical, thoracic and lumbar regions.
13. Demonstrate the ability to perform a laminectomy with or without transpedicular decompression for tumor, infection, or trauma.
14. Demonstrate techniques for spinous process arthrodesis of the subaxial cervical spine for fracture or dislocation.
15. Demonstrate the ability to manage postoperative complications of spinal surgery including:
 - a. hematoma
 - b. infection
 - c. spinal fluid leak
 - d. new neurologic deficit
16. Demonstrate the ability to perform a tethered cord release.
17. Demonstrate the use of intraoperative spinal neuronavigation devices, included Iso-C.

NS 5-6:

1. Demonstrate the ability to function independently in all phases of management of patients with spinal disorders.
2. Demonstrate the ability to perform occipital-cervical arthrodesis.
3. Demonstrate the ability to properly place sublaminar wires, lateral mass screws, lower cervical/upper thoracic pedicle screws, C2 pars interarticularis screws, and C1-2 transarticular screws for the management of cervical spine disorders.
4. Demonstrate the ability to perform, with assistance if necessary, transoral odontoidectomy.
5. Demonstrate common techniques for performing C1-2 arthrodesis.
6. Demonstrate the ability to perform anterior cervical corpectomy followed by arthrodesis.
7. Demonstrate the ability to perform, with assistance if necessary, transthoracic, thoracoabdominal, retroperitoneal, and transabdominal approaches to the thoracic and lumbar spine.
8. Demonstrate the ability to perform costotransverse and lateral extracavitary approaches to the thoracolumbar spine.
9. Demonstrate the ability to excise a herniated thoracic disc by use of the above-mentioned approaches.
10. Demonstrate the ability to perform vertebral corpectomy of the thoracolumbar spine for tumor, infection, or trauma, utilizing the above-mentioned approaches.
11. Demonstrate the ability to perform anterior arthrodesis of the thoracolumbar spine.
12. Demonstrate the proper placement of transpedicular screws in the thoracic and lumbar spine.

13. Demonstrate the proper placement of laminar, transverse process, and pedicle hooks in the thoracic and lumbar spine.
14. Demonstrate the ability to resect intradural spinal neoplasms.
15. Demonstrate the ability to perform methylmethacrylate vertebroplasty.
16. Demonstrate techniques of open reduction of fractures and dislocations of the cervical, thoracic, and lumbar spine.
17. Demonstrate the ability to surgically manage arachnoid cysts and spinal cord syrinx.
18. Demonstrate the ability to perform intradural procedures for congenital, neoplastic, and vascular
19. Demonstrate the ability to perform a minimally invasive fusion procedure.

Medical Knowledge

NS 1-2:

1. Review the anatomy of the craniocervical junction, cervical, thoracic, and lumbar spine, sacrum.
2. Interpret plain and dynamic radiographs, bone scans, myelograms, computerized tomographic (CT) scans, and magnetic resonance (MR) scans of patients with spinal disorders.
3. Review the signs, symptoms, and pathophysiology of common syndromes of degenerative spinal disorders: radiculopathy, myelopathy, instability, and neurogenic claudication.
4. Identify the common syndromes of spinal cord injury, including complete transverse injury, anterior cord injury, Brown-Sequard injury, central cord injury, cruciate paralysis, syringomyelia, conus syndrome, and sacral sparing. Describe the pathophysiology of spinal cord injury.
5. Describe the cauda equina syndrome.
6. Recite the differential diagnosis of cervical, thoracic, and lumbar pain.
7. Discuss the indications for cervical, thoracic, and lumbar discectomy.
8. Identify non-surgical spinal cord syndromes including amyotrophic lateral sclerosis, demyelinating conditions, and combined systems disease.
9. Review the initial management of spine and spinal cord injured patients including immobilization, traction, reduction, appropriate radiographic studies, and medical management.
10. Classify fractures, dislocations, and ligament injuries of the craniocervical region, subaxial cervical spine, thoracic, thoracolumbar junction, lumbar, and sacral spine. Describe the mechanism of injury and classify the injuries as stable or unstable. Review the indications for surgical management.
11. Discuss briefly the concept of grading schemes for spinal cord injury and myelopathy.

NS 3-4:

1. Review the biomechanics of the craniocervical junction, cervical spine, and thoracolumbar and lumbar spine.
2. Review the biomechanics of common internal spinal fixators.

3. Review the definition of spinal instability based upon the principles of Punjabi and White and other authors.
4. Recognize the radiographic signs of degenerative neoplastic, traumatic, and congenital spinal instability.
5. Review the indications for, and uses, and relative effectiveness of common spinal orthoses. Discuss the degree of segmental and regional immobilization these orthoses provide.
6. Review the indications for, and physiology of intraoperative spinal cord monitoring. Describe the technical aspects of intraoperative spinal cord monitoring.
7. Compare and contrast indications for anterior and posterior approaches to the cervical spine for the treatment of herniated cervical discs, spondylosis, and instability.
8. Discuss the role of corpectomy in the management of cervical disorders.
9. Compare and contrast the indications for anterior cervical discectomy with and without anterior interbody fusion.
10. Discuss the indications and techniques for anterior and posterior cervical spinal internal fixators.
11. Explain the biology of bone healing and options for bone grafting in spinal surgery.
12. Review the diagnosis and management of primary spinal tumors, spinal cord tumors, and spinal metastatic disease including indications for dorsal decompression, ventral decompression, and radiotherapy.
13. Discuss the management principles for gunshot and other penetrating wounds to the spine.
14. Review the signs, symptoms, and management options in the treatment of the adult tethered cord syndrome and syringomyelia.
15. Review management principles for spontaneous and postoperative spinal infections.
16. Review the management principles for intraoperative and postoperative cerebrospinal fluid leaks.
17. Discuss the surgical management of intradural congenital, neoplastic, and vascular lesions.

NS 5-6:

1. Describe indications for the use of angiography and endovascular procedures in the management of spinal disorders.
2. Discuss the management of cervical degenerative disease secondary to rheumatoid arthritis. Describe factors which make it different from the management of non-rheumatoid disease.
3. Compare and contrast the treatment options for cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament, including multilevel anterior cervical corpectomy and fusion, laminectomy, laminectomy and fusion, laminoplasty, and nonoperative therapies.
4. Discuss the indications for posterior cervical spinal internal fixators.
5. Compare and contrast the transthoracic, transpedicular, costotransverse, and lateral extracavitary approaches to a herniated thoracic disc, thoracic tumor, or thoracic spinal injury.

