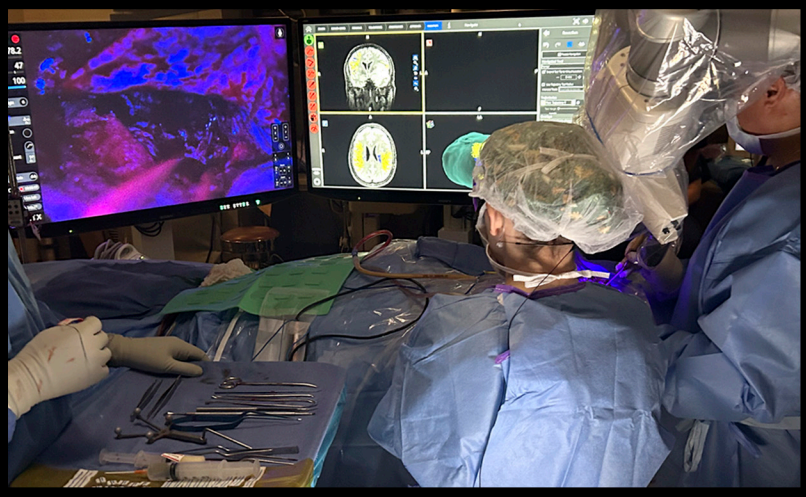
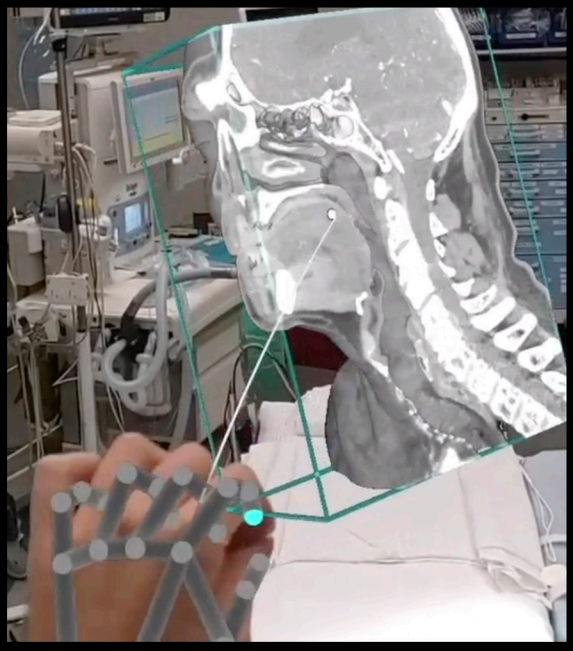




University of Pittsburgh

Department of Neurological Surgery

2023 Annual Report

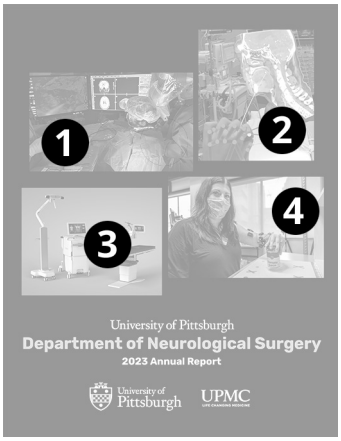
University of Pittsburgh

UPMC
LIFE CHANGING MEDICINE

2023 Department of Neurological Surgery Annual Report

University of Pittsburgh

Table of Contents:



On the Cover:

1) Costas Hadjipanayis, MD, PhD, and Justiss Kallos, MD, perform first tumor resection in the world using voice-controlled, robotic-assisted MODUS X surgical exoscope with fluorescence-guided surgery visualization, 2) Edward Andrews, MD, is advancing research in augmented reality for the operating room at the Alba Tull Center for Neuro Imaging and Therapeutics, 3) neurosurgeons are using robotics like The Mazor X™ Robotic Guidance Platform for minimally invasive surgery to optimize efficiency and safety, 4) exciting new spinal cord stimulation research led by Marco Capogrosso, PhD, and Peter Gerszten, MD, helped stroke patient regain use of her hand and arm and has given hope to stroke patients with paralysis.

Faculty, Residents & Staff

Faculty

• Chair and Professor:
Robert M. Friedlander, MD, MA

• Professors:
C. Edward Dixon, PhD
(Vice Chair, Research)
Paul A. Gardner, MD
Peter C. Gerszten, MD, MPH
(Vice Chair, Quality Improvement)
Jorge A. González-Martínez, MD, PhD
(Vice Chair)
Stephanie Greene, MD
(Vice Chair, Education)
Costas G. Hadjipanayis, MD, PhD
(Executive Vice Chair)
D. Kojo Hamilton, MD
L. Dade Lunsford, MD
John J. Moossy, MD
Ajay Niranjan, MD, MBA
David O. Okonkwo, MD, PhD
Ian F. Pollack, MD
(Vice Chair, Academic Affairs)
Mingui Sun, PhD
Parthasarathy D. Thirumala, MD

• Associate Professors:
Taylor Abel, MD
Nitin Agarwal, MD
Jeffrey Balzer, PhD
Diane L. Carlisle, PhD
Donald J. Crammond, PhD
Avniel Ghuman, PhD
Bradley Gross, MD
Ava Puccio, PhD, RN
Fang-Cheng (Frank) Yeh, MD, PhD

• Assistant Professors:
Kalil G. Abdullah, MD
Sameer Agnihotri, PhD
Edward Andrews, MD,
Katherine M. Anetakis, MD
Thomas J. Buell, MD
James Cushing Bayley, MD
Marco Capogrosso, PhD
Luke C. Henry, PhD
Baoli Hu, PhD
Robert Kellogg, MD
Gary Kohanbash, MD
Michael J. Lang, MD
Michael McDowell, MD
Antony MichealRaj, PhD
Natalie Sandel Sherry, PsyD
Georgios Zenonos, MD
Pascal O. Zinn, MD, PhD

Faculty and residents at 2023 resident graduation dinner held at Pittsburgh Zoo & PPG Aquarium, June 24.

• Clinical Professors:
Matt El-Kadi, MD, PhD
(Vice Chair)
Joseph C. Maroon, MD
Daniel A. Wecht, MD, MSc
David S. Zorub, MD

• Clinical Associate Professors:
Or Cohen-Inbar, MD PhD
Vincent J. Miele, MD
Michael J. Rutigliano, MD, MBA

• Clinical Assistant Professors:
Robert L. Bailey, MD
J. Brad Bellotte, MD
Bryan Bolinger, DO
Salem El-Zuway, MD
Chikezie I. Eseonu, MD
Kathryn Hoes, MD
David L. Kaufmann, MD
Vinayak Narayan, MD
Varun Shandal, MD
Jeremy G. Stone, MD
Fadi Sweiss, MD
Bart Thaci, MD

• Research Associate Professors:
Yue-Fang Chang, PhD

• Research Assistant Professors:
Shaun W. Carlson, PhD
Shawn R. Eagle, PhD
Esther Jane, PhD
Daniel Premkumar, PhD

Residents
• PGY-7:
David T. Fernandes Cabral, MD
Zachary C. Gersey, MD
Justiss A. Kallos, MD
Roberta K. Sefcik, MD

• Chief Residents:
Hussam Abou-Al-Shaar, MD
Ricardo Fernández-de Thomas, MD
Arka N. Mallela, MD
Gautam Nayar, MD

• PGY-6:
Daryl P. Fields II, MD, PhD

• PGY-5:
Ali A. Alattar, MD
Hansen Deng, MD
Joseph Scott Hudson, MD
Andrew D. Legarreta, MD

• PGY-4:
Prateek Agarwal, MD
Jeffrey R. Head, MD
Rachel C. Jacobs, MD
David J. McCarthy, MD

• PGY-3:
Sharath K. Anand, MD
Andrew M. Faramand, MD
Sakibul Huq, MD
Anthony J. Schulien, MD

• PGY-2:
Joe H. Garcia, MD
Eric M. Nturibi, MD
Willman H. Shuman, MD
James S. Yoon, MD

• PGY-1:
Hussein H. Abdallah, MD
Stephanie M. Casillo, MD
Albin A. John, MD
Oliver Y. Tang, MD

Advanced Practice Providers
Lauren Carroll, MPAS, PA-C
Shannon Casey, PA-C
Kayla Churman, PA-C
Theodora Constantine, PA-C
Alissa Conway PA-C
Abigail Crum, MPAS, PA-C
Kassandra Deane, PA-C
Amanda Driscoll, PA-C
Julia Freyer, PA-C
Amanda Gans, PA-C
Nicole Gray, PA-C
Nicholas Grice, PA-C
Kayla Grom, PA-C
Samantha Gulick, PA-C
Cheyenne Harris, CRNP
Chrisanne Hennicke, PA-C
Danielle Hudak, PA-C
Anna Kampas, PA-C
Sarah Kwiatkowski, CRNP
Lucille Lewis, MPAS, PA-C
Kathleen Mannion, PA-C

Hope Maromonte, MPAS, PA-C
Kristin Mellon, MPAS, PA-C
Kelsey Michenko, PA-C
Alexis Papay, PA-C
Anne Parisi, CRNP
Hannah Pierre, CRNP
Suzan Semroc, PA-C
Kristina Setzenfand, PA-C
Edward Shaffer, PA-C
Gina Shaffer, PA-C
Kaila Simcoviak, PA-C
Alyssa Simon, PA-C
Brianna Stuparitz, PA-C
Jessica Sullivan, PA-C
Sarah Tappe, CRNP
Brooke Testa, PA-C
Kristen Thompson, PA-C
Erin Thomson, PA-C
Svetlana Trofimova, MPAS, PA-C
Jenna Turnley, PA-C
Louisa Urgo Shin, PA-C
Jennifer Wojcik, CRNP
Rachel Wrigley, PA-C

Department Administration

• Executive Administrator:
Stacey Lang

• Assistant Administrator:
Drake Watters

• Financial Administrator:
Tara Horr

• GME Academic Manager:
Melissa Lukehart

Department Overview

Stuart Niles Rowe

Dorothy Klinke Nash

Sidney Goldring

Anthony F. Susen

History

Neurological surgery in the city of Pittsburgh began in 1936 with the arrival of Stuart Niles Rowe, a promising young surgeon trained under the auspices of Charles M. Frazier in Philadelphia. Rowe's arrival marked the birth of a dedicated neurosurgical division that would become a leader in the field. His move here was prompted by a letter from L.H. Landon, Sr., MD, the chief of general surgery at West Penn Hospital, emphasizing the need for a formally trained neurosurgeon in Pittsburgh. It is said that Rowe won a coin toss over William J. Gardner for the opportunity to migrate to the Pittsburgh area and set up practice. Gardner subsequently moved to the Cleveland area and developed his own neurosurgical center.

Rowe, a Michigan native, developed a strong clinical practice in Pittsburgh based on the many, loosely affiliated community hospitals in the area. His goal was to establish a strong neurosurgery service in Pittsburgh. He also had a strong interest in research and wrote several pioneering papers on the neurosurgical treatment of pain, brain abscess and cerebral trauma.

Rowe's plans were put on hold during World War II as he volunteered for military service, serving as an Army lieutenant colonel, treating casualties triaged to a southern England military hospital. Upon his return to Pittsburgh at the end of the war, he again led the neurosurgery service at the university, which was then a section under the Division of General Surgery. Rowe then restarted his mission to unify the neurosurgical service in the Pittsburgh area. He also began to train residents, a journey that would eventually produce one of the strongest neurosurgical training programs in the country.

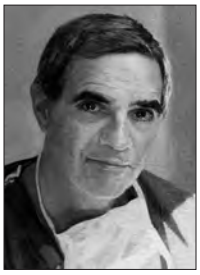
During this time, a landmark moment in the history of neurosurgery occurred with the hiring of Dorothy Klenke Nash, MD, the first woman to practice neurosurgery in the United States. A graduate of the elite Bryn Mawr (Pa.) College in 1921 and the Columbia College of Physicians and Surgeons in 1925, Nash received training in both neurology and neurosurgery under the guidance of Byron Stookey at Bellevue (N.Y.) Hospital in the late 1920s.
She moved to Pittsburgh in 1936, but did not gain a hospital appointment until a chance meeting with Morris Abel Slocum, MD, then chief of general surgery at St. Margaret Hospital. At the time, Nash was volunteering as a phlebotomist at a local blood bank. While donating blood, Slocum learned of Nash's background in neurosurgery and quickly appointed her acting chief of neurosurgery at St. Margaret. She later joined Rowe at Presbyterian University Hospital, paving the way for other women in the field. Rowe placed his service under Nash's care while he served during World War II.

Rowe began the first formal neurosurgery residency program at West Penn Hospital in 1949. Another program was also established at Mercy Hospital in the same year under the direction of Floyd Bragden, MD, who arrived in Pittsburgh three years after Rowe. The two programs were consolidated under the University of Pittsburgh at Presbyterian University Hospital in 1952, where it continues to this day.

With Rowe's own training firmly based in academic neurosurgery, he sought to acquire residents with a commitment to research, teaching and independent thought. Rowe believed that neurosurgery training should not only teach exceptional technique, but also the critical clinical decision-making skills necessary to succeed. He preached the underlying need for thorough literature review and independent research as a means for broadening clinical knowledge.

In 1964, Henry Bahnson, MD, the chair of General Surgery, appointed Sidney Goldring, MD, of St. Louis as the first chief of the Division of Neurological Surgery. After two years, Dr. Goldring returned to St. Louis where he was named professor and chair of neurosurgery at Washington University.

Upon Goldring's departure, Anthony F. Susen, MD, was named the second chief of the Division of Neurological Surgery. Susen—trained at Bowman Gray Medical School and Harvard—had joined the university in 1953 as a clinical instructor and worked with Rowe into the 1960s. He held the same belief as Rowe that residency training programs should stress thorough literature review and independent research as well as exceptional techniques. Susen was also the first pediatric neurosurgeon in the Pittsburgh area and, at the time, was the only pediatric-focused neurosurgeon between Chicago and New York. Under his direction, other facilities including Children's Hospital of Pittsburgh and the Veterans Administration Medical Center, became part of the service.



Peter Jannetta

In 1971, Peter Joseph Jannetta, MD, was appointed the first chair of the University of Pittsburgh Department of Neurological Surgery. Dr. Jannetta is universally known for his work in the treatment of cranial nerve disorders, developing a microvascular decompression procedure—widely known as the Jannetta Procedure—that offers trigeminal neuralgia patients an effective therapeutic alternative when medications fail. Although Dr. Jannetta's scientific and leadership contributions are significant, perhaps his greatest achievement is the legacy of outstanding international leaders he trained in neurosurgery. During his tenure, he trained 49 residents—including four future department chairmen—and was honored with an endowed professorship, appropriately named after Walter E. Dandy—considered one of the founding fathers of neurosurgery. In June of 2000, Dr. Jannetta retired from the University of Pittsburgh and, subsequently, took a position with Allegheny General Hospital.

L. Dade Lunsford

In 1997, L. Dade Lunsford, MD, was selected as the second department chair. In the ensuing decade, Dr. Lunsford guided the department to an elite position in the academic community. Under his guidance, the department established itself as one of the top academic neurosurgical departments in the country—continuing Dr. Jannetta's tradition of training strong, well-rounded residents—and developed into one the most extensive neurological research programs in the nation. Dr. Lunsford also established the department as one of the leading stereotactic radiosurgical programs in the world. In 1987, he was responsible for bringing the Gamma Knife to the University of Pittsburgh, the first center in the U.S. to offer this minimally invasive form of brain surgery. The department now has two such devices and is a world leader in Gamma Knife treatment and education, having treated nearly 18,000 patients.

Amin Kassam

In June of 2006, Dr. Lunsford announced his decision to step down as department chair in order to devote more time to his clinical work, clinical investigation, and resident and fellow training. University of Pittsburgh School of Medicine dean, Arthur S. Levine, MD, appointed Amin Kassam, MD, assistant professor of neurological surgery and co-director of the Minimally Invasive endoNeurosurgery Center, as interim chairman of the department. Dr. Kassam was subsequently appointed chair by Dr. Levine in May of 2007. In June of 2009, Dr. Kassam resigned as chairman and subsequently left the department.

Robert Friedlander

On June 1, 2010, Robert M. Friedlander, MD, a noted cerebrovascular and neuro-oncologic surgeon and researcher, became the fourth chair in the department's history. Dr. Friedlander carved a prominent career as a clinician and scientist at Harvard Medical School and Women's Hospital in Boston before coming to Pittsburgh. His strong leadership in both clinical and research areas has further established the University of Pittsburgh Department of Neurological Surgery as a world-leader in the academic neurosurgical field.

In June of 2011, the University of Pittsburgh Department of Neurological Surgery residency program was ranked as the most productive residency program in the nation in terms of graduates remaining and contributing in academic neurosurgery, according to a study published online in the *Journal of Neurosurgery*.

The study's authors sought to determine those programs that produce a high number of graduates remaining within academic programs and the contribution of these graduates to academic neurosurgery. In the study, 97 academic neurosurgery departments with 986 faculty members were analyzed. All data regarding training program and medical school education were compiled and analyzed according to the center from which each faculty member graduated. The neurosurgery training program at the University of Pittsburgh produced the highest number of academic neurosurgeons in this sample.

In another similar study published in the *Journal of Neurosurgery* in 2015, the department ranked among the top five neurosurgical residency programs in the country in terms of academic publishing output of faculty. In this comprehensive, five-year study, researchers used bibliometrics—the statistical analysis of written publications—to calculate the objective impact of academic papers. The results showed that the University of Pittsburgh Department of Neurological Surgery had the third highest score of 103 neurosurgical residency programs across the United States for papers published by its faculty from 2009 through 2013.

Goals/Mission

The Department of Neurological Surgery at the University of Pittsburgh began more than 75 years ago with a commitment to patient care, education and research. Today these goals are still paramount in our pursuit of excellence: first, to provide outstanding care to patients with neurological disease; second, to equip neurosurgeons of the future with state-of-the-art techniques and analytical skills to lead the field of neurosurgery; and third, to foster research designed to enhance the treatment of diverse diseases affecting the nervous system. Although the faculty has had a wide variety of interests over the years, their unity of vision has been remarkable in this regard.

Organization

A complete faculty list is available on page 4.

A complete resident list is available on page 5.

The main offices of the Department of Neurological Surgery at the University of Pittsburgh are housed on the fourth floor of UPMC Presbyterian in the Oakland section of the city of Pittsburgh. The current full-time faculty includes 15 professors, nine associate professors and 17 assistant professors. In addition, there are 18 clinical faculty, five research faculty, 29 residents at various levels of training, and more than 40 advanced practice providers. The support staff includes more than 200 clinical coordinators, administrative assistants, nurses, technicians and other personnel.

The department has created a unique environment where "centers of excellence and focused programs" flourish. In this model, neurosurgical subspecialists devote time to research and patient care in focused programs. The use of centers of excellence has strengthened neurosurgery at the University of Pittsburgh and facilitated attainment of our mission.

Our Centers of Excellence

Brain and Spine Injury Program

The Brain and Spine Injury Program consists of a number of programs developed to better understand and treat the problems associated with traumatic injury to the central nervous system, brain and spinal cord, in both adults and children.

The department's adult clinical neurotrauma division, led by David Okonkwo, MD, PhD, remains a world leader in the treatment of and research into traumatic brain and spinal cord injury. The neurotrauma service works closely with integral colleagues from the Trauma Division, Critical Care Medicine, Neurophysiology, Neuroradiology, and Physical Medicine and Rehabilitation to provide the most sophisticated treatments available for brain and spinal cord injury patients.

The department collaborates with investigators worldwide to advance the evaluation, treatment and outcomes of patients suffering traumatic injuries of the spinal column and spinal cord. The Neurotrauma Clinical Trials Center (NCTC) provides the infrastructure necessary to carry out the large number of active research protocols ongoing within the program. Recent trials launched include the first stem cell trial for chronic spinal cord injury to be conducted in Pennsylvania.

Clinical efforts in traumatic brain injury are conducted in collaboration with research carried out through the Brain Trauma Research Center (BTRC) under the direction of C. Edward Dixon, PhD. Research conducted both at the center and at other brain injury research programs clearly demonstrates the potential for improving outcome using therapies designed to treat biochemical derangements that occur following impact to the brain. The BTRC has pioneered efforts using temperature manipulation and cerebral blood flow monitoring in the treatment of severe head injury and has conducted landmark investigations into the mechanisms of induction and recovery of head trauma and secondary injury.

Brain Tumor Program

The University of Pittsburgh Department of Neurological Surgery Brain Tumor Program—led by Costas Hadjipanayis, MD, PhD; Kalil G. Abdullah, MD; James Bayley, MD; and Pascal Zinn, MD, PhD—is comprised of a multidisciplinary team of researchers, physicians, and healthcare professionals dedicated to conducting cutting-edge research, delivering state-of-the-art clinical care, and developing innovative treatments for brain tumor patients. The program is one of the largest clinical and most productive basic/translational brain tumor programs in the country, encompassing research across the adult and pediatric brain tumor science spectrum and supported heavily in funding from the National Institutes of Health and other generous foundations.

One of our program's key strengths lies in its collaborative approach. Researchers and clinicians from diverse fields, including neurosurgery, radiation oncology, neuro-oncology, neuropathology, and neuroradiology, work together to tackle the complex challenges associated with brain tumors. This multidisciplinary collaboration fosters a comprehensive understanding of brain tumor biology, enables faster translation of discoveries into clinical practice, and ultimately improves patient care with clinical trials.

As an international referral program for adult brain tumors, the program ranks among the top programs in the nation. Faculty members provide consultation and guidance for local, national, and international referrals. Patients with both primary brain and spine tumors and metastatic tumors are seen in the UPMC Hillman Cancer Center multidisciplinary clinics that include representation from neurosurgery, medical neuro-oncology, and radiation oncology. A weekly multidisciplinary neuro-oncology tumor board is a forum for a team of specialists to review patient problems and to formulate management recommendations. The tumor board draws from the expertise of the neurosurgery, neurology, radiology, neuropathology, and radiation oncology faculty at UPMC. Similarly, there is a weekly skull base tumor board with involvement from otolaryngology/head and neck cancer specialists, neuro-ophthalmology, radiology, and adult neurosurgery. Education, support, and counseling for family members are important parts of our program.

Neurosurgical oncology care at the University of Pittsburgh Department of Neurological Surgery includes subspecialized neurosurgeons providing the best treatments available for patients with both benign and malignant tumors of the brain and spine. Neurosurgical oncologists are dedicated to discovering novel and effective therapies for these diseases through clinical trials and translational bench-to-bedside trials based on scientific breakthroughs developed in our laboratories.

Neurosurgical oncology at UPMC is one of the most robust and innovative programs in the world, with one of the largest volumes of patients treated on an annual basis. The program has been a leader in the implementation of cutting-edge technologies such as stereotactic radiosurgery (SRS) using the Gamma Knife, LINAC-based stereotactic radiosurgery, and image-guided brain tumor resection. Important new and innovative technologies such as the robotic-assisted surgical exoscope, MR-guided laser interstitial thermal therapy (LITT), and fluorescence-guided surgery (FGS) are routinely employed within our brain tumor program. The use of advanced imaging modalities, such as high-definition white matter fiber tract imaging (tractography) and magnetoencephalography (MEG), has also facilitated better outcomes for selected patients with tumors. In addition, awake craniotomy techniques with brain mapping tumor are routinely used to maximize safe removal of brain tumors.

An important multidisciplinary effort towards enhancing the workflow for complex awake brain tumor surgery at UPMC includes the addition of pre-, intra-, and postoperative neuropsychological testing by Natalie Sherry, PhD, and Luke Henry, PhD. Preoperative functional imaging, including magnetoencephalography (MEG), led by Ajay Niranjan, MD, director of the UPMC Brain Mapping Center, as well as intraoperative high-definition fiber tracking (HDFT) by Frank Yeh, PhD, director of the High-Definition Fiber Tractography Lab, have permitted the identification of important functional pathways in the brain to avoid during brain tumor surgery. The integration of our world class intraoperative neuromonitoring program led by Parthasarathy Thirumala, MD, along with, Jeffrey Balzer, MD, Katherine Anetakis, MD, and Donald Crammond, PhD, permits maximal safe removal of brain tumors.

Our medical neuro-oncology team is an important component of our patient care efforts and is comprised of four active neurooncologists led by Jan Drappatz, MD, and including Frank Lieberman, MD, Megan Mantica, MD, and Jeremy Rich, MD. This team provides outstanding care to our brain tumor patients, and has multiple clinical trials open to accrual at the UPMC Hillman Cancer Center. The neuro-oncology team is also actively studying other neurological complications of systemic cancer and its treatment, including stroke, neurobehavioral disorders, neurological complications of chemotherapy and/or radiation therapy, and paraneoplastic neurological syndromes.

Our radiation oncology program, led by John Flickinger, MD, Christopher Wilke, MD, Andrew Zureick, MD, and Serah Choi, MD, provides comprehensive expertise in clinical care of a wide spectrum of benign and malignant diseases affecting the brain and spine. The leading-edge treatments used include Gamma Knife radiosurgery, LINAC based stereotactic radiosurgery, radiation therapy using a variety of technological treatment planning including 3D conformal radiation therapy and intensity modulated radiation therapy (IMRT). In collaboration with Peter Gerszten, MD, spine stereotactic body radiation therapy (SBRT) is used to treat patients with oligometastatic, and previously irradiated spinal metastases. This therapeutic approach offers a treatment option in situations where no viable options were previously available.

Another notable aspect of our brain tumor program is its commitment to education and training. The University of Pittsburgh provides robust training opportunities for aspiring neurosurgeons, neuro-oncologists, and researchers, fostering the development of the next generation of brain tumor specialists. A new CAST-approved neurosurgical oncology fellowship is now available for trainees. We also offer fellowship training in medical neuro-oncology. The fellowship is accredited through the United Council for Neurologic Subspecialties, directed by Megan Mantica, MD, and supported through a generous donation by the Karp family, in memory of Henry “Hank” Karp. It aims to inspire future neuro-oncologists to lead research and care innovations in the U.S. and around the world. This dedication to education helps to build a strong foundation for future advancements in brain tumor research and treatment.

Overall, the Brain Tumor Program at the University of Pittsburgh Department of Neurological Surgery has established itself as a leading center for brain tumor research and clinical care. Its multidisciplinary approach, groundbreaking research, innovative treatments, and commitment to education make it a beacon of hope for patients and a driving force in advancing our understanding and management of brain tumors.

Cerebrovascular Neurosurgery Center

The Comprehensive Center for Cerebrovascular Neurosurgery at the University of Pittsburgh Medical Center is a subspecialized multidisciplinary clinical unit that evaluates and treats all forms of vascular disorders of the brain and spinal cord. Given the high volume of cases managed by the center, it serves as a national and international resource for the management of patients with complex cerebrovascular disease, including aneurysms, arteriovenous malformations (AVMs), arteriovenous fistulas (AVFs), carotid disease, Moya-Moya, and cavernous malformations. With a group of highly subspecialized physicians, center faculty prospectively assess patients and provide broad state-of-the-art treatment options. Since cerebrovascular disease can often be treated using a spectrum of complementary techniques, experts evaluate cases and provide recommendations with the goal of minimizing risks and maximizing long-term efficacy.

The center is directed by department chairman Robert M. Friedlander, MD. Other members of our team include Paul A. Gardner, MD; Bradley A. Gross, MD; Michael J. Lang, MD; Daniel A. Wecht, MD; and Georgios Zenonos, MD. As part of the cerebrovascular center, Dr. Gross serves as director of endovascular neurosurgery.

Challenging cases are reviewed prospectively in our weekly multidisciplinary cerebrovascular conference. All the key subspecialists are represented and discuss the individual features of each case. Individual consideration is given to each patient to tailor the most effective therapy taking into consideration a number of important features including patient age, overall health status, and specific anatomical consideration of their vascular abnormality.

The Cerebrovascular Neurosurgery Center works in close collaboration with the UPMC Stroke Institute—staffed by neurologists with additional training in vascular neurology. Our endovascular neurosurgeons and interventional neurologists perform acute interventions for ischemic strokes at one of the highest rates in the country and are involved in innumerable trials advancing the field. For patients with complex, elective cerebral ischemic disease, Dr. Lang has a very busy practice in cerebral revascularization, offering cutting-edge cerebral bypass options, among.

Center for Clinical Neurophysiology

The Center for Clinical Neurophysiology (CCN) at UPMC was organized in 1981 to serve as an interdepartmental resource serving then-Presbyterian University Hospital, Montefiore Hospital and Children's Hospital of Pittsburgh. At that time, the CCN was composed of just a few clinicians providing diagnostic testing and intraoperative neurophysiological monitoring (IONM) services for only very specific surgeries in the neurosurgical and orthopedic disciplines.

The service has now grown to providing more than 8,000 IONM cases per year at all UPMC pavilions, as well as supporting UPP and non-UPP surgeons at non-UPMC hospitals. The use of IONM at UPMC reaches across many surgical disciplines and has proven to be an invaluable adjunct not only in adult and pediatric neurosurgical procedures but also in orthopedic, ENT, vascular, cardiothoracic and interventional neurological procedures.

The CCN and its highly trained and nationally renowned faculty and technical staff's primary goal is to provide high-quality service in a cost-efficient manner to the UPMC patient population. The center focuses on interdisciplinary research to improve the understanding

and the value of IONM to predict and prevent neurological injury. In addition, CCN faculty have established two annual IONM courses and a formal, clinical training program at Carlow University. The first undergraduates in this program, graduated in May of 2020.

Parthasarathy Thirumala, MD, is director of the CCN and is joined by Jeffrey Balzer, PhD; Donald Crammond, PhD; Katherine Anetakis, MD; and Varun Shandal, MD.

The CCN is the largest and busiest academic IONM program in the country, offering and providing services at all UPMC hospitals including UPMC Hamot, Horizon, Altoona, Somerset, Susquehanna, Western Maryland and Pinnacle. In addition, the CCN provides professional and technical services at Excela Health System, Indiana Regional Hospital and Trinity Health System. The CCN faculty can achieve this service expansion to community hospitals through the use of telemedicine technology. Patients in community hospitals, more than 100 miles away, can receive the same quality care in real-time without having to travel to Pittsburgh.

Intraoperative multimodality monitoring at UPMC includes expertise in somatosensory evoked potentials (SSEP), brainstem auditory evoked potentials (BAEP), transcranial motor evoked potentials (TcMEP), direct cortical motor evoked potentials (dcsMEP) electroencephalography (EEG) and electromyography (EMG). Direct peripheral nerve recordings (CNAP and CMAP) are also performed, as well as single unit micro-electrode recordings (MER) and macrostimulation performed for subcortical mapping during placement of DBS electrodes in various subcortical structures. EEG is used to monitor cerebral function and ischemic risk during cerebral and peripheral vascular procedures, including cerebral aneurysm treatment, carotid endarterectomy and a variety of cardiothoracic procedures.

EEG recorded directly from the pial surface of the brain, or electrocorticography (ECoG), is used to help determine resection margins in epilepsy surgery, and to monitor for seizures during direct electrical stimulation of the brain surface carried out while mapping eloquent cortex in awake patients. In addition to providing IONM services, the CCN also performs diagnostic evoked potential testing, and transcranial Doppler studies.

The CCN is proud to provide a high-quality, high value service at a significantly low cost to patients, which it can achieve by constantly evaluating and improving clinical services through its various research initiatives and quality improvement programs. The center's cutting-edge research efforts—represented by multiple, peer-reviewed publications in high quality journals each year—have demonstrated the value of the application of multimodality intraoperative neurophysiological monitoring to improved patient safety during various peripheral and central nervous system operative procedures.

Complex Brain Surgery Program

The Complex Brain Surgery Program, under the direction of department chairman Robert Friedlander, MD, is devoted to the surgical treatment of lesions and tumors located in deep, eloquent or difficult-to-reach regions of the brain. The goal of the program is to provide gentle, accurate, and safe surgery for the most complex lesions and locations, often regarded as inaccessible or high-risk.

This program has its foundation on a precise and meticulous knowledge of microsurgical neuroanatomy and neurosurgical approaches, and is built upon extensive surgical experience at UPMC, and intense microsurgical learning and research conducted at the Surgical Neuroanatomy Lab and the Fiber Tractography Lab at the University of Pittsburgh.

Areas of surgical expertise include intrinsic tumors in eloquent brain areas and deep white matter, limbic/paralimbic tumors (insula, medial temporal lobe, cingulum), intraventricular and thalamic lesions, pineal and posterior tentorial incisura tumors, cerebellar and brainstem lesions.

A unique feature of this program is the application of sophisticated presurgical planning techniques, such as surgical simulation with crafted anatomical specimens and High-Definition Fiber Tractography (HDFT), to carefully develop the most effective and less invasive operative plan.

HDFT is an advanced MRI-based non-invasive imaging technique, with its surgical applications pioneered by Dr. Friedlander, to study the three-dimensional structure of the fiber tracts of patients with intrinsic brain lesions. HDFT provides a superior presurgical evaluation of the fiber tracts for patients with complex brain lesions, including benign, low grade, and high-grade tumors. The combination of HDFT with accurate neuroanatomical knowledge of the white matter tracts is the key to design the less invasive trajectory into a target lesion and apply more effectively intraoperative electrical mapping techniques for maximal and safe tumor resection in eloquent cortical and subcortical regions.