6. Discuss the indications for lumbar fusion for congenital disorders, iatrogenic disease, and degenerative disease, ranking indications from least to most controversial.
7. Compare and contrast the indications for anterior or posterior lumbar interbody fusion and intertransverse fusion for lumbar disease.
8. Discuss internal fixation options for posterior lumbar interbody fusion and intertransverse fusion.
9. Summarize the most common types of spinal tumors in the following categories:
 - a. intradural/intramedullary
 - b. intradural/extramedullary
 - c. extradural/extramedullary.
10. Discuss nonoperative and operative treatment options for fractures and dislocations affecting the atlas and axis.
11. Compare and contrast the indications for nonoperative treatment, anterior approaches, and posterior operative approaches for the treatment of fractures and dislocations of the subaxial cervical spine.
12. Describe the indications for anterior, posterior, and posterolateral procedures in the management of thoracolumbar tumor, trauma, or infection.
13. Compare and contrast the indications for anterior and posterior spinal fixators in the management of thoracolumbar tumor, trauma, or infection.
14. Discuss reconstruction options for vertebral body defects after corpectomy for tumor, trauma, or infection.

Neurotrauma:

Patient Care

NS 1-2:

1. Perform and document pertinent history, physical findings, and radiologic findings in a multitrauma patient.
2. Differentiate central from peripheral nervous system injuries.
3. Insert intravascular monitoring devices for use in the hemodynamic management of critically ill patients, including central venous lines, pulmonary artery catheters, and arterial catheters.
4. Insert intracranial pressure monitoring devices, including ventriculostomy catheters and electronic (fiberoptic or miniaturized strain gauge) devices.
5. Perform twist-drill or burr-hole drainage of subdural fluid collections.
6. Decide appropriately which patients require emergency craniotomy and other procedures.
7. Position patients appropriately for procedures/surgery and begin emergency procedures if more experienced neurosurgeons have not yet arrived.
8. Assist with opening and closure of craniotomies.
9. Perform elective tracheotomies and be able to perform emergency tracheotomies.
10. Be able to intubate patients in both emergency and elective situations.

NS 3-4:

1. Perform the following surgical procedures in uncomplicated cases:
 - a. craniotomy for subdural and/or epidural hematoma
 - b. craniotomy for penetrating head injury
 - c. craniotomy for intracerebral hematoma or contusion
 - d. craniotomy for depressed skull fracture
 - e. decompressive craniectomy
 - f. repair/cranialization of frontal sinus fracture
 - g. craniotomy/craniectomy for posterior fossa epidural, subdural, or intracerebral hematoma
 - h. simple cranioplasty
2. Manage traumatic skull base fractures with CSF leak.
3. Manage infections associated with open CNS injuries.

NS 5-6:

1. Perform the above procedures (listed under #1 for “NS 3-4”) in complicated cases.
2. Reconstruct complex cranial defects, with assistance from other specialties as indicated.
3. Reconstruct traumatic skull base defects, with assistance from other specialties as indicated.
4. Explore and repair peripheral nerve injuries.

Medical Knowledge

NS 1-2:

1. Describe the systematic assessment of multitrauma patients.
2. Rank management priorities in multitrauma patients appropriately.
3. Discuss principles of resuscitation of multitrauma patients including appropriate fluid resuscitation, and explain the anticipated effects of shock and resuscitation on fluid shifts and on electrolyte balance.
4. Name an initial choice for intravenous fluids for a newly admitted Intensive Care Unit (ICU) patients with the following diagnoses and explain changes in that choice based upon specific changes in the patient’s diagnosis, clinical condition, electrolyte and volume status:
 - a. head injury
 - b. stroke
 - c. tumor
 - d. infection
 - e. hydrocephalic
5. Propose appropriate initial ventilator settings for patients with different types of common neurosurgical conditions and explain changes in that choice based upon specific changes in the patient’s metabolic or pulmonary status.

6. List the mechanisms of action and potential complications of commonly used pressors and hypotensive agents.
7. Discuss indications, pharmacologic mechanism, duration of action, and effect on the neurologic examination for sedative, paralytic, and analgesic agents commonly used in the ICU.
8. Explain the indications, advantages, and risks for various hemodynamic monitoring tools (e.g., pulmonary artery catheters, indwelling arterial lines) used in critically ill patients.
9. Discuss the pathophysiology and management of coagulopathy after head injury.
10. Describe basic principles of nutritional management in neurosurgical critical care.
11. Explain the treatment of posttraumatic seizures.
12. Outline basic principles of ICU management of patients with spinal cord injury.
13. Name the major structures supplied by the major vessels of the brain and spinal cord.
14. Discuss the evaluation, treatment, and prognosis of subarachnoid hemorrhage, both traumatic and spontaneous.
15. Explain the pathophysiology and treatment of cerebral vasospasm.
16. Formulate a diagnostic and treatment plan for patients with cerebral ischemia.
17. Explain the evaluation and management of birth-related intracranial hemorrhage, spinal cord injury, and brachial plexus injury.
18. Describe a systematic approach to the examination of the peripheral nervous system.
19. Describe basic principles of management of peripheral nerve injuries.
20. List principles of rehabilitation of different types of neurosurgical patients.
21. Define brain death and discuss methods of making such a diagnosis.
22. Describe the pathophysiology of electrical injuries to the nervous system and review treatment of same.

NS 3-4:

Describe the pathophysiology of intracranial hypertension and explain a plan for its management, including arguments for and against various treatments.

NS 5-6:

1. Discuss management priorities in polytrauma patients with severe neurological and systemic trauma.

Practice Based Learning and Improvement

1. Analyze and assess your cerebrovascular, spinal, and trauma practice experience, at a minimum through the morbidity and mortality conference format. Maintenance of a resident portfolio is encouraged. Participate in analysis of complications and formulate means to improve patient outcomes.
2. Utilize online resources, including PubMed and evidence based medicine databases to locate the latest and best information on cerebrovascular, spinal, and trauma patient problems.

3. Apply knowledge of study design and statistical methods to appraise the literature on cerebrovascular, spinal, and trauma issues, to conduct your own scientific studies (with faculty mentors), and to participate in monthly journal club and other conferences. Use such knowledge in preparing preoperative and core lecture conferences.
4. Participate in the education of other residents, medical students, and health care professionals regarding cerebrovascular, spinal, and traumatic neurosurgical patients.

Interpersonal and Communication Skills/ Professionalism

1. Develop an effective and respectful relationship with patients and families with cerebrovascular, spinal, and traumatic neurosurgical problems.
2. Help to lead the health care team involved in cerebrovascular, spinal, and trauma management.
3. Maintain relevant medical records in a timely manner.
4. Constantly work on effective communication skills.

Professionalism

1. Learn to treat patients and families with respect.
2. Demonstrate sensitivity to the patient's problems.
3. Learn to deal constructively with severe complications and death.