Center for Cranial Base Surgery

Cranial base surgery has a long tradition at the University of Pittsburgh. The UPMC Center for Cranial Base Surgery—under the current direction of Paul Gardner, MD, and Georgios Zenonos, MD, in the Department of Neurological Surgery, and Carl Snyderman, MD, MBA, and Eric Wang, MD, in the Department of Otolaryngology—is the first skull base center to be established in North America and has pioneered both transcranial microscopic and endoscopic endonasal approaches to the skull base and brain. Michael McDowell, MD, a graduate of the UPMC Skull Base Fellowship, works in collaboration with other members of the center to provide comprehensive endoscopic and open skull base surgical care at UPMC Children's Hospital of Pittsburgh, with particular focus on cranio-cervical junction disease including tumors, basilar invagination, and other causes of cranio-spinal instability requiring instrumentation. They also work in regular collaboration with Costas Hadjipanayis, MD, PhD, director of the UPMC Center for Image-Guided Neurosurgery, and L. Dade Lunsford, MD, who established the first Gamma Knife center in North America at UPMC in 1987, and was also the first to introduce radiosurgery for the non-operative treatment of skull base tumors.

Experts at the UPMC Center for Cranial Base Surgery continue to lead the field of minimally invasive brain surgery by developing new techniques, tools and approaches that have made it possible to access many tumors, regardless of size. Since 1997, more than 4,000 endonasal surgeries have been performed in adults and children, making UPMC one of the busiest centers in the world for the surgical treatment of tumors of the pituitary region and cranial base. By combining this innovative approach with other minimally invasive approaches, such as transorbital and endoscopic-assisted retromastoid and keyhole approaches, as well as the full complement of standard skull base approaches, the team at UPMC provides a full array of options for cutting-edge treatment of skull base disease. In addition, the Center for Cranial Base Surgery has also been designated as a Pituitary Tumor Center of Excellence by the UPMC Health Plan, setting the standard for pituitary tumor treatment in the region. This designation is based on high volume practice with regular metrics which uphold a high standard of care for the entire UPMC system.

Drs. Gardner, Snyderman, Zenonos and Wang, along with Tonya Stefko, MD, from the Department of Ophthalmology, and Barry Hirsch, MD, Philip Perez, MD, and Andy McCall, MD, neurotologists from the Department of Otolaryngology, comprise a team of experts in cranial base surgery, advancing patient care through clinical outcomes studies, in-depth anatomical study, molecular science and genetics research and an international training program. Research activities are coordinated by Benita Valappil, MPH, clinical research director, and include participation

in multicenter trials, banking of tumor tissue for research and maintenance of clinical research database.

Supported by expert physician assistants Rachel Rogers, Lucille Lewis, Cheyenne Harris and Kayla Grom and a highly experienced subspecialty nursing team, patients are evaluated and guided through even the most complex, multidisciplinary care, provided to patients throughout our region, across the U.S. and around the globe.

The concept of team surgery allows the center to select the best surgical approach for each tumor, with a surgical plan designed around the particular needs of the individual patient. Treatment is designed to offer the best surgical outcome with the least side effects and maximal preservation of function. A full array of transcranial approaches, minimally invasive keyhole approaches and endoscopic endonasal approaches are routinely applied with proven and studied success. The UPMC Center for Cranial Base Surgery is also a major teaching and research destination for surgeons and other health care professionals looking to learn more about these techniques. Faculty teach three CME courses yearly at UPMC, featuring live surgery and hands-on laboratory work. They also travel the world teaching these procedures to the next generation of skull base surgeons.

The University of Pittsburgh Medical Center has been designated as a "Multidisciplinary Team of Distinction" by the North American Skull Base Society. This designation is based on meeting NASBS membership criteria and may not be construed as a medical referral.

Cranial Nerve Disorders Program

The Cranial Nerve Program, under the direction of Georgios Zenonos, MD, along with Paul Gardner, MD, joins experts in a variety of medical disciplines, including neurosurgery, neurology, neurophysiology, radiology, anesthesia, neuro-oncology, and neuro-otology with the intent of providing the most advanced care for a variety of brain disorders. The goal of the program is to provide the very best outcomes for patients with a variety of disorders in the most minimally invasive manner.

Building upon the pioneering work accomplished at the University of Pittsburgh by former long-time chairman Peter J. Jannetta, MD, with his ground-breaking development of microvascular decompression (MVD), our Cranial Nerve Program is an international leader in the management of trigeminal neuralgia, hemifacial spasm and glossopharyngeal neuralgia, among over cranial nerve disorders.

The center is driven by outcome-based clinical research and basic science research projects aimed at understanding the biologic mechanisms of diseases within the realm of the center. In recent years, this research has resulted in improved outcomes for patients and new therapies for a variety of disorders.

Epilepsy, Movement Disorders and Psychiatry Surgical Program

The Epilepsy, Movement Disorders and Psychiatry Surgical Program, under the direction of Jorge A. González-Martínez, MD, PhD, at the University of Pittsburgh encompasses the treatment of medically intractable epilepsy, movement disorders and psychiatry disorders. These pathological neurological conditions are similar in that successful neurosurgical treatment requires an expert understanding of the involved brain networks and their potential for modulation by functional neurosurgical procedures, as well as multidisciplinary teams that deliver surgical care to these special groups of patients. Dr. González-Martínez has expertise in both adult and pediatric patients. Pediatric patients are treated at the UPMC Children's Hospital of Pittsburgh, one of the best pediatric hospitals in the country, as noted in *U.S. News and World Report*.

UPMC also houses the region's foremost centers for the comprehensive neurosurgical treatment of all types of adult and pediatric epilepsy, including epilepsy caused by lesions visible on MRI (mesial temporal sclerosis, cortical dysplasia, neurodevelopmental brain tumors, cavernous malformations, etc.) and epilepsy where the seizure onset location is not obvious and must be localized by intracranial monitoring, including stereo-electroencephalography (SEEG). Part of the University of Pittsburgh Comprehensive Epilepsy Center, the surgery program is one of the busiest—and most renowned—programs offering the latest less invasive, innovative and conventional surgical treatments, including responsive neurostimulation, laser thermal ablation, deep brain stimulation and incisionless endoscopic nasal resections in patients with temporal lobe epilepsy.

Dr. González-Martínez, co-director of the epilepsy center, has the country's largest experience in SEEG implantations, SEEG guided resections and neuromodulation surgeries, with more than 3,000 successful surgical procedures performed. In order to promote an optimal safety profile and seizure outcome, many procedures are performed under robotic guidance. In addition of developing and implementing the SEEG method in North America, Dr. González-Martínez is also a pioneer in robotic surgery, having performed more than 1,000 procedures using this technique. The University of Pittsburgh has the largest experience in robotic neurosurgery in the country and was one of the first institutions in adopting the novel technology.

In addition to clinical activities, The Epilepsy, Movement Disorders and Psychiatry Surgical Program is considered one the premier programs in the country regarding translational and basic science research, working in collaboration with the University of Pittsburgh Department of Neuroscience, Carnegie Mellon University Department of Biomedical Engineering, John Hopkins University and Aix Marseille University in France. The program's research activities are led by Dr. González-Martínez and his research team and conducted through the University of Pittsburgh Cortical Systems Laboratory.

Human Neural Prosthetics Program

The Human Neural Prosthetics Program—under the surgical direction of Jorge A. González-Martínez, MD, PhD—is the result of a multidisciplinary effort to explore the utilization of brain computer interfaces for improving the lives of patients with motor disabilities. In 2007, a collaborative group was established—representing expertise in engineering, neuroscience and rehabilitation—to promote clinical trials using brain computer interfaces to control neural prosthetic devices.

Researchers obtained an initial grant to evaluate micro-ECoG grids in patients in the Epilepsy Monitoring Unit. Data from this study demonstrated that patients could utilize a brain computer interface to control a computer cursor. This grant served as the kick-start for two clinical trials.

In the first, quadriplegic patients are implanted with a custom-designed ECoG grid for up to 30 days. The first subject was able to obtain consistent three-dimensional cursor control using a 3D visual environment. He was also able to successfully control a robotic arm. Additional subjects have also successfully achieved cursor control in a 3D virtual environment and control of a robotic arm. The initial work was funded by the Cortical Control of a Dextrous Prosthetic Hand study funded by National Institute of Neurological Disorders and Stroke (NINDS) and Andrew B. Schwartz, PhD (Department of Neurobiology) was the principal investigator.

A second study utilizes microelectrode arrays that penetrate the surface of the brain. This study is funded by the Defense Advanced Research Projects Agency (DARPA) and is part of the Revolutionizing Prosthetics Program, Phase 3 study for which Michael L. Boninger, MD, former chairman of the Department of Physical Medicine & Rehabilitation, is the principal investigator. In the study, two 96-channel electrode arrays were implanted into the brain of a quadriplegic

individual. This study participant was able to obtain control of up to 10 degrees of freedom. Using seven degrees of freedom, she has been able to utilize the robotic arm to perform standardized rehabilitation tasks, such as placing objects on a shelf. Once FDA approval was obtained, she was able to interact personally with the robotic arm and was able to grasp a food item and feed herself. As part of the Revolutionizing Prosthetics Program, Phase 3 study, investigators also obtained FDA approval to place stimulating arrays in conjunction with recording arrays in anticipation of adding sensory feedback to the control of the robotic arm. A second subject was implanted with two recording arrays in motor cortex and two stimulating arrays in sensory cortex. This subject was able to experience a natural-like sense of touch when the fingers of the robotic arm were stimulated by touch. In sensory tests, he was able to correctly identify which finger was touched while blindfolded.

The success of these early studies has led to additional collaborations. The first collaboration is funded by a $7 million NIH grant (Michael Boninger, MD, Physical Medicine and Rehabilitation) to expand our research team to include the University of Chicago. We join Sliman Bensmaia, PhD, and Nicholas Hatsopoulos, PhD, to expand our research efforts with the goal of restoring hand function in patients with paralysis. The second new collaboration is funded by a $1.2 million NIH award (Jennifer Collinger, PhD, Physical Medicine and Rehabilitation) to better understand the underlying neural activity of reaching and grasping. We will be collaborating with University of Pittsburgh researchers, Aaron Batista, PhD, and Patrick Loughlin, PhD, from the Swanson School of Engineering, and Carnegie Mellon researchers Steven Chase, PhD, and Byron Yu, PhD, from the College of Engineering.

Neuroprothetics and spinal cord stimulation expert Marco Capogrosso, PhD—director of the department's Spinal Cord Stimulation Laboratory—provides unparalleled support through his research efforts in spinal cord injury (SCI) and limb motor control.

In June of 2021, the program was awarded a $6.37 million National Institutes of Health grant to study how population dynamics in motor cortex change with behavioral context and how they are shaped by sensory feedback. Through this proposal, researchers hope to gain a better understanding of how motor cortical activity generalizes across static and dynamic behaviors as well as the potential to drive plasticity within cortical circuits that communicate sensorimotor information, which has relevance for understanding skill learning and improving rehabilitation after injury.

As research in spinal cord injury continues, Dr. Capogrosso is also working with Peter Gerszten, MD, and Robert Friedlander, MD, to see if SCS should not only be seen as a therapy for SCI alone, but more generally as an intervention to tackle dysfunction of the corticospinal tract-motoneuron-sensory afferent circuit in the spinal cord, the building block of movement. They have subsequently started two parallel clinical trials: the first is to explore the effects and mechanisms of SCS for the recovery of upper limb motor control after stroke and the second trial is exploring the effects and mechanisms of SCS for the treatment of motor deficits in patients with spinal muscular atrophy, a genetic disease of the Ia-motoneuron system. The group recently reported the preliminary findings of their stroke trial demonstrating that SCS improved strength, dexterity, and motor control in the first two participants suffering from moderate and severe chronic stroke. While they continue to collect data on preliminary safety and efficacy in both trials, they are simultaneously conducting a battery of imaging and electrophysiology tests in order to study the mechanisms of SCS outside the application of SCI. Drs. Capogrosso, Friedlander and Gerszten hope to be able to show that SCS is a disease modifying intervention for dysfunctions of the spinal sensorimotor units and, therefore, could be applied to a variety of disorders of this simple but critical neural unit in motor control. Hopefully, this research program will contribute to the global efforts to defeat paralysis in all its forms.

Center for Image-Guided Neurosurgery

The Center for Image-Guided Neurosurgery (CIGNS) directed by Constantinos Hadjipanayis, MD, PhD, incorporates the expertise of individuals in, neurosurgical oncology, Gamma Knife stereotactic radiosurgery, stereotactic and functional neurosurgery neuro-oncology, radiation oncology and neuroradiology. Ajay Niranjan, MD, MBA, is associate director of the center and L. Dade Lunsford, MD, is director emeritus. The goal of the center is to provide quality patient care using minimal access or minimally invasive stereotactic and radiosurgical technology, image-guided brain tumor surgery, MRI-guided focused ultrasound, and advanced imaging of the brain that incorporates magnetoencephalography (MEG). In 1981, the center was the first U.S. center to install a dedicated computed tomography (CT) scanner in a unique stereotactic operating room suite.

The CIGNS was also the first North American center to initiate a clinical program for Gamma Knife stereotactic radiosurgery in 1987 and continues to be an international leader in this field. Currently, two Gamma Knife units are located at UPMC Presbyterian, one of the few clinical sites in the world with two clinical units. In the summer of 2023, the center upgraded one of its units to the latest generation Gamma Knife, Esprit, which incorporates advanced robotics, expands the role of radiosurgery to include cranial vertebral junction targets, provides greater patient access, and enhances patient safety. Both the existing ICON® Gamma Knife and the new Esprit system incorporate a cone beam CT imaging system to facilitate a mask stereotactic fixation system for selected patients.

Gamma Knife technology represents one of the most advanced and minimally invasive methods to treat patients with brain tumors, skull-based tumors, arteriovenous malformations (AVMs), and pain or movement disorders. Over 18,000 patients have undergone Gamma Knife stereotactic radiosurgery at UPMC Presbyterian since 1987. In addition, spinal radiosurgery using several radiosurgical systems is offered under the direction of neurosurgeon Peter Gerszten, MD, who serves as the Peter E. Sheptak Endowed Professor at the University of Pittsburgh.

In 2023, the CIGNS will incorporate a new therapeutic device to its armamentarium for disorders of the brain that incorporates focused ultrasound and use of a sophisticated MRI. The minimally invasive and incisionless technology termed, ExAblate Neuro, will be the first focused ultrasound system in western Pennsylvania. This device represents the next generation of image-guided neurosurgery and is FDA-approved for lesional thalamotomy for essential tremor. The new focused ultrasound technology will also be used in research studies for patients with brain tumors (sonodynamic therapy) in combination with novel chemotherapy agents (blood brain barrier disruption). The ExAblate Neuro system will be used in research studies with Alzheimer's and epilepsy patients as well. Jorge González-Martínez, MD, PhD, will be actively treating patients with the ExAblate Neuro system for essential tremor in addition to the CIGNS leadership (Hadjipanayis and Niranjan) and will be engaged in research studies as well.

A major focus of the CIGNS is sophisticated imaging of the brain to localize important functions of the brain (speech, motor, vision, and sensory functions). In 2021, UPMC installed the new MEGIN TRIUX® Neo magnetoencephalography (MEG) unit to perform functional brain mapping in patients with brain tumors, epilepsy, trauma, and degenerative brain disorders. The MEG is routinely used in the CIGNS for presurgical planning and determination of important regions of the brain to avoid for safer surgery by our neurosurgical oncologists and epilepsy surgeons. Dr. Niranjan is the operations director of the MEG project. He continues to pursue cutting edge MEG research that seeks to develop more specific paradigms to pinpoint the anatomic areas of speech, visual, motor, and sensory function.

The Center for Image-Guided Neurosurgery is an international training site for radiosurgery and minimally invasive neurosurgery, holding six week-long training courses per year. Over the last 20 years, more than 2,500 neurosurgeons, neurootologists, radiation oncologists, medical physicists, and nurses have trained at this center. These courses are among the highest rated post-graduate courses offered at the University of Pittsburgh. In 2015, the center opened a new state-of-the-art education and training facility equipped with the latest generation high-definition display systems. In July of 2020—during the early COVID pandemic—the center switched to online Gamma Knife training courses. Course participants from around the world become "temporary" students at the University of Pittsburgh for one week. Instruction is possible using more than 35 lectures, videos, and course materials. Hands on training in collaboration with Elekta, Inc. allows students to turn their personal computers temporarily and remotely into radiosurgery planning workstations. Students can now study radiosurgery effectively, avoiding the transportation and housing costs involved with national or international travel. CIGNS also participates in the training of selected fellows who compete for the Leksell Gamma Knife Society three-month fellowship in Pittsburgh. Finally, neurosurgery residents at UPMC spend a three-month dedicated block for study during their third year of training to complete certification in brain radiosurgery, typically participating in more than 150 cases during the rotation.

In addition, the center conducts numerous clinical, long-term outcome research projects (typically producing 20+ peer reviewed publications each year). CIGNS is the coordinating center for the International Radiosurgery Research Foundation (IRRF), a multi-institutional international clinical consortium of centers of excellence performing stereotactic radiosurgery. The IRRF currently has members from the United States, Asia, Africa, Europe, and Asia. Multiple retrospective clinical trials have been published or are underway. More than 10,000 articles have now been published worldwide in the field of stereotactic radiosurgery. The University of Pittsburgh has the highest number of studies, having been cited more than 100 times.