Systems Based Practice

1. Utilize all components of the health care system in the care of cerebrovascular, spinal, and trauma patients (i.e. consultants, physical therapy, speech therapy, discharge planning).
2. Learn to practice cost-effective health care by ordering only those tests, medications, and therapies which are effective for these disorders.
3. Learn to identify and intervene in patient safety issues pertaining to these patients.

Neurosurgical Oncology

Patient Care

NS 1-2:

1. Perform a complete history and physical examination on patients with intracranial neoplasms.
2. Review appropriate radiographic studies with a radiologist and formulate a differential diagnosis for patients with intracranial neoplasms.
3. Prepare patients for cranial tumor surgery.
4. Understand the positioning of patients for craniotomy and craniectomy.
5. Assist in the opening and closing of craniotomies and craniectomies for neoplasms.
6. Place lumbar drains.
7. Demonstrate the ability to open and close scalp incisions.
8. Perform ventriculostomies.
9. Demonstrate proper postoperative wound care.

NS 3-4:

1. Independently determine a differential diagnosis based on the patient's history, physical examination, and radiographic studies.
2. Position patients for craniotomy and craniectomy.
3. Perform the opening and closing of craniotomies and craniectomies.
4. Assist in the resection of intracranial neoplasms.
5. Resect skull lesions.
6. Operatively treat supra- and infratentorial brain abscess.
7. Demonstrate the ability to manage postoperative complications including but not limited to:
 - a. brain edema
 - b. meningitis
 - c. cranial flap infection
 - d. postoperative seizures
8. Assess the need for appropriate pre-, intra-, and postoperative monitoring.

NS 5-6:

1. Demonstrate the capability to function independently in all phases of management of patients with intracranial neoplasms.
2. Perform resection of supra- and infratentorial intra-axial and extra-axial neoplasms.
3. Perform resection of pituitary lesions.
4. Perform or serve as first assistant for skull base procedures.
5. Oversee the pre- and postoperative management of patients with intracranial neoplasms.

Medical Knowledge

NS 1-2:

1. Summarize the epidemiology, incidence, and risk factors for intracranial neoplasms.
2. Summarize the tenets of tumor biology including genetic factors, molecular and biochemical processes associated with invasion. Describe the natural history of intracranial neoplasms.
3. List a differential diagnosis of lesions requiring biopsy and describe their pathophysiology.
4. List the various types of bone tumors involving the calvarium.
5. Describe and differentiate:
 - a. astrocytomas, including the accepted World Health Organization (WHO) grading scheme
 - b. gliomas other than astrocytomas
 - c. metastatic tumors, including location and common origins
 - d. infectious, granulomatous, and cystic lesions that may present in a tumor-like manner
6. Define the cell or origin of meningioma, its common intracranial locations, and the expected presentation for each location.
7. Define the embryological origin of arachnoid cysts and their natural history; list the etiologies of other cystic lesions of the brain, including tumoral and infectious.
8. Describe the anatomic location, cell of origin, clinical presentation, age at presentation, and natural history of common intrinsic posterior fossa neoplasms, including cerebellar astrocytoma, medulloblastoma, and ependymoma.
9. Describe the anatomy of the posterior fossa and the relation of the cranial nerves to the brain stem and skull.
10. Illustrate the relationship of the facial, vestibular, and cochlear components of the acoustic nerve at the internal auditory meatus.
11. Describe the various tumors that may arise in the cerebellopontine angle (CPA).
12. Describe the management of a patient with a brain abscess, including the role of stereotactic drainage or open drainage.
13. Explain the medical workup of a patient with a diagnosed brain abscess.
14. Specify the follow-up and evaluation of the patient with a brain abscess following surgical treatment.
15. Describe the embryological origin of craniopharyngioma. List the common locations of the tumor.
16. Describe the common presentations of pituitary tumors, the cell of origin, and endocrinopathies associated with:
 - a. null cell adenomas
 - b. somatotrophic adenomas
 - c. prolactinomas
 - d. corticotrophic secreting adenomas
 - e. thyrotrophic-secreting adenoma
17. Define the medical management of the secreting pituitary tumors. Explain the role of surgery in each of the tumors above.
18. Describe the etiology of fibrous dysplasia, its presentation and general management. List the indications for surgery for benign tumors of bone at the base of the skull, and potential adjuvant therapy.
19. List the tumors that may be routinely approached through a transtemporal route.

20. Describe the indications for use of lumbar spinal drainage in skull base surgery, and its implementation. List all complications associated with continuous lumbar spinal drainage.
21. Illustrate the general principles of stereotaxis and the underlying localization techniques used in the presently used frame-based and frameless systems.

NS 3-4:

1. Describe appropriate postoperative management with drainage of brain abscess or cyst.
2. Describe the appropriate surgical management and postoperative treatment of bony skull lesions.
3. Describe the role of surgery in arachnoid cysts, infectious cysts, and tumor-related cystic lesions. Describe the adjuvant treatment of parasitic cysts.
4. Explain the rationale and indications for various skull base approaches to the anterior, middle and posterior cranial fossae. Identify the important anatomical landmarks for each approach. Illustrate the general principles used in prophylaxis of CSF leaks employed in skull base surgery.
5. Describe the neurosurgical management for the following tumors involving the anterior cranial fossa:
 - a. meningioma
 - b. fibrous dysplasia
 - c. esthesioneuroblastoma
 - d. osteoma of the frontal sinus
 - e. chondroma, chordoma
 - f. mucocele
 - g. bony metastasis
6. Explain the use of the balloon occlusion test of the carotid artery, its indication for use in skull base tumor surgery, how it is performed, and how the information gained influences surgical management.
7. Explain the surgical advantage of transposing the facial nerve during a transtemporal skull base approach.
8. Describe the transcondylar approach, the relationship of the lower cranial nerves, and the exposure gained over a routine suboccipital craniectomy.
9. Illustrate the transpetrosal approach and the relationship of the transverse and sigmoid sinuses with skull bony landmarks such as the asterion, mastoid and inion.
10. Describe the intradural course of the trochlear nerve, trigeminal nerve through Meckel's cave and the abducens nerve and Dorello's canal.
11. Describe the surgical management of the frontal sinus which has been exposed during craniotomy for anterior skull base surgery. Illustrate the development and use of a frontal vascularized pericranial flap and explain its indication. Similarly, illustrate the use of a myocutaneous flap of the temporalis muscle and list the locations for application.
12. Describe the general methods employed for embolization of tumors of the head and neck, and the indications for such procedures.
13. Compare and contrast the methods for stereotactic radiation, including particle beam, gamma ray or linear accelerator, and the indications for each technique.

NS 5-6:

1. Describe the indications for transcranial orbitotomy and list the lesions which require this approach.
2. Discuss the surgical management and postoperative treatment of astrocytomas, gliomas other than astrocytomas, metastatic brain tumors, infectious granulomas, and cystic lesions presenting in a tumor-like manner. Review the role of radiotherapy, chemotherapy, and other adjunctive treatments of these neoplasms.
3. Describe the role of surgery for intracranial meningioma, and the relation between the surgical option and location of tumor. Discuss adjuvant treatments of meningioma and their efficacy.
4. Discuss the surgical treatment of common intrinsic posterior fossa neoplasms, including cerebellar astrocytoma, medulloblastoma, and ependymoma including the role of ventricular drainage, and surveillance imaging. Present adjuvant treatment options and outcomes for the various posterior fossa intrinsic tumors.
5. Address the surgical goals of treatment, complications of surgical treatment, and adjuvant therapy for posterior fossa meningioma.
6. List and illustrate the various approaches for removal of a vestibular schwannoma, and the rationale and indication for each approach.
7. Describe the role of stereotactic radiosurgery and microsurgery in the management of vestibular schwannoma.
8. List the various approaches to the midline clivus and review the indications for each approach. Outline the surgical and medical management of tumors of the clivus and midline skull base.
9. Explain the management goal for a patient with craniopharyngioma, and the risks of surgical treatment and conservative treatment. Describe the various surgical approaches used to resect craniopharyngiomas and the options for adjuvant treatment, including radiotherapy and chemotherapy (systemic and local).
10. Illustrate the transnasal-transphenoidal approach and its indications. Define the options for treatment of recurrent pituitary tumors of all types (including medical management). Describe the risks of the approach and the management of the complication of CSF leak.
11. Illustrate the various skull base approaches to the anterior, middle and posterior cranial fossae in detail, explaining the key anatomical landmarks and strict indications for the approach. List the complications relevant to each approach and the management of each complication.
12. List a differential diagnosis of orbital tumors, their usual location within the orbit, medical and surgical management of the tumor and the approach used to remove the tumor if indicated.
13. List the various tumors and their location in which an orbitocranial approach may be indicated for their removal.
14. Compare and contrast the exposure offered by the pre- and postauricular infratemporal approach, and the indications for each approach.
15. Illustrate transposition of the facial nerve during a transtemporal skull base approach.

16. Describe the location of meningiomas intracranially which are amenable to preoperative embolization.

Stereotactic and Functional Neurosurgery

Patient Care

NS 1-2:

1. Obtain a history and physical examination on a patient with Parkinson's disease, essential tremor, or epilepsy.
2. Obtain appropriate ancillary tests: MRI, EEG, functional imaging.
3. Formulate a differential diagnosis for movement disorders and causes of epilepsy.
4. Perform stereotactic frame application.
5. Perform burr hole craniostomy and twist drill craniostomy.
6. Perform stereotactic target determination for frame-based coordinates (for stereotactic brain biopsy).
7. Perform a stereotactic brain lesion biopsy.

NS 3-4:

1. Perform simple radiosurgery dose-planning.

NS 5-6:

1. Perform complex radiosurgery dose-planning.
2. Perform stereotactic craniotomies.
3. Perform deep brain stimulation and/or functional lesioning procedures.

Medical Knowledge

NS 1-2:

1. Discuss the considerations of stereotactic frame placement in regard to target localization and purpose of procedure (biopsy, craniotomy, functional, radiosurgery).
2. Describe the direct and indirect basal ganglion-thalamocortical motor pathways.
3. Define and distinguish each of the following entities:
 - a. tremor
 - b. rigidity
 - c. dystonia
 - d. chorea
 - e. athetosis
4. Describe the pathophysiology of Parkinson's disease and cerebellar tremor.
5. Explain the primary symptoms treated by ventro-lateral (VL) thalamotomy pallidotomy.

6. Discuss the advantages and disadvantages of stereotactic biopsy compared to open biopsy procedures.
7. Discuss the differential diagnosis of a newly discovered ring-enhancing intracranial mass.
8. Discuss the differential diagnosis of a newly discovered non-enhancing intracranial mass.
9. Define different seizure types (partial, partial-complex, generalized, etc).
10. Define medically intractable epilepsy.
11. Describe the anatomy of the mesial temporal lobe.
12. Define brachytherapy.
13. Define conventional care for patients with high-grade gliomas.
14. Review the limitations of conventional care for patients with high-grade gliomas.
15. Describe the anatomy of the trigeminal nuclei, root, ganglion and divisions.
16. Define typical trigeminal neuralgia, atypical trigeminal neuralgia, and trigeminal neuropathy.
17. Explain the potential causes for trigeminal neuralgia.
18. Define stereotactic radiosurgery.
19. Explain the differences between radiosurgery and radiation therapy.
20. List the potential indications for radiosurgery.
21. List the reported complications of radiosurgery.
22. Compare advantages and disadvantages of frame-based or frameless stereotactic craniotomies to non-stereotactic craniotomies.

NS 3-4:

1. Describe factors guiding the choice of neuroimaging (CT, MRI, angiography) for stereotactic procedures.
2. Explain the rationale for various MRI sequences used for tumor localization and functional procedures.
3. Discuss the benefits and limitations of frame-based stereotactic procedures.
4. Discuss patient selection for VL thalamotomy, pallidotomy, and deep brain stimulation.
5. Discuss the advantages and disadvantages of ablative procedures.
6. List the potential complications of VL thalamotomy, pallidotomy, and bilateral thalamotomies or pallidotomies.
7. Discuss technical considerations to minimize the potential for an intracranial hemorrhage after a stereotactic biopsy.
8. Discuss technical considerations to minimize the potential for a non-diagnostic stereotactic biopsy.
9. Describe the appropriate trajectories to biopsy a lesion in the pineal region, midbrain, pons, and medulla.
10. Compare the advantages and disadvantages of radiosurgery and surgical resection for tumors and vascular malformations.

NS 5-6:

1. Identify the microelectrode recordings of the thalamus, globus pallidus, and subthalamic nucleus.
2. Identify the primary indications for medial thalamotomy and cingulotomy.
3. Describe the evaluation of a patient with medically intractable epilepsy.
4. Discuss the indications for placement of depth electrodes.
5. Describe the surgical treatment of epilepsy in detail.
6. Explain the effect of patient selection on the reported results of brachytherapy for high-grade gliomas.
7. Describe the methods used to localize and percutaneously penetrate the foramen ovale.
8. List the potential advantages and disadvantages for the following trigeminal rhizotomy procedures:
 - a. glycerol
 - b. radiofrequency
 - c. balloon compression
 - d. radiosurgery
11. Discuss the dose-volume relationships for radiation-related complications after radiosurgery.
12. Discuss potential sources of inaccuracy for stereotactic procedures.
13. Discuss advantages and disadvantages of deep brain stimulation compared to ablative techniques.