Each year, more than 600 patients undergo Gamma Knife radiosurgery at the CIGNS, making it one of the busiest centers in the world. Each year, center faculty publish approximately 20 clinical research studies, now exceeding more than 700 combined peer reviewed publications and over 1,400 publications when book chapters and presentations are included.

In 2022, the third edition of *Intracranial Stereotactic Radiosurgery* was released by CRC Press, with Dr. Lunsford, and Jason Sheehan, MD, co-director of the Gamma Knife Center at the University of Virginia—and former fellow at the University of Pittsburgh—serving as editors.

More than 100 U.S. or international fellows have received training at this center since 1987. The center provides an opportunity for advanced training in image-guided stereotactic and functional surgery at the fellowship level. The CAST-approved fellowship has two tracks, one for candidates interested in a functional focus (movement disorders, pain, and epilepsy with study supervised by Dr. González-Martínez) and one for candidates focusing on neurosurgical oncology and radiosurgery (supervised by Drs. Hadjipanayis, Lunsford and Niranjan). The functional track includes epilepsy and movement disorder experience plus three months on the radiosurgery service. The radiosurgery track includes nine months on the radiosurgery service and three months on the functional service. Currently, all PGY-3 residents spend three months on the Gamma Knife service each year. In addition, there is now a CAST-accredited neurosurgical oncology fellowship that will incorporate GK radiosurgery into the curriculum in addition to surgical resection of primary brain, skull-based, and spinal tumors at UPMC Presbyterian Shadyside.

The multidisciplinary Center for Image-Guided Neurosurgery includes the clinical and research efforts of radiation oncologists John Flickinger, MD, Christopher Wilke, MD, Yoshio Arai, MD, and Susan Rakfal, MD. The participating medical physics group consists of Greg Bednarz, PhD and

Kelin Wang, PhD. Lana Trofimova, PAC, and Louisa Urgo Shin, PAC, provide patient care assistance for the Gamma Knife program. Five full time dedicated, and very talented, nurses headed by Jonet Vacsulka, BSN, and assisted by RNs Mark Geminetti, Devi Willaman, Miranda Crum, Zarina Corwin, and Brenda Unghajer provide pre, intra, and post radiosurgery care to more than 600 patients every year. They are all especially trained in conscious sedation techniques to provide comfort and attentive care to our patients.

Kelly Powell, Dana Adams, and Julie Martin are an extremely capable administrative team that ensures prompt patient approvals and care.

Pediatric Neurosurgery

The Pediatric Neurosurgery Division at UPMC Children's Hospital of Pittsburgh (CHP) is led by Ian Pollack, MD, and also includes Stephanie Greene, MD, Taylor Abel, MD, Robert Kellogg, MD, and Michael McDowell, MD. The division provides care for children with tumors, spinal and cranial deformities, vascular malformations, spasticity and epilepsy, and peripheral nerve disorders, and has gained international recognition for the treatment of pediatric brain tumors, intractable epilepsy, neurovascular lesions, cerebral palsy, traumatic brain injury, and disorders of the skull base and cranio-cervical junction.

The center's neurosurgeons work closely with specialists in pediatrics, surgery, radiation therapy, pediatric neuro-oncology, physical therapy, orthopedics, plastic surgery, otolaryngology, critical care, pediatric neurology and social services. Through its neuro-oncology program, the center provides comprehensive, multi-disciplinary care for patients with brain and spinal cord tumors, in collaboration with the oncology and radiation therapy programs. Patients may be eligible for treatment in one of many innovative research protocols at CHP. These protocols—several of which are unique to CHP or available at only a few centers throughout the country—provide CHP patients access to new treatments and promising studies.

Dr. Pollack is the institutional principal investigator and chair of the neurosurgery committee in the Pediatric Brain Tumor Consortium, supported by the National Cancer Institute to perform cutting-edge clinical trials in children with brain tumors, and serves as the principal investigator on several studies involving vaccine-based immunotherapy for children with challenging brain tumors. The clinical program at CHP has been enhanced by the completion of an intraoperative MRI suite, which facilitates the goal of achieving safer and more extensive resections in challenging childhood brain tumors and allowing immediate postoperative imaging without the need for a second anesthetic.

These clinical advances are coupled with a robust and rapidly growing research enterprise, encompassing a state-of-the-art pediatric brain tumor bank, as well as a series of eight NIH R01, P01, and R21-funded research projects, and a cadre of rising-star investigators, including Sameer Agnihotri, PhD, Gary Kohanbash, PhD, Baoli Hu, PhD, and Antony MichealRaj, PhD. These activities build upon the division's existing strength in experimental therapeutics and immunobiology, with a goal of developing the next generations of precision-medicine-based clinical trials.

Patients with vascular anomalies such as aneurysms, arteriovenous malformations, cavernous malformations, and moyamoya syndrome are managed by Dr. Greene, the director of vascular neurosurgery at CHP. The Neurovascular Center of Excellence was founded by Dr. Greene, together with our pediatric endovascular surgeon, Alhamza Al-Bayati, MD, in 2022. This multidisciplinary center provides comprehensive care for children with cerebrovascular anomalies, allowing for experts in related specialties to work together to recommend the best, most comprehensive, plan of care for individual patients. Select patients undergo further evaluation at the department's Center for Image-Guided Neurosurgery for possible radiosurgical treatment;

angiography by our endovascular neurosurgical team led by Dr. Al-Bayati for further definition of anomalies and possible embolization of feeding vessels to reduce blood flow to a malformation; and assessment by our vascular neurologists for management of seizures, dystonia, and neurologic deficits that may be identified during the course of the evaluation process. The center also includes experts in genetics, hematology,cardiology, connective tissue disorders, physical medicine and rehabilitation, neuroradiology, and neuropsychology. The center welcomes patients from around the country, and is one of the few such centers in the United States. The members of the center are well-published in pediatric neurovascular disease. Several clinical and translational research studies are underway, including a prospective clinical study on vein of Galen malformations, and laboratory projects analyzing genetic mutations in pediatric arteriovenous malformations and cavernous malformations. Patients with vascular problems involving more than one organ system, or those with syndromes such as Sturge-Weber, hereditary hemorrhagic telangiectasia or PHACES, are seen in the multidisciplinary Vascular Anomalies Clinic, one of the largest clinics of its kind in the country.

The Pediatric Epilepsy Surgery Program, led by Dr. Abel, is the only center in the region able to provide comprehensive epilepsy surgery evaluation and performs more than 120 epilepsy surgeries each year. A comprehensive pre-surgical evaluation, using state-of-the-art neuroimaging and electrophysiology resources, is performed to identify the specific site in the brain causing seizures and to determine its relationship to important functional areas of the brain. Patients with focal epilepsy can be treated with the full range of treatment options including lesionectomy, cortical resection, lobar resection, or hemispheric disconnection—with or without a period of direct cortical recordings (i.e., SEEG or subdural grid electrodes) to elucidate epileptic cortex. The surgical epilepsy program is equipped with both a ROSA robot and O-Arm intraoperative CT scanner, which enables frameless robot-assisted SEEG implantation. Approaches are tailored to minimize the use of craniotomies when possible. The program is one of the highest volume centers for MR-guided laser ablation in North America. Direct cortical modulation with responsive neural stimulation (RNS) is also available when the seizure focus involves eloquent cortex. For children with drug-resistant multi-focal or generalized epilepsy, all available palliative procedures are available, including vagus nerve stimulation and deep brain stimulation. A multidisciplinary epilepsy surgery clinic provides streamlined, comprehensive evaluation of children with drug-resistant epilepsy for surgery.

Dr. Abel's basic research program focuses on understanding the neural basis of voice and speech perception. This effort is funded by multiple federal grants, including an R01 and R21. The epilepsy surgery program's clinical research efforts, also directed by Dr. Abel, focus on comparative effectiveness of different epilepsy surgery strategies, and is funded by both PCORI and industry.

The program is also involved in cutting edge clinical and basic research focused on developing and applying new and improved treatments for children with movement disorders. Dr. Kellogg manages this aspect of the practice and participates in The Spasticity and Movement Disorders Clinic that is held weekly. This clinic is made up of a team of pediatric medical professionals who specialize in the comprehensive, multidisciplinary evaluation and treatment of children and young adults with spasticity and other movement disorders, such as cerebral palsy, spasticity, dystonia, chorea, athetosis and tremor. The purpose of the clinic is to determine whether a patient would benefit from treatment with oral medications, intrathecal baclofen, selective dorsal rhizotomy, intramuscular botox injection, deep brain stimulation, orthopedic procedures, or other therapies. Additionally, the division offers intraventricular baclofen pumps, which is a therapy pioneered at CHP by A. Leland Albright, MD, that has been revived with the addition of Dr. Kellogg. With the ROSA robot and O-Arm, asleep frameless stereotactic deep brain stimulation is available for children with dystonia and other movement disorders requiring neuromodulation.

The division is an integral collaborator in the Cleft-Palate and Craniofacial Center in the management of children with craniofacial disorders. Because children with complex craniosynostosis often require a staged approach to the treatment of their cranial, mid-facial and lower facial deformities, close multidisciplinary follow-up is maintained throughout childhood and adolescence to optimize long-term functional and cosmetic outcome. The center offers a panoply of surgical options, ranging from innovative endoscopic techniques that have been refined at CHP, as well as a broad range of open approaches carefully tailored to the child's anatomy.

The division is actively involved in the Brain Trauma Research Program, the Fetal Diagnosis and Treatment Center, the Vascular Anomalies Center and the Brachial Plexus Program. In conjunction with a team of specialists at UPMC Magee-Womens Hospital, Dr. Greene has established a program to treat babies with myelomeningocele, or open spina bifida, with *in utero* surgery here in Pittsburgh. Babies who are not candidates for *in utero* surgery undergo conventional closure of the defect within several days of birth. These children are seen throughout childhood by a multidisciplinary team of medical professionals in the Spina Bifida Clinic at Children's Hospital, one of the largest such clinics in the country. Expectant mothers are referred by the Fetal Diagnosis and Treatment Center at UPMC Magee-Womens Hospital for counseling in the pediatric neurosurgery clinic if prenatal imaging reveals a potential neurosurgical abnormality. Dr. Greene has been collaborating with maternal-fetal medicine experts at UPMC Magee-Womens Hospital and bioengineers as a PI on multiple grants to create a medical device for use in the in utero treatment of congenital aqueductal stenosis, a common cause of hydrocephalus.

The Brachial Plexus Birth Injury Clinic—run through the division of pediatric plastic surgery—manages infants with birth injuries to the brachial plexus in a collaborative fashion with specialists from neurosurgery, plastic surgery, orthopedic surgery, and physical and occupational therapy. UPMC Children's Hospital of Pittsburgh is one of a handful of centers in the country that have a dedicated multidisciplinary clinic for these patients and is the only such program in the region. Older patients with peripheral nerve tumors or injuries are seen by Dr. Greene independently of the Brachial Plexus Birth Injury Clinic.

UPMC Children's Hospital of Pittsburgh is a member of the Hydrocephalus Clinical Research Network, a group of 11 premier pediatric neurosurgical departments in North America that are dedicated to designing and undertaking field-changing prospective research into pediatric hydrocephalus. In addition, CHP is also a member institution in the Park-Reeves Syringomyelia Research Consortium, a group dedicated to solving important clinical problems within the realm of Chiari malformation and syringomyelia. These efforts have led to dozens of publications that have helped to advance the field in collaboration with other consortium sites.

In recent years, the division has added Dr. McDowell to our team, who brings particular expertise in the management of cranial base anomalies after completing both endoscopic cranial base and pediatric neurosurgical fellowships. With this unique combination of skill sets, he leads the pediatric initiatives of the internationally acclaimed UPMC Center for Cranial Base Surgery in order to provide unmatchable care for disorders of the pituitary gland, skull base, and craniocervical junction. Dr. McDowell also brings research expertise in near infrared spectroscopy (NIRS) as a noninvasive way of monitoring brain function and intracranial pressure. He recently received the 2021 Hydrocephalus Association Award for his groundbreaking work that may soon have wide-reaching applications for disorders of intracranial pressure include trauma, Chiari malformation, craniosynostosis, and hydrocephalus. A large-scale clinical trial is underway to validate this technology in children and adults with neurosurgical conditions.

Together, the increased complement of neurosurgeons, supported by six full-time advanced practice providers, has enabled expansion of the division's outreach program to multiple com-

munities beyond our immediate geographic area, combined with an extensive telemedicine presence. Our research initiatives are also supported by four full-time research coordinators, allowing us to maintain a broad array of clinical studies to place our site on the cutting edge of Pediatric Neurosurgery patient care, while advancing the field in general.

Finally, our division members maintain an active role in organized neurosurgery and allied fields. In addition to his consortium involvement, Dr. Pollack has served as immediate past-chair of the American Board of Pediatric Neurosurgery and is currently chair of its nominating committee, a director on the Accreditation Council for Pediatric Neurosurgical Fellowships, and a principal investigator with the Children's Brain Tumor Network. Dr. Greene serves on the editorial board of the premier journal in the field, *Journal of Neurosurgery: Pediatrics*, and is the chair of the Traveling Fellowship SubCommittee of the Education Committee of the AANS/CNS Section on Pediatric Neurosurgery. She is a member of the AANS/CNS Joint Section Executive Committee. As the fellowship director at CHP, Dr. Greene is on the American Board of Pediatric Neurological Surgeons Fellowship committee and is a regular guest examiner for the American Board of Neurological Surgeons oral board examination. She is the only neurosurgical member of the North American Fetal Therapy Network (NAFTNet) Steering Committee and is a member of the National Spina Bifida Patient Registry Coordinating Committee. Dr. Abel serves on multiple committees in the American Epilepsy Society and AANS/CNS Section on Pediatric Neurosurgery, including the AES Membership Council, the AES Neurosurgery Task Force, and is the founding chair of the AES Early Career Committee. Dr. Abel also serves on the AANS/CNS Joint Guidelines Committee. Dr. McDowell is the chair of the Industry Relations Committee of the AANS/CNS Section on Pediatric Neurosurgery and the course director of the acclaimed "Brain and Blade" course for pre-clinical medical students, for which he was awarded the 2021 University of Pittsburgh Dean's Distinguished Teaching Award.

Pituitary Center

Over the last few decades, there has been a dramatic shift in the standard of care for pituitary surgery with the introduction of endoscopic techniques. The UPMC Center for Skull Base Surgery has been a pioneer and leader in the development of these techniques and has performed over 4,000 endoscopic endonasal skull base procedures. Since the introduction of the endoscopic endonasal approach, more than 1,400 pituitary surgeries have been performed at the UPMC Pituitary Center, and our surgical team, consisting of Paul Gardner, MD, and Georgios Zenonos, MD, from neurosurgery, and Carl Snyderman, MD, MBA, and Eric Wang, MD, from otolaryngology, currently performs more than 100 operations for pituitary tumors every year. The Pituitary Center is led by a dedicated neuro-endocrinology team of Pouneh K. Fazeli, MD, (director), Hussain Mahmud, MD, and Esra Karslioglu-French, MD who specialize in the medical treatment of patients with pituitary tumors and pituitary-related hormone deficiencies or over-production.

Numerous studies now show better outcomes and lower complication rates in centers with more experienced pituitary surgeons. This experience–outcome effect is likely more pronounced in complex cases such as invasive adenomas, reoperations for recurrent adenomas, giant pituitary adenomas, Cushing's disease, and acromegaly.

As a result, the Pituitary Society has proposed consensus criteria for pituitary centers of excellence (PCOEs), including a baseline requirement of 50 surgical cases per year. In addition, multidisciplinary care via a center of excellence model has been espoused and its advantages well described, even leading to a call for accreditation for PCOEs. Based on the above, combined with UPMC's long-standing expertise and major role in the development of endoscopic pituitary surgery, it is logical that UPMC create a system-wide pathway of care for pituitary tumors. This has led to formation of official pituitary center of excellence criteria within UPMC and recognition of COE status for our skull base center surgeons. In addition, in conjunction with co-surgeon/pedi-

atric neurosurgeons, the Center for Skull Base Surgery is the only group with expertise in pediatric skull base surgery and performs pediatric pituitary surgeries at UPMC Children's Hospital of Pittsburgh in collaboration with pediatric tumor neurosurgical specialist, Michael McDowell, MD.

All physicians on the current pituitary COE team are subspecialty trained. The UPMC Pituitary Center is a multidisciplinary team which includes: neurosurgery, endocrinology, otolaryngology, neuro-ophthalmology, neuroradiology/head and neck radiology, endovascular neurosurgery, radiation oncology (including Gamma Knife radiosurgery), neuroanesthesia, neuro-oncology, and neuropathology. As one of the leading centers for pituitary tumors worldwide, our triple mission is to provide comprehensive care and support to patients with pituitary disorders; to provide residency and fellowship training, as well as continuing medical education in the management of pituitary and neuroendocrine disease; and to contribute to basic science and clinical research in pituitary disorders. As a result of this collaboration, UPMC has become a regional, national and international center for referral.