Pediatric Neurosurgery:

Patient Care

NS 1-2:

1. Perform complete history, physical examination and assessment on newborns, infants, and children.
2. Interpret results of the physical examination, laboratory and radiological studies to arrive at a differential diagnosis.
3. Perform subdural, intraventricular and lumbar punctures in children.
4. Perform a shunt tap.
5. Perform a twist drill or burr hole for subdural, parenchymal, or ventricular access or as part of a craniotomy.
6. Perform a craniotomy or craniectomy for evacuation of subdural or epidural lesion.
7. Perform a craniectomy as part of skull biopsy.
8. Perform craniotomy for elevation of depressed skull fracture.
9. Place a ventriculoperitoneal, jugular, or pleural shunt.
10. Revise a ventriculoperitoneal, jugular, or pleural shunt.
11. Perform a cranioplasty with artificial material or homologous material.
12. Perform a laminectomy in a patient with normal spinal anatomy.
13. Position a patient for intracranial or intraspinal surgery.

14. Demonstrate an ability to open and close cranial and spinal wounds to include dural opening and repair.
15. Complete a sagittal synostectomy.

NS 3-4:

1. Close an open spinal or cranial neural tube defect.
2. Repair an intracranial encephalocele.
3. Perform the opening for a complex craniofacial repair.
4. Perform the exposure for supratentorial and infratentorial lesions (excluding pineal, suprasellar and intraventricular locations).
5. Perform the exposure for spinal exploration in a patient with abnormal spinal anatomy or reoperation.
6. Evacuate an intraparenchymal hematoma.
7. Accomplish endoscopic third ventriculostomy in uncomplicated settings.
8. Apply and utilize frameless or framed stereotactic modalities for lesion location and shunt placement.
9. Accomplish repair of a Chiari malformation.
10. Accomplish an uncomplicated detethering procedure.
11. Perform a cranial vault expansion.
12. Perform placement of baclofen type pumps.
13. Perform spinal fusion without instrumentation.
14. Apply a vagal nerve stimulator.

NS 5-6:

1. Perform exposure for suprasellar, pineal and intraventricular lesion (including orbito-frontal, transcallosal and supracerebellar).
2. Remove uncomplicated posterior fossa and supratentorial lesions.
3. Repair complex tethered cords (e.g. lipomyelomeningocele, retethering, and diastematomyelia).
4. Accomplish exposure for intradural spinal neoplasms.
5. Utilize an endoscope to communicate trapped CSF spaces.
6. Remove intracranial vascular malformation less than 3 cm in size and in non-eloquent brain.
7. Perform placement of grids for seizure monitoring.
8. Perform rhizotomy for spasticity.
9. Perform temporal lobectomy in an uncomplicated patient.
10. Perform stereotactic biopsy of supratentorial lesion.
11. Perform spinal fusion utilizing instrumentation.
12. Accomplish endoscopic third ventriculostomy in uncomplicated settings.
13. Assist with complex craniofacial surgery.
14. Assist with a vascular procedure for moyamoya disease.

Medical Knowledge

NS 1-2:

Myelomeningocele and its Variants, Meningocele, Encephalocele, Chiari Malformations, Occult Spinal Dysraphism, Split Cord Anomalies, Segmentation Anomalies, Craniofacial Syndromes and Phakomatosis

1. Review the embryology of the central nervous system (CNS) and its supporting structures.
2. List the abnormalities a neurosurgeon may treat which are congenital/developmental in nature and classify them with respect to their embryology defect.
3. Describe the incidence, epidemiology and inheritance patterns.
4. State other disorders associated with this set of diseases.
5. Describe the anatomic and pathophysiologic parameters which distinguish amongst these diseases.
6. Develop a diagnostic treatment plan along with prognostication of outcome with optimal management.
7. List disorders which may be referred for neurosurgical care but do not require surgery.
8. Display current knowledge of the molecular basis for these diseases where known.
9. Describe the expected outcome if treatment is not undertaken.

Hydrocephalus and Other Disorders of CSF Circulation

1. Describe the normal physiology of CSF.
2. Delineate the different etiologies of hydrocephalus and their relative incidence.
3. Explain how to differentiate between CSF collections which require treatment and those which do not.
4. Indicate the various treatment options for the management of hydrocephalus.
5. Distinguish between treatment options for hydrocephalus with normal CSF and contaminated (e.g. infection, blood) CSF.
6. List the complications associated with each treatment option for hydrocephalus and the diagnosis and treatment of same.
7. Differentiate between low-pressure and high-pressure hydrocephalus.
8. Describe the presentation and diagnostic approach to a patient with suspected shunt malfunction.
9. Define how the diagnosis of hydrocephalus is made.
10. List nonsurgical diseases which may be mistaken for hydrocephalus but require treatment different than surgery.
11. Review the causes of cerebral atrophy.

Neoplasia

1. Delineate the differences between pediatric and adult tumors.
2. List the common tumor types occurring in children and their typical location.
3. Describe the changing tumor type and location based upon age.
4. Identify lesions which require biopsy as part of the treatment/diagnostic plan.
5. Describe the typical presentations of tumors.
6. Describe appropriate evaluation for patients suspected of having a tumor.
7. Classify tumor types as to degree of malignancy, role of surgical vs. nonsurgical therapy, and outcomes of optimal treatment.
8. Discuss the possible complications associated with specific tumor types.
9. Describe the pertinent anatomy for surgical treatment of midline or hemispheric cerebellar tumors and hemispheric cerebral tumors.
10. Discuss appropriate preoperative management of patients with tumors.
11. Compare the role of biopsy, subtotal resection and total resection in the management of tumors.
12. List possible complications of the treatment options, their diagnostic evaluation and treatment.

Infection

1. Describe the presentations of a shunt infection.
2. List the indications for ventricular lumbar and subarachnoid CSF sampling.
3. List the common organisms seen in shunt infections.
4. Describe treatment plans for shunt infection.
5. List risk factors and risks of shunt infection and the proper diagnostic protocol to establish the presence of a shunt infection.
6. Describe common presentations of intracranial and intraspinal suppuration.
7. List host risk factors which are associated with CNS infections.
8. Describe appropriate diagnostic protocol to establish the presence of CNS infection.
9. Discuss the timeliness and utility of surgical therapy for the treatment of CNS infection both shunt-related and non-shunt-related.

Other

1. Delineate the various types of spasticity and movement disorders seen in children.
2. List seizure types.
3. Describe surgical lesions which may be related to seizures.
4. Describe surgical and non-surgical treatment options regarding the alleviation of spasticity in children.
5. Discuss the pathophysiology of craniosynostosis.