Spine Services Division

The Neurosurgical Spine Services Division at the University of Pittsburgh is a multidisciplinary organization composed of specialists in the fields of physical therapy, physical medicine and rehabilitation, interventional neuroradiology and neurological spine surgery. Specialists from these fields work together as a unified group to provide the highest quality care for patients and athletes who have spine injuries, painful disc conditions, neck, arm, back or leg pain.

D. Kojo Hamilton, MD, is the director of the Neurosurgical Spine Services Division and chief of spine at UPMC Presbyterian. David O. Okonkwo, MD, PhD, leads the spine trauma and spinal deformity program and Dr. Hamilton provides specialty care in the treatment of cervical misalignment and spinal deformity. Peter C. Gerszten, MD, MPH, leads the percutaneous and spine radiosurgery programs. Thomas J. Buell, MD, joined the division in 2022 with an expertise in complex spine deformity cases and spine oncological surgery. Nitin Agarwal, MD, joined the division in 2023 and leads the division's minimally invasive spine and robotics surgery program.

The Neurosurgical Spine Services Division offers comprehensive care for all types of spinal disorders, including degenerative, traumatic, and oncologic conditions. The initial treatment approach is typically non-surgical, with surgical options reserved for patients with recurrent or disabling symptoms and/or progressive deficits. Complete diagnostic testing of all spinal and nerve disorders is available through the center.

The spinal deformity program, led by Dr. Okonkwo, offers full-scale analysis, longitudinal tracking and treatment interventions for patients with scoliosis and thoracolumbar spinal deformity. The team of deformity practitioners continues to push the surgical envelope and combines unique skill sets to provide each and every patient with the least invasive yet maximally effective treatment options.

Dr. Hamilton correspondingly treats complex cervical deformity, such as swan neck and chin-on-chest disorders, in addition to thoracolumbar scoliosis, oncologic and degenerative spine conditions. Dr. Buell, who completed advanced training in complex spine surgery at the University of Virginia and Duke University, is a prolific academician poised to make significant contributions to this subspecialty.

The spine radiosurgery program, led by Dr. Gerszten, is one of the most experienced centers in the world in treating a wide variety of benign and malignant spine and paraspinal tumors that has proven highly effective, safe, and painless, and avoids many of the risks associated with open surgery.

Within the division is the Center for Surgical Pain Management led by John J. Moossy, MD. This program provides a variety of surgical options for the management of medically intractable pain syndromes. The range of treatment varies from neuroaugmentation (i.e., spinal cord stimulation and intrathecal opioids) to surgical decompression (with or without spinal fusion) to ablative neurosurgery.

The Neurosurgical Spine Services Division works together as a unified team, utilizing a multidisciplinary approach to maximize patient care and outcomes. An array of research studies and protocols are employed to deliver unsurpassed treatment strategies, ensuring that patients receive the best state-of-the-art care in the country.

Accomplishments and Highlights for Fiscal Year 2022-23

July 2022

- Division administrator Desiree Playso-Doyle and UPMC systems analyst Michaela Lionetti received the second place Presby Patient Satisfaction Award at the UPMC Quality and Safety Fair for their Neurosurgery Imaging Portal Project.
- Shawn Eagle, MD, was a guest on the *Monarch Human Performance* podcast talking about the current state and future of traumatic brain injury research.

August 2022

- Joseph Maroon, MD, took first place in his age group in the Chicago Sprint Triathlon with a time of 2h:25m. This is also the first race he competed with his 27 year-old daughter, Isabella, who finished with a time of 1h:48m.

- Ava Puccio, PhD, was promoted to associate professor.

September 2022

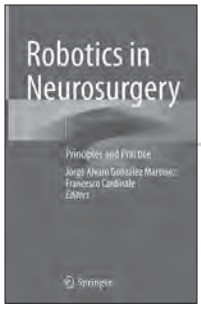
- Michael McDowell, MD, was featured on WTAE-TV discussing the care and recovery a nine-year-old girl who was recovering from a near-fatal atlantooccipital dislocation of the top of the neck from the bottom of the skull.
- Resident Kamil Nowicki, MD, PhD, and department chair Robert Friedlander, MD, along with third-year University of Pittsburgh med student, Aditya Mittal were awarded a $30,000 pilot grant from the University of Pittsburgh's Clinical and Translational Science Institute (CTSI) for a project to create a blood test—Cerebral Aneurysm Test 7—to detect cerebral aneurysm formation.

- L. Dade Lunsford, MD, was selected to receive the Allen Humphrey Excellence in Mentoring Award from the University of Pittsburgh. The award is presented to a Deans Summer Research (DSRP) mentor who has demonstrated exemplary care and commitment in all aspects of DSRP student mentoring
- Congratulations to Aditya Mittal—med student in Robert Friedlander, MD, lab—who received a 2022 Humanity in Action Racial Equity Grant for his work focusing on disparities and differences in inflammatory aneurysm formation and detection in women and minorities.
- Resident Arka Mallela, MD, was selected as a 2022 American Epilepsy Society fellow.

- Robert Friedlander, MD, participated in a special 'fireside chat' with CNN medical correspondent Sanjay Gupta, MD, at the 2022 Global Manufacturing & Industrialization International Summit in Pittsburgh discussing a variety of medical issues including COVID, brain health, and the Havana Syndrome. Dr. Friedlander also was featured in UPMC social media posts saluting outstanding employees with Hispanic backgrounds during Hispanic Heritage Month.
- Fang-Cheng (Frank) Yeh, PhD, was promoted to associate professor.

October 2022

- Xiaoran (Zel) Zhang, MD, received the best resident presentation award at the 16th Annual Stuart Rowe Society Lectureship and Resident Research Day. Hussam Abou-Al-Shaar, MD, and Kamil Nowicki, MD, PhD, also received awards.



- Robert Friedlander, MD, was featured on WPXI-TV 'Our Region's Business' segment discussing the latest advances in neurosurgery and the extensive scope of neurosurgical care at UPMC.
- *Robotics in Neurosurgery: Principles and Practice*, a review of the basic applications, technical challenges and practical solutions of robotic surgery in the field of neurosurgery, co-authored by Jorge González-Martínez, MD, PhD, was published by Springer.
- Marco Capogrosso, PhD, was awarded a five-year, $8 million grant from the National Institutes of Health (NIH) Brain Research Through Advancing Innovative Neurotechologies® (BRAIN) Initiative to design and test a system for the electrical neurostimulation of the cervical spinal cord to reduce arm and hand motor impairments in people with severe stroke. Peter Gerszten, MD, MPH, is a co-investigator in the research.
- Leading stereotactic radiosurgery and surgical neuro-oncologist Costas Hadjipanayis, MD, PhD, joined the University of Pittsburgh Department of Neurological Surgery as a successor to neurosurgery icon L. Dade Lunsford, MD, directing the department's UPMC Center for Image-Guided Neurosurgery. Dr. Hadjipanayis will also serve as co-director of the newly formed UPMC Brain Tumor Center and director of the Brain Tumor Nanotechnology Laboratory, both at the UPMC Hillman Cancer Center. He will also serve as executive vice-chair for the department.

- Sameer Agnihotri, MD, received the 2022 Hillman Cancer Junior Scholar Award for his meritorious work in translational cancer research.

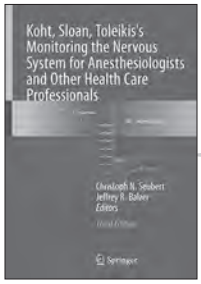
November 2022

- Kristen Thompson, PA-C, physician assistant with the UPMC Children's Hospital of Pittsburgh Division of Pediatric Neurosurgery, was recognized as the UPMC 2022 Advanced Practice Provider of the Year. Kristen was chosen from over 4,000 APPs across the health center for this honor.

- Resident Daryl P. Fields, MD, PhD, received the inaugural LiveLikeLou Foundation (LLLF) Post-Doctoral Fellowship, a two-year $150,000 grant to fund his amyotrophic lateral sclerosis (ALS) research project studying spinal cord stimulation in the treatment of motor deficits

December 2022

- Robert Friedlander, MD, and the Clear Thoughts Foundation were featured in a WPXI-TV story on a Pittsburgh family working to cure dementia nearly 10 years after their father's death.
- The Center for Image-Guided Neurosurgery treated their 18,000th patient using the groundbreaking Leksell Gamma Knife stereotactic radiosurgery procedure. First introduced in North America in 1987 at then Presbyterian University Hospital by L. Dade Lunsford, MD, the Gamma Knife pioneered minimally invasive stereotactic radiosurgery, providing a single-day outpatient strategy for a wide variety of vascular, tumor, pain and abnormal movement indications.



- *Koht, Sloan, Toleikis's Monitoring the Nervous System for Anesthesiologists and Other Health Care Professionals*, a completely revised third edition essential resource on intraoperative neurophysiological monitoring, co-authored by Jeff Balzer, PhD, was published by Springer.
- Taylor Abel, MD, and Bradley Gross, MD, were promoted to associate professor.

- David Okonkwo, MD, PhD, appeared on the *Neurosurgery Podcast* to explain why urgent surgical decompression for spinal cord injury shouldn't be a debate, and how UPMC is taking steps to accelerate care.

January 2023

- Joseph Maroon, MD, was featured in a CNBC.com article that discussed his six-step method to living a long, healthy life.

- Fourteen University of Pittsburgh neurosurgeons were named among the top doctors in the field of neurological surgery in a national survey conducted by Castle Connolly, an independent research group with the stated mission of helping people find the best in healthcare. The list included Brad Bellotte, MD; Matt El-Kadi, MD, PhD, Robert M. Friedlander, MD; Paul A. Gardner, MD; Peter C. Gerszten, MD; Jorge A. González-Martínez, MD, PhD; Stephanie Greene, MD; Costas G. Hadjipanayis, MD, PhD; D. Kojo Hamilton, MD; L. Dade Lunsford, MD; Vincent J. Miele, MD; David O. Okonkwo, MD, PhD; Ian F. Pollack, MD; and Daniel A. Wecht, MD, MSc.

- Sameer Agnihotri, PhD was one of five researchers receiving a prestigious Distinguished Scientist Award from the Sontag Foundation, the largest funder of brain cancer research in North America.

- In a paper published in *Nature Cell Biology*, physician-scientists from the University of Pittsburgh and UPMC Children's Hospital of Pittsburgh discovered that medulloblastomas hijack a skill that normal brain cells use during their early development to help tumors metastasize. Developing drugs that can dismantle tumor cells to obtain this capability might pave the way for new and effective treatments. Baoli Hu, PhD, was senior author on the study.

- A study published in the *Journal of Neurophysiology*, suggests that voice and face recognition are linked even more intimately than previously thought. It offers an intriguing possibility that visual and auditory information relevant to identifying someone feeds into a common brain center, allowing for more robust, well-rounded recognition by integrating separate modes of sensation. Taylor Abel, MD, was senior author on the study.

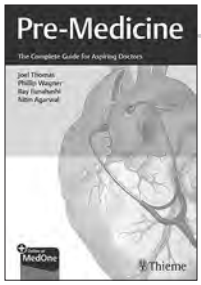
- A patient of Paul Gardner, MD, was featured on *Global Edmonton TV*, discussing her trip to Pittsburgh for specialized endonasal treatment for a rare brain tumor.

February 2023

- Taylor Abel, MD, was awarded the Donald S. Fraley Medical Student Mentoring Award from the University of Pittsburgh School of Medicine.

- Researchers from the University of Pittsburgh—including Marco Capogrosso, MD, and Peter Gerszten, MD—and Carnegie Mellon University reported in *Nature Medicine* on a neurotechnology that stimulates the spinal cord and improves arm and hand mobility, enabling people affected by moderate to severe stroke to conduct their normal daily activities more easily. The study received wide-spread international media attention including the BBC, *Wall Street Journal, USA Today, New York Times*, CNN and National Public Radio.

- Spine surgery specialist and neurosurgery education advocate Nitin Agarwal, MD, joined the department as an associate professor and director of the department's Minimally Invasive Spine and Robotics Surgery program. A 2021 graduate of the department's residency program, Dr. Agarwal will also work closely with the department's residency program director, D. Kojo Hamilton, MD, as the program's associate director.



- *Pre-Medicine: The Complete Guide for Aspiring Doctors*, a comprehensive resource for students considering a career in medicine, co-authored by Nitin Agarwal, MD, was published by Thieme.

March 2023

- Hussein Abdallah, MD; Stephanie Casillo, MD; Albin John, MD; and Oliver Tang, MD, matched into the UPMC/University of Pittsburgh neurological surgery residency program.
- Robert Friedlander, MD, was featured in a UPMC Life Changing Medicine commercial conveying the message, "The culture of innovation is one that we strive for."
- Jorge González-Martínez, MD, PhD, was featured in a *UPMC Physician Journal* video that talked about the latest advances in novel surgical methods for treating epilepsy.

- Stephanie Greene, MD, was selected as one of the Exceptional Women in Medicine for 2023 by Castle Connolly Top Doctors. Dr. Greene was also a guest on the *That's Pediatrics* podcast discussing the innovative fetal neurosurgery and pediatric neurovascular surgery programs at UPMC Children's Hospital of Pittsburgh.
- Daniel Rivera—med student in Costas Hadjipanayis, MD, PhD, lab—received a scholar-in-training award by the Society for Thermal Medicine for work evaluating magnetic hyperthermia therapy as an adjuvant to chemotherapy and radiation for the treatment of glioblastoma.
- Joseph Maroon, MD was the honored guest speaker at the 2023 Spine Summit in Miami, Fla., providing a talk on his 40-year career of caring for elite athletes.

April 2023

- Resident Daryl P. Fields II, MD, PhD, won one of two best clinical science poster awards at the 21st Annual Richard L. Simmons Research Day sponsored by the University of Pittsburgh Department of Surgery.

- Costas Hadjipanayis, MD, PhD, and chief resident Justiss Kallos, MD, performed the first tumor resection in the world using the new voice-controlled, robotic-assisted SynaptiveMed MODUS X surgical exoscope with fluorescence-guided surgery visualization.
- Residents Arka Mallela, MD; Joseph Garcia, MD; and Hussam Abou-Al-Shaar, MD, received presentation awards at the 2023 American Association of Neurological Surgeons annual meeting in Los Angeles. Mallela received the Stryker CNS Tumor Award; Garcia received the Cerebrovascular Section Best Basic Scientific Paper Abstract Award; and Abou-Al-Shaar received the Lunsford & Leksell Radiosurgery Award.

May 2023

- Resident Prateek Agarwal, MD, was selected as a Council of State Neurosurgical Societies socioeconomic fellow for the 2023-24 term.

- Joseph Maroon, MD, helped launch the National Sports Brain Bank at the University of Pittsburgh. The research bank is set up to study head trauma specific to athletes and its relationship to chronic traumatic encephalopathy (CTE). The announcement of the launch received media attention across the country including in the *New York Times* and *Forbes Magazine*.
- Peter Gerszten, MD, and patient were featured in a WTAE-TV story on a first-of-its-kind collaborative study with Marco Capogrosso, MD, and Carnegie Mellon's Doug Weber that uses electrodes to restore stroke patients' mobility.

- Stephanie Greene, MD, and the Department of Neurology's Alhamza Al-Bayati, MD, were featured on WDTV-TV (Bridgeport W.Va.) discussing the advanced, multi-disciplinary work done at the UPMC Children's Hospital of Pittsburgh Neurovascular Center.

- UPMC Williamsport neurosurgeon Fadi Sweiss, MD, was selected by the Pennsylvania Medical Society as one of the top state physicians under 40. Recipients were nominated by colleagues and selected by a committee of PMS member physicians.
- Nitin Agarwal, MD, was featured in Thieme International's celebration of Asian Americans and Pacific Islanders in education, research and medicine.
- Melissa Lukehart was recognized at the Society of Neurological Surgeons annual meeting for her 25+ years of service as program administrator for the University of Pittsburgh/UPMC neurosurgery residency program.

June 2023

- Robert Friedlander, MD, was a guest on the AANS *Practice and Business Management* podcast, discussing career strategies in neurosurgery and managing the largest academic neurosurgery program in the U.S.

- Jorge A. González-Martínez, MD, PhD, was named the inaugural Stuart Niles Rowe Endowed Chair in Neurosurgery at the University of Pittsburgh. The chair is named in honor of Stuart Niles Rowe, MD, widely considered the founding father of neurosurgery and neurosurgery training in Pittsburgh.
- In a paper published in *ACS Chemical Neuroscience* researchers identified a potential biomarker for early screening of Alzheimer's disease (AD), possibly allowing physicians to identify those at significant risk for the disease and potentially offering early therapeutic treatment options. Joseph Maroon, MD, collaborated with Pravat Mandal, PhD, on the study.

- A paper authored by resident Hansen Deng, MD—"Time to Follow Commands in Severe Traumatic Brain Injury Survivors With Favorable Recovery at 2 Years"—was selected as the 2023 Neurotrauma and Critical Care Paper of the Year by the Congress of Neurological Surgeons.

Education Programs

The Department of Neurological Surgery provides medical education in a wide variety of forums at UPMC and the University of Pittsburgh. The faculty contributes to undergraduate and graduate-level education at many sites and to the continuing education of their professional colleagues.

Undergraduate Level
Selected faculty of the Department of Neurological Surgery participate in several undergraduate courses at the University of Pittsburgh. In addition, undergraduate students are offered shadowing opportunities with various faculty members while they evaluate and operate on patients at UPMC. To qualify, an undergraduate student must obtain faculty permission and complete online training courses related to patient confidentiality. Medical students often round with the evening-on-call neurosurgery resident at UPMC Presbyterian in order to get real-life observations of the types of clinical problems encountered, as well as insights into the life of a neurosurgery resident.

Medical Students
Department faculty participate in teaching clinical neuroscience and neuroanatomy to first- and second-year medical students. Several Pitt medical students spend elective time doing clinical research with faculty members from various centers in the department. During their surgery core clerkship, third-year medical students may elect to take a two-week introductory subspecialty experience in neurosurgery.

Selective fourth-year medical students at the University of Pittsburgh, as well as visiting medical students from other schools, may elect to take a four-week clinical subinternship on the neurosurgery services at UPMC, during which they participate in all phases of the training program as well as in supervised patient care services. Typically, each four-week rotation includes experience on cranial, spinal and pediatric neurosurgery.

• Visiting Medical Students
The Department of Neurological Surgery at the University of Pittsburgh Medical Center offers a clinical elective that is open to enrolled fourth-year medical students in good academic standing at any U.S. medical school. Students who have completed their core clinical training and will be in the fourth year of medical education at their LCME- or AOA-accredited home institution in North America may apply for an elective through the Visiting Student Learning Opportunities (VSLO) program. Elective rotations (subinternships) are four weeks in length.

• Clerkships
One-month clerkships offered to senior medical students from other medical schools attract 10-20 students each year. In their senior year selective students may participate in ongoing research projects in the Department of Neurological Surgery under the supervision of an advisor. This experience trains students in basic or clinical neurosurgical research techniques and procedures and offers in-depth education in basic neurosciences. Other medical students seek a more formal and longitudinal exposure to neurosurgical investigation, and complete an approved scholarly project. Pitt medical students often use this educational opportunity as the base for their required graduation scholarly project.

• Pitt Med Neurosurgery Interest Group
The Neurosurgery Interest Group (NSIG) at the University of Pittsburgh School of Medicine is devoted to fostering an interest in the exciting field of neurological surgery. The group connects medical students to key resources in the Department of Neurological Surgery and provides opportunities to shadow, conduct cutting-edge research, and network with the department. Mentoring from several senior residents in our program helps to stimulate interest in the field.

Under the direction of senior residents and participating faculty, the department offers focused lectures and demonstrations on neurosurgical topics to Pitt medical students. The goal is to provide a background of the current advances in neurosurgery to prospective students interested in a neurosurgical career.

Residency Program

The UPMC Department of Neurological Surgery offers a seven-year (PGY 1-7) residency program that is internationally renowned as a training ground for exceptional neurosurgeons. Accredited by the UPMC Graduate Medical Education Council, as well as the Accreditation Council on Graduate Medical Education (ACGME), the program is currently approved to train 28 residents, four each year (29 residents until June 30, 2025). The goal of the program is to provide exceptional clinical and scientific education to top-notch graduates of medical schools who wish to be future leaders in the field of neurological surgery. The program focuses on training to maximize medical knowledge, build patient care skills, and provide for practice based and systems-based learning. The department stresses professionalism as well as interpersonal and communication skills, and relies heavily on both inpatient and outpatient use of informatics.

The University of Pittsburgh Department of Neurological Surgery—which can trace its roots to 1936 and has offered a residency training program dating back to the late 1940s—has always stressed a strong commitment to patient care, education and research. Today, the department is the largest neurosurgical academic provider in the United States, performing over 9,000 major procedures annually system-wide, the majority of which are performed at our academic hospitals of UPMC Presbyterian, UPMC Shadyside, UPMC Mercy, UPMC Children's Hospital of Pittsburgh and the VA Pittsburgh Healthcare System, University Drive.

An article published in *USA Today* in February of 2018, ranked the University of Pittsburgh neurological surgery residency program as one of the top five programs in the country, citing the "advanced technology and focus on innovation" available here. In a ranking published in Becker's Spine Review in August of 2018, our program was ranked among the top five in the country based on a peer-rated, review-based survey.

A 2015 study published in the *Journal of Neurosurgery* showed that our department ranked among the top five neurosurgical residency programs in the country in terms of academic publishing output of faculty. Another Journal of Neurosurgery article showed that our department ranked as the most productive residency program in the nation in terms of graduates remaining and contributing to academic neurosurgery.

In 2018, the department completed a 50-year retrospective assessment of training at our program, published in the *Journal of Neurosurgery*. In each decade, beginning in 1971, we looked at admitted residents and finishing residents, tracking any changes in professional or behavioral events during training. We surveyed 98 graduates and analyzed the data in 76% who completed the survey. This study does not indicate that residents have changed in any significant way over these 50 years. The vast majority of resident graduates express satisfaction with their career choice and its overall positive impact on their families.

More than eighty years at the forefront of neurosurgical care have demonstrated that we are a proven international leader in patient care, research and training. Resident performance and tracking is performed twice per year using the ACGME Milestones project.

• PGY-1

Residency training at the department begins with the first-year experience. PGY-1 residents who enter the field as novices in neurosurgery will rotate on the neurosurgical, critical care medicine,

and neuropathology services. The first year of training is critically evaluated to optimize the introductory experience in neurosurgery. It is designed to optimize performance for the next year, when full integration into patient care teams is accomplished. The United States Medical Licensing Examination Step 3 is expected to be completed during the PGY-1 year. Residents may also have the opportunity to participate in a practice run of the written board examination (American Board of Neurological Surgery) during the PGY-1 to PGY-3 years.

• PGY-2

The PGY-2 year represents an in-depth introductory year to clinical neurosurgery and emphasizes critical care, basic operative techniques, and initial clinical decision making. The department emphasizes the importance of the flow of information and communication between residents, senior residents and responsible faculty. PGY-2 residents routinely spend a block of three months on the cranial service, three months at UPMC Mercy, three months on the neurooncology service (UPMC Shadyside), and three months on the trauma service.

Most junior residents participate in more than 250 neurosurgical procedures during their first year. PGY-2 residents will complete basic training in many procedures, such as lumbar puncture, external ventricular drain placement, intracranial pressure monitor insertions and placement of cerebral blood flow technologies such as Licox tissue oxygenation monitors. Initial case experience includes the selection and identification of patients who will undergo craniotomy, routine spinal procedures and trauma cases.

Clinical judgment is enhanced by spending an average of one day per week in the physician outpatient office. Numerous mid-level providers, including physician assistants and nurse practitioners, provide support both on the hospital floors and in the outpatient clinics.

• PGY-3

The PGY-3 year emphasizes clinical experience in brain and spinal surgery including vascular neurosurgery (an initial intro to endovascular and open vascular techniques), image-guided surgery, functional neurosurgery, and pediatric service (UPMC Children's Hospital of Pittsburgh).

Attendance at a training course in stereotactic radiosurgery, as well as initial experience in movement disorder, pain surgery and neuro-oncological surgery are obtained during this year. Each fall, PGY-3 residents also attend the annual Research Update in Neuroscience for Neurosurgeons (RUNN) course at Woods Hole, Mass. This course provides an update on exciting developments in neuroscience and is intended to catalyze residents to pursue neuroscience basic or clinical research.

• PGY-4

In the PGY-4 year, senior residents in neurological surgery will gain additional critical experience in multiple cranial and spinal cases in order to reach the next set of milestones in their education. Consolidation of medical knowledge, enhanced patient care skills and intense practice-based learning will occur in this year. During this time, residents take the ABNS written board examination for self-assessment/or credit. PGY-4 residents spend a significant portion of their time in the operating room. Increasingly difficult procedures are assigned to senior residents and include complex spinal procedures with instrumentation, craniotomies for intra-axial tumors, meningiomas and posterior fossa surgery. Residents spend nine months on the adult service and three months as senior resident on the pediatric service. Typically, a senior resident participates in between 400 and 500 cases per year.

• PGY-5

The PGY-5 block provides a total of nine months of focused career development opportunities for senior residents. During this time, residents will spend three months as the chief resident at the VA Pittsburgh Healthcare System where they will gain additional surgical and service management skills. During this time, residents take the ABNS training exam for credit. All residents must pass the exam in order to graduate. The departmental target goal is a performance on the written boards at or above the 50th percentile.

The remaining time is flexibly designed for residents to actively pursue clinical or research-focused subspecialty training, along with investigations on topics that will eventually foster their subsequent career and provide benefit to the future course of neurosurgery. There are two paths for trainees in the PGY-5 block: the Clinical Investigator Path and the Surgeon Scientist Investigator Path:

Clinical Investigator Path:

The clinical investigator path includes a 21-month period of time during the PGY-5 and PGY-6 or PGY-7 years (i.e., residents will complete their chief residency year in PGY-6 or PGY-7 depending on enfolded fellowship plans) for subspecialty training. Residents will identify a primary mentor by the PGY-4 year. The resident in this path must have identified a clinical subspecialty focus that will supplement career development and submit an internal funding grant request (Copeland Grant) on a clinical topic. The resident must complete and submit four to six publications in peer-reviewed journals during this interval of time. Residents also will participate in the Clinical and Translational Science Institute (CTSI) Seminar Series. Residents are expected to present at the AANS (American Association of Neurological Surgeons), CNS (Congress of Neurological Surgeons) or subsection meetings relative to their clinical or scientific work.

Surgeon Scientist Investigator Path:

During this interval of time, residents have 21 months to further develop a preclinical and academic research career working in a functional and dedicated laboratory. Some residents choose to enter one of two NIH T32 postdoctoral research fellowship programs available through the University of Pittsburgh's Department of Anesthesia and Department of Surgery as well as the university's Physician Scientist Incubator Program. This program is designed to train the highest quality biomedical physician investigators, focusing on those with MD degrees with PhD doctoral training, seeking careers involving pre-clinical research.

Residents will identify a primary mentor by their PGY-4 year. Residents in this path are able to submit for national grants using existing mechanisms from the AANS, CNS, NIH, and industry. Residents are expected to submit four to six peer-reviewed journal articles during this time. Residents also will have the opportunity to gain a master of science degree but must begin this process one year in advance. Selected residents who wish to obtain a PhD will be fully evaluated for this opportunity but must dedicate additional blocks of training time after they complete the residency training in order to complete such an advanced degree. All residents are expected to present their work at one or more national scientific meetings. During their PGY-6 year, residents are freed from responsibility from both outpatient and operating room coverage, except for elective and approved moonlighting performed on the UPMC Presbyterian neurological surgery service.

The University of Pittsburgh provides a wide spectrum of faculty mentors and opportunities for research in neurosurgery, neurology, neuroscience, psychiatry, physical medicine and rehabili-

tation, neuro-imaging, neuropathology, bioengineering, public health, and regenerative medicine (McGowan Institute of Regenerative Medicine). Research may be funded from numerous sources, including the Walter Copeland Fund of the department (which is administered by The Pittsburgh Foundation). Residents in the department's program have competed successfully for AANS, CNS and American College of Surgeons grants. All residents are expected to write scientific papers and to supplement this with additional book chapters. Residents are expected to learn the principals of investigation under the supervision of faculty mentors.

Residents at all levels are expected to attend the departmental teaching conferences, which are mandatory. Neurosurgical knowledge is gauged by performance on written boards, as well as by semi-annual written evaluations and meetings. Each year a promotion to the next level of training is determined by the departmental competency review committee.

• PGY-6

PGY-6 residents return to the service as residents on the clinical services at UPMC Presbyterian, UPMC Shadyside, UPMC Mercy, and in selected cases at UPMC Children's Hospital of Pittsburgh. Coverage responsibilities include chief of the cranial service, the spinal service and the trauma service. On average, chief residents perform 400-500 major cases during PGY-6, such as clipping of aneurysms, skull-based tumors, complex spine surgery, and posterior fossa surgery. As future practitioners of neurosurgery, they also learn responsibilities of clinical oversight of the service that they are leading. They serve as primary instructors to the younger residents. By the time of their completion of the chief year, residents often have performed more than 1500 neurosurgical procedures as monitored by the ACGME online Accreditation Data System (ADS) database.

• PGY-7

Completing the case log requirements and skill set acquisition in the PGY-6 year allows residents to pursue subspecialty clinical or research training in their last year of clinical neurosurgery before final graduation in June. Selected enfolded fellowship opportunities exist in spine (CAST approved), skull base, endovascular (CAST approved), and stereotactic-functional (CAST approved) training. For selected residents pursuing the surgeon scientist pathway, further research opportunities as well as mentoring for grant submission can be pursued.

• General

Residents in this program have a particularly unique experience in microneurosurgery, pediatric, endoscopic, image-guided neurosurgery including radiosurgery, and open/endovascular surgery, including a large volume of complex vascular bypass cases. In addition to daily teaching rounds, led by individual members of the department faculty, the department holds a series of weekly resident conferences and review lectures to discuss specific neurosurgical concepts, techniques, problems and solutions. Both faculty and residents are regular participants in these programs, many of which include formal didactic presentations. The training program includes the following faculty/resident conference:

Multidisciplinary Brain Tumor Board (weekly)
Chairman's Conference (twice monthly)
Faculty Teaching Conference (weekly)
Image-Guided/Radiosurgery Conference (weekly)
Written Boards Preparation Conference
Patient Care Conference (weekly)
Pediatric Neurosurgical Conference (twice weekly)
Pituitary Conference (quarterly)
Skull Base Conference (weekly)
Spine Conference (weekly)

Residents' Conference (weekly)
Visiting Professor Series (four to six per year)

The chief residents present the weekly patient care conference. Each resident also presents one or more annual 30-minute lectures on basic neurosurgical topics or recent research. To teach the skills required for the oral boards, several conferences use a board-simulated approach to those cases presented. The visiting professor also reviews interesting cases with the residents and attends a journal club.

Trainees have been extremely productive during their clinical and non-clinical years. They commonly have 10 or more publications in refereed journals and multiple presentations at national meetings by the completion of their residency.

Since 1980, residents in the department have been awarded three Congress of Neurological Surgeons Preuss Awards for brain tumor research, two CNS clinical fellowships, American College of Surgeons research scholarships, the CNS Margot Anderson Foundation Fellowship in Brain Restoration Research, and two CNS Wilder Pen ield Clinical Investigation Fellowships. Six University of Pittsburgh residents have received the Van Wagenen Fellowship, a prestigious award given annually by the American Association of Neurological Surgeons to a North American neurosurgical resident who is graduating that year. At each annual meeting, residents and faculty often receive named awards for their abstract presentations.

Despite the extensive experience in all aspects of brain, spine, and peripheral nerve surgery, some residents elect to complete post-residency fellowships with other prestigious mentors. In particular, residents who wish to have a career focus in pediatric neurosurgery obtain prestigious fellowships at other institutions prior to beginning their neurosurgical careers.

Although the program's focus is on training academic neurosurgeons interested in clinical and basic science research, it has produced many outstanding private practice neurosurgeons as well. Half of the department's graduates in the last 25 years serve as full-time academic faculty members, and 25 percent have clinical affiliations with academic institutions.

• Neurosurgery Residency Research Opportunities
Comprehensive programs in basic science and clinical research are conducted by department faculty along with investigators throughout the university community. Current research projects include:

Animal Models of Epilepsy
Brain Tumor Research
Clinical and Basic Science Head Injury Program
Clinical Outcomes of Radiosurgery
Computer-Image Integration into Surgical Planning
Intracranial Blood Flow and Saccular Aneurysm Formation
Research in Spinal Tumors and Spine Biomechanics
Spasticity
Stem Cells
Studies on Cranial Nerve Disorders
Teleradiography
Viral Vectors in Tumor Management

Basic science and clinical research projects are an integral part of department faculty and trainee activities. Most residents spend 18-24 months working on such projects. Local, regional

and national peer-reviewed funding resources continue to grow and support productive basic and clinical research. Internal funding from the Walter Copeland Fund provides seed money for many unique and fascinating projects undertaken by residents and faculty. In many cases these projects subsequently receive extramural research funding.

• Neurosurgery Residency Special Features

The Department of Neurological Surgery at the University of Pittsburgh has created a unique environment where centers of excellence flourish. The goals are to provide outstanding neurosurgical patient care, to promote education, and to perform clinical and basic science research. This group of dedicated individuals, including faculty, residents, and staff, is one of the most productive departments in the world.