Cerebrovascular

1. Delineate the possible causes of an atraumatic intracerebral or subarachnoid hemorrhage.
2. Delineate the possible causes of cerebral infarction/ischemia.
3. Discuss the common locations of arteriovenous shunts and their presentation, evaluation, and treatment (includes dural AVM).
4. Discuss the embryology of the cerebral and spinal vasculature and its possible role in vascular anomalies in children.
5. Describe the common locations and types of aneurysms seen in children and how they differ from those seen in adults.
6. List the possible presentations of Vein of Galen aneurysms, their diagnosis and management.
7. List the possible causes of aneurysms in children which are not congenital in nature.
8. Describe the pathophysiology, treatment, and outcome of intraventricular hemorrhage in the neonate.

Trauma

1. List the appropriate diagnostic tests to evaluate a children who has sustained multisystem trauma.
2. Describe the Glasgow Coma Scale and its use.
3. List the salient historical and exam features which lead one to the diagnosis of non-accidental trauma.
4. Discuss the management of the cervical spine in a child who is comatose.
5. Describe the anatomy of the child's spine which causes the epidemiology of spinal cord injury to differ from adults.
6. Describe the common injuries seen as a result of birth trauma and discuss their diagnosis and management.
7. Describe the use of antibiotics and anticonvulsants in CNS trauma.
8. Review the evaluation and management of a child who has sustained a head injury with loss of consciousness but is now awake.
9. Discuss the management of depressed skull fractures, both open and closed.
10. Describe the diagnosis and management of spinal column injury.
11. Discuss the diagnosis and management of spinal cord injury without radiologic abnormality (SCIWORA).
12. Describe the intracranial pressure (ICP) compliance curve and discuss its utility in the management of head injury.
13. List the parameters needed to decide on letting an athlete who has sustained a CNS injury return to activity.
14. Discuss the concept of "brain death", its diagnosis and role in organ donation.
15. Discuss the importance and interplay between ICP and cerebral perfusion pressure (CPP) in the management of head and spinal cord injury.
16. Define the concept of "secondary injury".

17. Discuss the role of invasive monitoring in all its forms in closed head injury (CHI).

NS 3-4:

Myelomeningocele and its Variants, Meningocele, Encephalocele, Chiari Malformations, Occult Spinal Dysraphism, Split Cord Anomalies, Segmentation Anomalies, Craniofacial Syndromes and Phakomatosis

1. Enumerate the indications for surgery, surgical options and expected outcomes for each disease entity.
2. Explain the indications for and utility of intraoperative monitoring.
3. Describe appropriate timing of intervention and its rationale.
4. Describe the pathophysiology and presentation of the tethered cord syndrome.

Hydrocephalus and Other Disorders of CSF Circulation

1. Describe normal ICP dynamics and their relation to establishing a differential diagnosis of CSF flow disturbance.
2. Define “slit ventricle system” and how it is diagnosed and treated.
3. Define “brain compliance” and relate how that can affect ventricular size.
4. List indications for and describe technique of accessing a shunt for CSF samples.
5. List disease states which are commonly associated with hydrocephalus.

Neoplasia

1. Discuss the differential diagnosis and evaluation of tumors located in the following areas:
 - a. suprasellar
 - b. pineal region
 - c. intraventricular
2. Discuss the treatment/diagnostic options for tumors in each location listed in #1 including surgical approaches.
3. Describe the appropriate evaluation and treatment of patients with neoplastic processes associated with:
 - a. neurofibromatosis
 - b. tuberous sclerosis
 - c. von Hippel Lindau
4. Discuss the appropriate use of skull base approaches for specific tumor locations.
5. List tumors which will require adjunctive therapy and describe those therapies and potential complications thereof.
6. Discuss the global management of tumoral hydrocephalus.
7. Cite the long-term outcome and complications for treatment of the common cerebellar and supratentorial hemispheric tumors.

Infection

1. Compare the differing patterns of infection as seen in immune-compromised patients to those with a functioning immune system.
2. Discuss the sequelae of CNS infection, both shunt-related and non-shunt-related.
3. List all acceptable treatment options for CNS infection with the pros and cons of each plan.
4. Demonstrate an understanding of the different etiologies for subdural and epidural empyema and brain abscess and differing treatments thereof.
5. Provide a complete differential diagnosis in regard to infectious disease for ring enhancing brain lesions.
6. Discuss the role of osteomyelitis in CNS infection.
7. Differentiate radiographically between infection and tumor of bone.

Other

1. Discuss variance in the surgical management of tumoral vs non-tumoral seizure foci.
2. Discuss surgical options, indications and outcome for non-lesional approaches (e.g., callosotomy).
3. Discuss various surgical options for the management of spasticity.
4. Discuss preoperative evaluation and planning for seizure treatment.
5. Discuss preoperative evaluation and planning for treatment of spasticity and postoperative management.

Cerebrovascular

1. Describe the nomenclature for congenital vascular anomalies and what, if any, role inheritance plays.
2. Describe the pathology, risk factors, diagnosis and treatment of moyamoya in children.
3. List the phakomatoses which have vascular anomalies associated with them and their treatment.

Trauma

1. Discuss the role of apoptosis in brain and spinal cord injury.
2. Compare the utility of epidural, subdural, parenchymal, and intraventricular ICP monitoring.
3. Differentiate between retinal hemorrhages and Terson's syndrome.
4. Describe the role of electrophysiological monitoring in the management and prognostication of the CNS injured patient.
5. Discuss the evidence for and role of steroid therapy in CNS injury.
6. Discuss the prognosis and management of penetrating injuries to the brain and spine.
7. Discuss the management of CSF leaks after head injury.

8. Describe the diagnosis and treatment of a traumatic leptomeningeal cyst.

NS 5-6:

Myelomeningocele and its Variants, Meningocele, Encephalocele, Chiari Malformations, Occult Spinal Dysraphism, Split Cord Anomalies, Segmentation Anomalies, Craniofacial Syndromes and Phakomatosis

1. Differentiate between the use of rigid and non-rigid skeletal fixation in the appropriate surgical setting for this group of disorders.
2. Explain the rationale for surgical treatment of a symptomatic disease.

Hydrocephalus and Other Disorders of CSF Circulation

1. Discuss the utility of expansion craniotomy in the treatment of hydrocephalus.
2. Differentiate between ventriculomegaly, compensated hydrocephalus, and pseudotumor cerebri.
3. Describe the pertinent anatomy of the ventricular system and prepontine cisterns.
4. Describe the role of venous outflow obstruction in hydrocephalus.