These accomplishments in both patient care and research have resulted in numerous publications. Each year, more than 200 refereed articles, abstracts, proceedings, book chapters, and books are published by this department. The department supports the largest number of neurosurgeons with federally-sponsored funding. Special features include:

Clinical and Laboratory Program for the Surgery of Cranial Nerve Disorders
Comprehensive Spine Surgery Center
Endoscopic Endonasal and Skull Base Surgery
Frameless Stereotactic Equipment (multiple technologies)
Magnetic Resonance Spectroscopy
Microsurgical Laboratory
Microelectrode Recording System
Laboratory for the Development and Evaluation of New Surgical Techniques
Two Gamma Knife Radiosurgical Suites
Spinal Radiosurgery
State-of-the-Art Neuroimaging:
- CT and MRI angiography
- High Definition Fiber Tractography
- Functional MRI, MRS
- Magnetoencephalography
- PET
- MR Research Center

Intraoperative CT Imaging (Dedicated OR Suite)

The coordinator of the department's medical education program is Melissa Lukehart. D. Kojo Hamilton, MD, is the department's residency director. Nitin Agarwal, MD, and L. Dade Lunsford, MD, are associate residency directors.

Teaching Awards

Annual departmental teaching awards are given to the best faculty teacher (selected by the residents) and to the best resident teacher (selected by faculty). For 2022-23, the faculty award was given to Nitin Agarwal, MD, (top). The resident honor was awarded to chief resident Xiaoran (Zel) Zhang, MD (bottom).

Fellowships

The University of Pittsburgh Department of Neurological Surgery has several fellowships including AO Spine and CAST (Committee on Advanced Subspecialty Training) approved fellowships. These fellowships offer advanced training in skull base surgery, endovascular surgery, pediatric neurosurgery, spine neurosurgery, stereotactic radiosurgery, intraoperative neuromonitoring and neurotrauma.

• Complex and Minimally Invasive Spine Deformity Fellowship
Complex and minimally invasive spine fellows are trained for all spinal diseases, degenerative, deformity, oncology and trauma spinal pathologies, with a special emphasis placed on open and minimally invasive techniques to treat adult spinal deformity and complex reconstructive spine surgery. Experience in all disorders of the craniocervical, cervical, thoracic, lumbar and sacral spine is available. The option for additional training in peripheral nerve, sports medicine and spinal stereotactic radiosurgery is available as well.

• Endoscopic and Open Skull Base Fellowship
The skull base fellowship is primarily focused on endoscopic and open skull base work surgery. About half of these cases are endoscopic endonasal surgeries and are performed in conjunction with their otolaryngology colleagues. The remaining cases are various open skull base cases, including lateral skull base approaches with neurotology, vascular and brain tumor procedures, minimally invasive transorbital approaches and some general cranial surgery.

• Endovascular Neurosurgery Fellowship
The endovascular neurosurgery fellowship at UPMC provides exceptional training in the management of complex cerebrovascular disease, with robust endovascular volumes totaling over 2,000 cases per year including over 300 stroke thrombectomies and over 150 aneurysm treatments. Fellows engage in innumerable multicenter ischemic and hemorrhagic disease trials gaining direct exposure and experience.

• Intraoperative Neuromonitoring Fellowship
The intraoperative neuromonitoring fellowship provides exceptional training in interpreting evoked potentials, electroencephalography, electromyography, as well as electrocorticography and cortical mapping during awake craniotomies. Fellows will have opportunities for clinical and translational research and will be well-prepared for careers in intraoperative neuromonitoring

• Neurocritical Care Fellowship
Neurocritical care fellows are part of the intensive care unit's patient care team that also includes Critical Care Medicine faculty, anesthesia and surgical residents and medical students. This collaborative team then develops a single treatment plan based on current evidence-based guidelines and local consensus-based protocols. As the fellows progress through the program, they are expected to take on more of a leadership role in the ICU, leading rounds and making decisions regarding patient care. This culminates in the junior attending rotation, during which faculty allow the fellow significant autonomy and provide feedback on leadership and decision-making skills.

• Neurosurgical Oncology Fellowship
The neurosurgical oncology fellowship is primarily focused on the surgical management of primary and metastatic brain tumors incorporating skull base tumors and spinal oncology. Fellows will have the opportunity to treat brain tumor patients with important technologies such as Gamma Knife stereotactic radiosurgery (SRS) and focused ultrasound. They will also be exposed to novel surgical approaches/treatments that include fluorescence-guided surgery (FGS), laser interstitial thermal therapy (LITT), tumor-related epilepsy surgery, photodynamic therapy, and robotic-assisted exoscope neurosurgery. Awake craniotomy and intraoperative brain mapping techniques (direct and subcortical stimulation) will be an important component of the fellowship.

• Neurotrauma Fellowship
The UPMC neurotrauma fellowship provides advanced training in surgical and medical management of traumatic brain and spinal cord injuries. The goal is to train the next generation of

neurotraumatologists by providing a comprehensive and supervised educational experience. Fellows are incorporated into all aspects of service leadership and engage with colleagues in Trauma Surgery, Critical Care, Neurology, Neuroradiology and other disciplines to master multidisciplinary management of the neurotrauma population. Progressive independence in patient evaluation and management and service leadership is encouraged during the course of the fellowship.

• Pediatric Fellowship
The ACPNF-accredited pediatric neurosurgery fellowship at UPMC Children's Hospital of Pittsburgh focuses on an overall training philosophy that covers the full gamut of the field with cutting edge approaches to brain tumors, epilepsy, movement disorders, vascular lesions, spinal cord malformations, and cranial base surgery, among other areas. We follow a graded responsibility model that provides increasing independence in the management of an extensive array of pediatric neurosurgery cases in one of the most picturesque pediatric hospitals in the country, supported by a panoply of state-of-the-art instrumentation.

• Spine/Trauma Fellowship
Fellows in the spine and neurotrauma track receive advanced training across all aspects of spinal disorders, with a special emphasis on management of acute neurosurgical emergencies. Fellows are integrated into the UPMC neurotrauma service and have the opportunity to pursue additional training in sports neurosurgery, including concussion evaluation and management and care of sports-related spine and peripheral nerve injuries. Spine/trauma fellows can shadow program faculty with professional and collegiate sports teams in Pittsburgh.

• Stereotactic Radiosurgery & Functional Fellowship
Stereotactic radiosurgery and functional fellows participate in all patient care activities at the UPMC Center for Image-Guided Neurosurgery including evaluation and management leading to decision making, participation in procedures designed to increase learning in the field, and pre- and post-operative care. Fellows participate in educational activities that improve clinical skill acquisition, prepare outcomes research, and publish in the clinical or basic science research arena.

Professional Courses
Principles and Practice of Gamma Knife Surgery, detailing the practical aspects of stereotactic radiosurgery using the Leksell Gamma Knife, is co-directed by Costas G. Hadjipanayis, MD, PhD; Ajay Niranjan, MD; and L. Dade Lunsford, MD. Principles of medical physics and radiobiology as they apply to single-session, focused, small-volume irradiation are covered. Patient selection techniques, didactic course presentations, and hands on computer skills are provided. More than 2,500 professionals from across the world have been trained in more than 120 courses during the past 20+ years. Course graduates are able to create radiosurgery dose plans for brain tumors, vascular malformations and trigeminal neuralgia. The week-long course is offered six times per year. In July of 2020, went to a unique virtual online format.

The Center for Image-Guided Neurosurgery faculty and staff presents *Gamma Knife Radiosurgery Training for Nurses*, a basic training course geared for nurses and other allied health personnel. The course covers device management, patient preparation, patient education, neuroimaging and post-radiosurgery care related to the Gamma Knife.

Comprehensive Endoscopic Endonasal Surgery of the Skull Base, co-directed by Carl Snyderman, MD, MBA; Paul Gardner, MD; and Eric Wang, MD, demonstrates minimally invasive techniques for endoscopic endonasal surgery of the ventral skull base. The anatomical and technical aspects of this procedure—along with the risks, benefits and outcomes—are presented via didactic

lectures, prosections, hands-on anatomical dissection, and live demonstration surgeries. This four-day course is designed for neurosurgeons, otolaryngologists, head and neck surgeons, and senior level residents, and is presented twice a year.

Complex Endoscopic Endonasal Surgery of the Skull Base, co-directed by Carl Snyderman, MD, MBA, Paul Gardner, MD, and Eric Wang, MD, highlights both surgical decision-making and advanced techniques in endoscopic endonasal skull base surgery (training levels 3-5). Course directors lead interactive case-based discussions, prosections, and hands-on anatomical dissection on the indications, limitations and technical nuances of these approaches by anatomical site. This three-day course is offered once a year and is designed for experienced endoscopic skull base teams.

Principles and Practice of Intraoperative Neuromonitoring, co-directed by Partha Thirumala, MD, and Jeffrey Balzer, PhD, is designed for advanced professionals who perform or support intraoperative neuromonitoring (IONM) procedures. The course highlights practice specifications, multimodality protocols, recent advances in the field, pre-/post-operative neurological evaluation, and telemedicine in IONM.

Peter J. Jannetta Lectureship

The Peter J. Jannetta Lecture—focusing on innovations in the field of neurosurgery—is held annually in honor of the former, long-time chair of the University of Pittsburgh Department of Neurological Surgery. Dr. Jannetta was internationally acclaimed for his development of microvascular decompression (MVD), an innovative procedure that moved blood vessels away from the trigeminal nerve, alleviating chronic pain and spasms in facial muscles. The procedure became commonly known as the 'Jannetta Procedure' around the world and brought relief to thousands.

Douglas Kondziolka, MD—Gray Family Professor of Neurosurgery and vice chair of research and director of the Center for Advanced Radiosurgery at New York University's Langone Medical Center, as well as editor-in-chief of *Neurosurgery*, the official journal of the Congress of Neurological Surgeons—was the Jannetta Lecturer for 2022-23, presenting a talk on "Navigating Organized Neurosurgery" on April 5, 2023.

Douglas Kondziolka, MD, addresses faculty and residents at 2023 Peter J. Jannetta Lectureship.

Stuart Rowe Society Lectureship and Research Day

The Stuart Rowe Society Lectureship and Resident Research Day showcases research activities in the field of neurological surgery and provides a forum for discussion. During this day, a series of talks are presented by department residents, each spotlighting a topical research issue relevant in the field. These talks are followed by discussion moderated by a special honored guest prominent in the field of neurosurgery. The honored guest will follow this discussion with a special lecture. The honored guest will also select a "Best Presentation" award presented at a special reception held in their honor later in the evening.

This spotlight on research was a principle first emphasized by Stuart Niles Rowe, MD, the first formally trained neurosurgeon to practice in Pittsburgh. Rowe is widely considered the founding figure of neurosurgery training in the city, establishing the base of what would later become the University of Pittsburgh Department of Neurological Surgery. Rowe believed that neurosurgery training should not only teach exceptional technique, but also the critical clinical decision-making skills necessary to succeed. He preached the underlying need for thorough literature review and independent research as a means for broadening clinical knowledge.

Linda Liau, MD, PhD, chair and executive medical director at the UCLA Department of Neurological Surgery, was the Rowe Lecturer for 2022-23, presenting a lecture on "The Promise of Immunotherapy for Treatment of Glioblastoma" on October 26, 2022.

Xiaoran (Zel) Zhang, MD, received the best resident presentation award at this year's Rowe Day for his talk, "B Cells and Tertiary Lymphoid Structures in Melanoma and Lung Metastases to the Brain." Hussam Abou-Al-Shaar, MD, took home runner-up honors for his presentation, "Stereotactic Radiosurgery for Vestibular Schwannoma in Neurofibromatosis Type 2: An International Multicenter Study of Treatment Response and Malignant Transformation Risk," while Kamil Nowicki, MD, PhD, received an honorable mention award for his presentation "From Small Molecule Inhibitors to Space-Age Alloys: Future Treatments for Cerebral Aneurysms."

Department chair Robert Friedlander, MD, (left), with Stuart Rowe honored guest Linda Liau, MD, PhD, residency program director D. Kojo Hamilton, MD, (right), and Rowe presentation winners Hussam Abou-Al-Shaar, MD, Zel Zhang, MD, and Kamil Nowicki, MD.

Dorothy Klenke Nash Lectureship
The Dorothy Klenke Nash Lecture is a celebration of the first female neurosurgeon to practice in the United States, working at the University of Pittsburgh and local area hospitals from the 1940s through the 1960s.

A graduate of the Columbia College (N.Y.) of Physicians and Surgeons and the Neurologic Institute of New York, Dr. Nash moved to Pittsburgh in 1936 and later became a senior surgeon at St. Margaret's Hospital in 1942. Shortly thereafter, she joined Stuart Niles Rowe, MD—widely considered to be the founding figure of neurosurgery in Pittsburgh—at Presbyterian University Hospital and the University of Pittsburgh School of Medicine.

A big advocate of women in medicine, Dr. Nash actively encouraged women to pursue careers in the field, providing vocational lectures aimed toward female students at the University of Pittsburgh. She was also extensively involved in volunteer activities in a number of areas including cerebral palsy and mental illness.

Karin Muraszko, MD, professor and chair emeritus at the University of Michigan Department of Neurosurgery, was the Nash Lecturer for 2022-23 presenting an update talk on "Chiari I—What Do We Really Know," on February 8, 2023.

Dorothy Klenke Nash honored guest lecturer Karin Muraszko, MD, (front) with department chair Robert Friedlander, MD, and department vice-chair of education Stephanie Greene, MD.

Fridays with Friedlander
Fridays with Friedlander is a live webcast hosted by department chair Robert M. Friedlander, MD, featuring department faculty, residents, alumni and prominent figures in medicine presenting updates on topical neurological surgery issues, followed by an interactive Q&A session.

Neurocirugía en UPMC
The Department of Neurological Surgery maintains a Spanish-language website at upmc.com/Services/neurosurgery/spanish/Pages/default.aspx to serve, educate and provide important information for Spanish-speaking visitors.

Faculty Biographies

Kalil G. Abdullah, MD

Assistant Professor
Director, Translational Neuro-Oncology

Kalil G. Abdullah, MD, MSc, is a neurosurgeon specializing in the treatment of adult brain tumors and is the director of Translational Neuro-Oncology Laboratory at the UPMC Hillman Cancer Center. Dr. Abdullah treats brain tumors using microsurgery techniques and awake craniotomies to map intricate regions of the brain during surgery. He also uses endoscopic and tubular approaches, intraoperative fluorescence, laser therapy and stereotactic radiosurgery to provide minimally invasive surgery options to his patients. Dr. Abdullah is an NIH-funded investigator developing new drug and treatment targets for brain cancers. He has been the principal investigator for numerous clinical trials for glioma and is actively involved in bringing promising brain tumor drugs from the laboratory to early-stage clinical trials. He has published more than 100 research articles including key neuro oncology advances in journals such as *Neuro-Oncology, Cancer Cell, Clinical Cancer Research, Nature Medicine* and *Nature*. Dr. Abdullah earned his medical degree at the Cleveland Clinic Lerner College of Medicine, where he was a National Institutes of Health Howard Hughes Medical Institute Scholar. He completed a residency in neurological surgery at the University of Pennsylvania and then received advanced training in open and endoscopic neurosurgical oncology through a fellowship at the Wellington Hospital in New Zealand. He completed an additional postdoctoral research fellowship in stem cell biology at the University of Pennsylvania, and holds a master's degree from the London School of Economics.

Specialized Areas of Interest
Brain tumors; hydrocephalus.

Board Certifications
Diplomate, American Board of Neurological Surgeons

Hospital Privileges
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons
Society for Neuro-Oncology
Pennsylvania Neurosurgical Society

Professional Activities
Tissue and Biospecimen Steering Committee, Glioma Therapeutics Network, NCI
Children's Brain Tumor Network Scientific Committee
Oligodendroglioma Proteomics Analysis Working Group, CPTAC/NCI
Ad hoc Reviewer, Center for Scientific Review, NIH

Education & Training
MD, Cleveland Clinic, 2012
Postdoc Fellow, University of Pennsylvania, 2017
Clinical Fellow, Wellington Regional Hospital, New Zealand, 2018
MSc, Health Economics, Policy, and Management, London School of Economics, 2019
Neurosurgery Residency, University of Pennsylvania, 2012-19

Kalil G. Abdullah, MD

Honors & Awards

Eugene P. Frenkel Scholar in Clinical Medicine, UT Southwestern, 2021
Early Clinical Investigator Award, Cancer Prevention and Research Institute of Texas, 2021
Emerging Investigator Award, Academy of Neurological Surgeons, 2020
Rising Star Award, Texas Super Doctors, 2019, 2020
Howard Hughes Medical Institute Scholar, National Institutes of Health, 2008

News Media Appearances: 2022-23

"Vulnerability in Brain Tumors May Open Door to New Treatments," National Cancer Institute, September 26, 2022.