Neoplasia

1. Describe the pertinent surgical anatomy for approaches to tumors in the following locations:
 - a. suprasellar
 - b. pineal region
 - c. intraventricular
2. Discuss the role of endoscopic third ventriculostomy in management of tumoral hydrocephalus.
3. Cite the long-term outcome and complications of all treatment options for tumors arising in the following locations:
 - a. suprasellar
 - b. pineal region
 - c. intraventricular
4. Discuss the utility of preoperative embolization and/or chemotherapy in the surgical management of specific tumors.
5. Discuss the role of stereotactic radiosurgery in the management of selected tumors.
6. Describe the presentations of hypothalamic hamartomas and the role of surgery in management.
7. Describe options for CNS monitoring during surgical therapy and their efficacy.
8. Discuss options for treatment and expected outcomes for recurrent tumors.

Infection

1. Describe in detail the differential diagnosis, evolution and treatment options of an immune-compromised patient with a ring enhancing brain lesion.

2. List the important aspects of the patient's history which may lead one to entertain the diagnosis of CNS infection, both shunt-related and non-shunt-related.
3. List diagnostic tools, other than CSF culture, which are utilized to diagnose a shunt infection.

Cerebrovascular

1. List the locations for traumatic vascular lesions and their risk factors, diagnosis, and treatment.
2. Discuss management options and controversies in the treatment of vascular disease in children.

Trauma

1. Discuss the potential complications and evaluation of comatose patients with skull base fractures.
2. Discuss the utility of lumbar drains and expansion craniectomy and the removal of frontal or temporal lobe in the management of refractory elevated ICP.
3. Describe the approaches to the management of traumatic ICH and its supporting data, both surgical and non-surgical.
4. List the vascular and endocrine complications seen after head injury.
5. Discuss the long-term management of a child who has sustained CNS trauma including rehabilitation and neuro-cognitive issues.
6. Discuss the management of peripheral nerve injuries in a child.

Practice Based Learning and Improvement

1. Analyze and assess your tumor, stereotactic, and tumor practice experience, at a minimum through the morbidity and mortality conference format. Participate in analysis of complications and means to improve individual and system practice patterns.
2. Utilize online resources, including PubMed and evidence based medicine databases to locate the latest and best information on tumor, stereotactic, and tumor patient problems.
3. Apply knowledge of study design and statistical methods to appraise the literature on tumors, to conduct your own scientific studies (with faculty mentors), and to participate in monthly journal club and other conferences. Use such knowledge in preparing preop and core lecture conferences.
4. Participate in the education of other residents, medical students, and health care professionals regarding tumor, stereotactic, and pediatric neurosurgical disease.

Interpersonal and Communication Skills/ Professionalism

1. Develop an effective and respectful relationship with patients and families with tumors.
2. Help to lead the health care team involved in tumor and pediatric patient management.
3. Maintain relevant medical records in a timely manner.
4. Constantly work on effective communication skills.
5. Learn to appreciate the special skills required to communicate effectively with pediatric patients and their families.

Professionalism

1. Learn to treat tumor, movement disorder, and pediatric patients and families with respect.
2. Demonstrate sensitivity to the spinal patient's problems.
3. Learn to deal constructively with severe complications and death.

Systems Based Practice

1. Utilize all components of the health care system in the care of tumor patients (i.e. consultants, physical therapy, speech therapy, discharge planning).
2. Learn to practice cost-effective health care by ordering only those tests, medications, and therapies which are indicated and effective.
3. Learn to work effectively with neurology in the evaluation and management of epilepsy patients. Learn to work effectively with pediatric critical care and other pediatric specialists in the management of pediatric neurosurgical problems.

VA Service

Peripheral Nerve Surgery:

Patient Care

NS 1-2:

1. Obtain a history and perform a motor and sensory examination of the peripheral nervous system.
2. Based on history and physical, anatomically localize the lesion.
3. Obtain appropriate ancillary tests:

- a. EMG/NCV
- b. metabolic screens
- c. imaging studies
4. Formulate a differential diagnosis for common entrapments.
5. Position and prep for common entrapment releases.
6. Perform a diagnostic nerve and muscle biopsy.
7. Obtain sural nerve for grafting.

NS 3-4:

1. Perform pre- and postoperative care of the patient with a peripheral nerve injury.
2. Evaluate a child with birth palsy.
3. Position a patient for nerve surgery:
 - a. all entrapment sites
 - b. brachial plexus surgery
4. Perform a neurolysis/decompression.
5. Expose the brachial plexus.
6. Manage the pain associated with nerve injury:
 - a. use of medications
 - b. use of rehabilitation
 - c. use of stimulation

NS 5-6:

1. Perform a consultation concerning a nerve injury.
2. Discuss the risks versus benefits of a surgical repair of a given nerve injury.
3. Determine the parameters confirming anticipated nerve regeneration:
 - a. anticipated advancing Tinel's sign
 - b. order of muscle re-innervation
4. Perform a nerve decompression:
 - a. carpal tunnel
 - b. ulnar nerve at elbow
 - c. peroneal nerve
5. Perform a nerve repair:
 - a. neurolysis
 - b. internal neurolysis
 - c. intraoperative nerve conduction
 - d. neuroma excision
 - e. placement and suture of nerve graft
6. Excise a nerve sheath tumor.
7. Expose a brachial plexus injury:
 - a. determine possible repairs including nerve transfers
 - b. expose the spinal accessory nerve

Medical Knowledge

NS 1-2:

1. Define the peripheral nervous system versus the central nervous system.

2. Discuss the major structural elements of a peripheral nerve:
 - a. epineurium
 - b. perineurium
 - c. endoneurium
 - d. axon
 - e. fascicle
 - f. Schwann cell
 - g. connective tissue
 - h. motor end plate
 - i. sensory receptor
3. Discuss the blood supply of the peripheral nerves.
4. Discuss the blood-nerve barrier.
5. Define axonal transport and differentiate fast from slow.
6. Describe an action potential including the flow of ions.
7. Describe the various nerve fibers in terms of size.
8. Discuss the significance of fiber size in terms of function (e.g., c-fiber - nociceptive).
9. Discuss the various forms of action potential propagation.
10. Discuss the pathophysiological response to various injuries by a nerve:
 - a. compression
 - b. ischemia
 - c. metabolic
 - d. concussive
 - e. stretch
11. Define and discuss apoptosis.
12. Define Wallerian degeneration.
13. Discuss nerve regeneration:
 - a. sprouting
 - b. nerve growth factors
 - c. rate of growth
 - d. remyelination
14. Define neuroma:
 - a. axonal tangle
 - b. mechano-sensitivity
 - c. neuroma-in-continuity
15. Define and discuss the pathophysiology and clinical significance of the Tinel's sign.
16. Describe the symptoms and signs of typical nerve injuries:
 - a. entrapment syndromes
 - b. stretch injuries
 - c. laceration injuries
 - d. concussive injuries
 - e. injection injuries
17. Distinguish upper versus lower motor neuron symptoms and signs in nerve injury:
 - a. anatomical definition
 - b. degree of atrophy
 - c. distribution of weakness

- d. reflex changes
- e. potential for recovery
- 18. Describe the classification of nerve injury:
 - a. Seddon classification
 - b. Sunderland classification
- 19. List the major peripheral nerves of body. Describe the motor and sensory innervation of each.
- 20. Draw the major components of the brachial plexus.
- 21. Describe the rating scales for motor power.
- 22. Describe the various sensory modalities and how to examine each.
- 23. Describe the symptoms and signs of common nerve entrapments:
 - a. carpal tunnel
 - b. ulnar entrapment at the elbow
 - c. lateral femoral cutaneous nerve
 - d. peroneal at fibular head
- 24. Define EMG and NCV.
- 25. Describe the changes in EMG and NCV in nerve entrapment.
- 26. Describe the nonoperative and operative treatment of entrapment syndromes.
- 27. Define:
 - a. coaptation
 - b. neurorrhaphy
 - c. neurotization
 - d. nerve transfer

NS 3-4:

- 1. Define the autonomic nervous system:
 - a. differentiate sympathetic and parasympathetic
 - b. discuss anatomic distribution
 - c. identify the various neurotransmitters
 - d. discuss Horner's syndrome
- 2. Compare and contrast a peripheral nerve to a cranial nerve:
 - a. histology
 - b. response to injury
 - c. root entry zone
- 3. Describe nerve regeneration in terms of:
 - a. specificity
 - b. pruning of sprouts
 - c. end to side sprouting
- 4. Draw the complete brachial plexus.
- 5. Discuss the lumbar plexus.
- 6. Discuss stretch injury, missile injury and avulsion injury:
 - a. definition
 - b. typical etiology
 - c. physical findings
 - d. electrical findings
 - e. nonoperative management

- f. indications for surgery
 - g. intraoperative findings
 - h. potential for recovery
7. Describe the anatomical location of the common entrapment sites. List the various bands and arcades that produce entrapment.
 8. Provide a differential diagnosis for common entrapment syndromes:
 - a. differentiate radiculopathies from entrapments
 - b. discuss repetitive strain disorder
 9. Discuss uncommon entrapment neuropathies:
 - a. Guyon's canal
 - b. suprascapular entrapment
 - c. radial tunnel/PIN
 - d. median nerve in forearm/AIN
 - e. tarsal tunnel (anterior and posterior)
 - f. piriformis syndrome
 10. Explain the use of EMG/NCV in the management of peripheral nerve disorders:
 - a. physiology
 - b. typical findings in neuropathy
 - c. typical findings in nerve injury
 - d. typical findings in nerve regeneration
 11. Discuss the common metabolic/inherited neuropathies.
 12. Discuss burn and electrical injury effects on nerves.
 13. Classify peripheral nerve tumors.
 14. Discuss the pathophysiology of NF1 and NF2.
 15. Discuss the timing of peripheral nerve surgery:
 - a. laceration injury
 - b. blunt injury
 - c. missile injury
 - d. iatrogenic injury
 - e. surgical injury
 - f. injection injury
 16. Discuss outcome priorities in brachial plexus surgery:
 - a. motor versus sensory
 - b. functional outcome- elbow flexion, shoulder abduction, etc.
 17. Discuss tension at the nerve repair site.
 18. Discuss nerve repair techniques:
 - a. direct coaptation
 - b. nerve graft
 - c. nerve transfer
 - d. donor (graft) nerves
 - e. epineurial repair
 - f. fascicular repair
 19. Describe intra-operative nerve evaluation:
 - a. visual
 - b. palpation
 - c. internal neurolysis

- d. nerve conduction
- e. biopsy

NS 5-6:

1. Discuss with the aid of diagrams the anatomy of the peripheral nervous system:
 - a. common sites of entrapments
 - b. the brachial and lumbar plexus
 - c. innervation of the bladder
2. Discuss the use of nerve grafting:
 - a. types of fixation (suture/glue)
 - b. types of grafts (nerve, vein, artificial)
 - c. end to side
3. Discuss entrapment syndromes:
 - a. thoracic outlet
 - b. double crush syndrome
 - c. repetitive strain
4. Discuss ulnar nerve decompression:
 - a. in situ decompression
 - b. transposition (subcutaneous/intramuscular/submuscular)
 - c. medial epicondylectomy
5. Differentiate brachial plexus injury from brachial plexitis.
6. Formulate a management plan for:
 - a. birth brachial plexus injury
 - b. acute nerve injury (stretch/compression/laceration/injection)
 - c. chronic nerve injury
 - d. failed nerve decompression
 - e. painful nerve/neuroma
7. Describe the management of nerve tumors:
 - a. imaging techniques, including MR neurography
 - b. indications for surgery in NF1
 - c. operative and adjuvant treatment for malignant peripheral nerve sheath tumors
 - d. use of monitoring during tumor surgery
 - e. fascicular dissection
8. Describe adjuvant therapies in nerve injury:
 - a. muscle and tendon transfers
 - b. prosthesis
 - c. joint fusion

Practice Based Learning and Improvement

1. Analyze and assess your peripheral nerve practice experience, at a minimum through the morbidity and mortality conference format. Participate in analysis of complications and means to improve individual and system practice patterns.
2. Utilize online resources, including PubMed and evidence based medicine databases to locate the latest and best information on peripheral nerve patient problems.
3. Apply knowledge of study design and statistical methods to appraise the literature on tumors, to conduct your own scientific studies (with faculty mentors), and to participate in monthly journal club and other conferences. Use such knowledge in preparing preop and core lecture conferences.
4. Participate in the education of other residents, medical students, and health care professionals regarding peripheral nerve disease.

Interpersonal and Communication Skills

1. Develop an effective approach to efficiently communicating with new and return patients in the outpatient clinic.
2. Learn to effectively use the online electronic medical record system at the GVAH.
3. Constantly work on effective communication skills with inpatients and their families.

Professionalism

1. Learn to treat patients and families with respect.
2. Demonstrate sensitivity to patient and their family in the outpatient clinic setting.

Systems Based Practice

1. Learn which tests are appropriate and cost-effective in the workup of common neurosurgical problems.
2. Learn to write effective daily clinical notes which succinctly convey pertinent health care information to the other members of the health care team.
3. Learn to dictate effective operative reports, which adequately document the key aspects of each surgical procedure.
4. Learn the basics of CPT coding for outpatient and surgical encounters.