Publications: 2022-23

• Refereed Articles:

Shi DD, Anand S, Abdullah KG, McBrayer SK. DNA damage in IDH-mutant gliomas: mechanisms and clinical implications. *J Neurooncol* 162(3):515-523 2023.

Yuan H, Wu X, Wu Q, Chatoff A, Megill E, Gao J, Huang T, Duan T, Yang K, Jin C, Yuan F, Wang S, Zhao L, Zinn PO, Abdullah KG, Zhao Y, Snyder NW, Rich JN. Lysine catabolism reprograms tumour immunity through histone crotonylation. *Nature* 617(7962):818-826, 2023.

Shi DD, Savani MR, Abdullah KG, McBrayer SK. Emerging roles of nucleotide metabolism in cancer. *Trends Cancer* S2405-8033(23)00064-X, 2023.

Nguyen TP, Wang W, Sternisha AC, Corley CD, Wang H-YL, Wang X, Ortiz F, Lim S-K, Abdullah KG, Parada LF, Williams NS, McBrayer SK, McDonald JG, De Brabander JK, Nijhawan D. Selective and Brain-penetrant Lanosterol Synthase Inhibitors Target Glioma Stem-like Cells by Inducing 24(S),25-epoxycholesterol Production. *Cell Chemical Biology* 30(2):214-229e18, 2023.

Sharma N, Mallela AN, Shi DD, Tang LW, Abou-Al-Shaar H, Gersey ZC, Zhang X, McBrayer SK, Abdullah KG. Isocitrate dehydrogenase mutations in gliomas: A review of current understanding and trials. *Neurooncol Adv* 10;5(1):vdad053, 2023.

Tang LW, Mallela AN, Deng H, Richardson TE, Hervey-Jumper SL, McBrayer SK, Abdullah KG. Preclinical modeling of lower-grade gliomas. *Front Onco* 13:1139383, 2023.

Shi DD, Anand S, Abdullah KG, McBrayer SK. DNA damage in IDH-mutant gliomas: mechanisms and clinical implications. *J Neurooncol* 162(3):515-523, 2023.

Richardson TE, Walker JM, Abdullah KG, McBrayer SK, Viapiano MS, Mussa ZM, Tsankova NM, Snuderl M, Hatanpaa KJ. Chromosomal instability in adult-type diffuse gliomas. *Acta Neuropathol Commun* 10(1):115, 2022.

Shi DD, Savani MR, Levitt MM, Wang AC, Endress JE, Bird CE, Buehler J, Stopka S, Regan MS, Lin Y-F, Puliyappadamba VT, Gao W, Khanal J, Evans L, Lee JH, Guo L, Xiao Y, Xu M, Huang B, Jennings RB, Bonal DM, Martin-Sandoval MS, Dang T, Gattie LC, Cameron AB, Lee S, Asara JM, Kornblum HI, Mak TW, Looper RE, Nguyen Q-D, Signoretti S, Gradl S, Sutter A, Jeffers M, Janzer A, Lehrman MA, Zacharias LG, Mathews TP, Losman JA, Richardson TE, Cahill DP, DeBerardinis RJ, Ligon KL, Xu L, Ly P, Agar NYR, Abdullah KG, Harris IS, Kaelin WG, McBrayer SK. De Novo Pyrimidine Synthesis is a Targetable Vulnerability in IDH Mutant Glioma. *Cancer Cell* 40(9):939-956.e16, 2022.

Bird CE, Traylor JI, Johnson ZD, Kim J, Raisanen J, Welch BG, Abdullah KG. Surgical Management of a Massive Frontal Bone Hemangioma: Case Report. *J Neurol Surg Rep* 83(3):e72-e76, 2022.

Kalil G. Abdullah, MD

Guo G, Gong K, Beckley N, Zhang Y, Yang X, Chkheidze R, Hatanpaa KJ, Garzon-Muvdi T, Koduru P, Nayab A, Jenks J, Sathe AA, Liu Y, Xing C, Wu SY, Chiang CM, Mukherjee B, Burma S, Wohlfeld B, Patel T, Mickey B, Abdullah K, Youssef M, Pan E, Gerber DE, Tian S, Sarkaria JN, McBrayer SK, Zhao D, Habib AA. EGFR ligand shifts the role of EGFR from oncogene to tumour suppressor in EGFR-amplified glioblastoma by suppressing invasion through BIN3 upregulation. *Nat Cell Biol* 24(8):1291-1305, 2022.

Research Activities
Dr. Abdullah's Translational Neuro-Oncology Laboratory focuses on identifying metabolic vulnerabilities in malignant glioma, and employs advanced preclinical models to exploit synthetic lethality in brain tumors.

Taylor Abel, MD

Associate Professor
Chief, Pediatric Epilepsy Surgery
Surgical Director, Pediatric Epilepsy Surgery Program

Taylor Abel, MD, is an American Board of Neurological Surgery and American Board of Pediatric Neurological Surgery certified pediatric neurosurgeon specializing in epilepsy surgery. He is surgical director of the Pediatric Epilepsy Surgery Program at UPMC Children's Hospital of Pittsburgh. Dr. Abel is from Seattle, Wash. and completed his undergraduate and medical education at the University of Washington. After his medical education in Seattle, Dr. Abel completed neurosurgery residency at the University of Iowa, where he received specialized training in epilepsy surgery and brain mapping techniques. At Iowa, Dr. Abel completed an NIH-funded postdoctoral fellowship—receiving the Ruth L. Kirschstein National Research Service Award—focusing on electrophysiologic mechanisms of face and voice identification in the temporal lobe. He is one of the few neurosurgeons in North America who has completed subspecialty fellowship training in both pediatric neurosurgery (Hospital for Sick Children, Toronto) and epilepsy surgery (Grenoble, France). Dr. Abel's clinical practice focuses on caring for children drug-resistant epilepsy and movement disorders. He founded and co-directs the UPMC Children's Hospital of Pittsburgh Multi-Disciplinary Pediatric Epilepsy Surgery Clinic, which focuses on providing comprehensive care to children with drug-resistant epilepsy. He performs traditional open epilepsy surgery, stereotactic and minimally invasive epilepsy surgery, and all forms of neuromodulation.

Specialized Areas of Interest
Pediatric epilepsy surgery; pediatric stereotactic and functional neurosurgery; general pediatric neurosurgery.

Board Certifications
American Board of Neurological Surgery
American Board of Pediatric Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Harrisburg
UPMC Magee-Womens Hospital
UPMC Presbyterian

Professional Organization Membership
American Association of Neurological Surgeons
American Epilepsy Society
Congress of Neurological Surgeons

International League Against Epilepsy
Joint Section on Pediatric Neurosurgery (AANS/CNS)
Society for Neurobiology of Language
International Society of Pediatric Neurosurgery
International Epilepsy Surgery Society

Professional Activities
Chair, Early Career Committee, American Epilepsy Society
Vice-Chair, Membership Council, American Epilepsy Society
Co-Chair, Research Subcommittee, AANS/CNS Joint Section on Pediatric Neurosurgery
Scientific Advisory Board, Pediatric Epilepsy Surgery Alliance

Education & Training
BS, Neurobiology, University of Washington, 2005
MD, University of Washington School of Medicine, 2010
Residency, University of Iowa Hospitals and Clinics, 2016
Fellowship, University of Iowa Hospitals and Clinics, 2016
Fellowship, Epilepsy Surgery, Centre Hospitalier Grenoble, Grenoble, France, 2017
Fellowship, Pediatric Neurosurgery, Hospital for Sick Children, Toronto, Canada, 2018
Certificate, Health Leadership and Business Fundamentals, University of Pittsburgh, 2022

Honors & Awards
The Donald S. Fraley Award for Outstanding Medical Student Mentorship, 2023
Pediatric Epilepsy Surgery Alliance Relentless Service Award, 2022
40 under 40, *Pittsburgh Magazine*, 2021
Robin and Judith Humphreys Fellowship in Pediatric Neurosurgery, 2017-18
NIH Clinical Research LRP Award, 2014-16
NIH Ruth L. Kirschstein National Research Service Award, 2014
Neurosurgery Resident Award, AANS/CNS Section on Stereotactic and Functional, 2014
Mary Gates Research Scholar, 2005

News Media Appearances: 2022-23
"To identify a familiar voice, human brains rely on sight," *Tech Explorist*, January 7, 2023.
"When hearing a familiar voice, the brain actually relies on your vision," studyfinds.org, January 5, 2023.

Publications: 2022-23
• Refereed Articles:
Rhone AE, Rupp K, Hect JL, Harford E, Tranel D, Howard III, MA, Abel TJ. Electrocorticography reveals the dynamics of famous voice responses in human fusiform gyrus. *J Neurophysiol* 129(2):342-346 2023.

Harford E, Houtrow A, Al-Ramadhani R, Sinha A, Abel, T. Functional outcomes of pediatric hemispherotomy: Impairment, activity, and medical service utilization. *Epilepsy Behav* 140:109099, 2023.

Muthiah N, Joseph B, Varga G, Vodovotz L, Sharma N, Abel TJ. Investigation of the effectiveness of vagus nerve stimulation for pediatric drug-resistant epilepsies secondary to nonaccidental trauma. *Childs Nerv Syst* 39(5):1201-1206, 2023.

Abel TJ, Muthiah N, Hect JL, Gonzalez-Martinez J, Salehi A, Smyth MD, Smith KJ. Cost-effectiveness of invasive monitoring strategies in epilepsy surgery. *J Neurosurg* [Online ahead of print], 2022.

Taylor Abel, MD

Chilukuri AS, Awkwayena E, Abel TJ. Insulo-opercular stereoelectroencephalography exploration in children and young adults: Indications, techniques, and safety. *Epilepsia Open* 7(4):729-736.

Remick M, Akwayena E, Harford E, Chilukuri A, White GE, Abel TJ. Subdural electrodes versus stereoelectroencephalography for pediatric epileptogenic zone localization: a retrospective cohort study. *Neurosurg Focus* 53(4):E4 2022.

Curtis K, Hect JL, Harford E, Welch WP, Abel TJ. Responsive neurostimulation for pediatric patients with drug-resistant epilepsy: a case series and review of the literature. *Neurosurg Focus* 53(4):E10 2022.

Rupp K, Hect JL, Remick M, Ghuman A, Chandrasekaran B, Holt LL, Abel TJ. Neural responses in human superior temporal cortex support coding of voice representations. *PLoS Biol* 20(7):e3001675 2022.

Alreja A, Ward MJ, Ma Q, Russ BE, Bickel S, Van Wouwe NC, González-Martínez JA, Neimat JS, Abel TJ, Bagić A, Parker LS. A new paradigm for investigating real-world social behavior and its neural underpinnings. *Behav Res Methods* [Online ahead of print], 2022.

Muthiah N, Sharma N, Vodovotz L, White GE, Abel TJ. Predictors of vagus nerve stimulation complications among pediatric patients with drug-resistant epilepsy. *J Neurosurg Pediatr* [Online ahead of print], 2022.

Research Activities
Dr. Abel directs the Pediatric Brain Electrophysiology Laboratory which seeks to understand how the human brain perceives voice, speech, and visual stimuli. Recent publications demonstrate categorical encoding of voice by specialized cortical regions of the temporal lobe and also processing of famous voices by visual areas typically dedicated to face processing.

Nitin Agarwal, MD

Associate Professor, Department of Neurological Surgery
Director, Minimally Invasive Spine and Robotics Surgery
Associate Program Director, Neurological Surgery Residency
Co-Director, Complex and Minimally Invasive Spine Deformity Fellowship

Nitin Agarwal, MD, joined the University of Pittsburgh Department of Neurological Surgery as an associate professor on February 1, 2023. As part of his educational mission, he serves as the associate program director of the UPMC/University of Pittsburgh neurological surgery residency program and co-director of the department's Complex and Minimally Invasive Spine Deformity Fellowship. On the clinical front, he is director of the department's Minimally Invasive Spine and Robotics Surgery program. Dr. Agarwal received his medical degree from Rutgers New Jersey Medical School. Afterwards, he completed his neurological surgery residency at the University of Pittsburgh. During this time, he also completed an enfolded fellowship in sports medicine as well as in minimally invasive and complex spine surgery. He then completed an AO Spine and Committee on Advanced Subspecialty Training (CAST) approved minimally invasive and complex spine surgery fellowship at the University of California, San Francisco with dual training from orthopedic and neurosurgical mentors. Prior to joining the University of Pittsburgh, Dr. Agarwal served as the director of neurotrauma at the Washington University School of Medicine in St. Louis with a clinical focus in spinal deformity surgery. Dr. Agarwal has funded-investigations in four concentrations: neurotrauma outcomes after severe traumatic brain injury and acute spinal cord injury, spine outcomes, socioeconomic research, and patient education. To date, he has published over 275 peer-reviewed articles and has spoken at several regional and national

conferences with over 300 oral and poster presentations. His health literacy research has been published in several high impact factor journals including JAMA Internal Medicine and he has also been featured by prominent healthcare-oriented news outlets such as Reuters Health. In addition, he is an editor for the following books, *Neurosurgery Fundamentals; Surviving Neurosurgery: Vignettes of Resilience; The Evolution of Health Literacy: Empowering Patients through Improved Education* and *Pre-Medicine: The Complete Guide for Aspiring Doctors*. Dr. Agarwal also maintains an active role in organized neurosurgery advocating for medical student and patient education. Moreover, he has pledged his commitment to advancing neurosurgery as a member of the Neurosurgery Research and Education Foundation Cushing Circle of Giving. Outside of neurological surgery, Dr. Agarwal has been deeply dedicated to martial arts, specifically the disciplines of Taekwondo, Krav Maga and Jiu-Jitsu. For over a decade, he served as a certified instructor, national judge and school owner. Dr. Agarwal credits martial arts with providing mental and physical discipline as well as adherence to a strict honor code.

Specialized Areas of Interest
Minimally invasive spine surgery; artificial disc replacement; robotic spine surgery; navigation-assisted surgery; endoscopic spine surgery; awake outpatient surgery; brain and spine trauma; sports medicine; cervical deformity; scoliosis surgery.

Professional Organization Membership
American Association of Neurological Surgeons
American Association of South Asian Neurosurgeons
American Medical Association
AO Spine
Cervical Spine Research Society
Congress of Neurological Surgeons
Council of State Neurosurgical Societies
International Society for the Advancement of Spine Surgery
Lumbar Spine Research Society
North American Spine Society
Society for Minimally Invasive Spine Surgery
Scoliosis Research Society

Professional Activities
UPMC Spine Value Analysis Committee

Education & Training
BS, Biology, The College of New Jersey, 2010
MD, Rutgers, The State University of New Jersey, 2014
Enfolded Fellowship, Sports Medicine, UPMC, 2019-20
Enfolded Fellowship, Minimally Invasive and Complex Spine Surgery, UPMC, 2018-20
Neurological Surgery Residency, UPMC, 2014-21
Fellowship, Minimally Invasive and Complex Spine Surgery, AO Spine/CAST Fellowship, University of California, San Francisco, 2021-22

Honors and Awards
Faculty Teaching Award, University of Pittsburgh Department of Neurological Surgery, 2023
Young Surgeon Travel Grant, UPMC Department of Neurological Surgery, 2023
SpineLine 5th Annual 20 under 40 Class, North American Spine Society, 2022
Young Surgeon Grant and Educational Track, Society for Minimally Invasive Spine Surgery Annual Forum, 2022
Young Clinician Investigator Award, NREF and the Academy of Neurological Surgeons, 2022

Thomas A. Zdeblick Best Paper Award, Lumbar Spine Research Society, 2022
Harold Rosegay Award, San Francisco Neurological Society, 2022
Educator of the Year Award, Congress of Neurological Surgeons, 2021
CSRS Resident and Fellow Scholarship, Cervical Spine Research Society Annual Meeting, 2021
Young Surgeon Grant and Educational Track, Society for Minimally Invasive Spine Surgery Annual Forum, 2021
Resident Teaching Award, University of Pittsburgh Department of Neurological Surgery, 2021
Branch Research Award, AANS/CNS Joint Section on Disorders of the Spine and Peripheral Nerves, 2021
SRS North American Meeting Scholarship for Residents and Fellows, Scoliosis Research Society, 2021
Young Surgeon Grant, International Society for the Advancement of Spine Surgery Annual Conference, 2021
AO Spine North America Fellowship Award, University of California, San Francisco, Department of Neurological Surgery, 2021
Distinguished Junior Mentor Award, University of Pittsburgh School of Medicine, 2020
Neurosurgery Research and Education Foundation Travel Grant, European Association of Neurosurgical Societies Spine Training Course, 2020
Young Surgeon Grant, Society for Minimally Invasive Spine Surgery Annual Forum, 2019
Young Investigator Award, 12th Annual Society of Lateral Access Surgery Meeting, 2019
First Place History E-poster Award, 87th American Association of Neurological Surgeons Annual Scientific Meeting, 2019
Young Surgeon Travel Grant, 16th Annual Meeting: State of Surgery Think Tank, 2019
Socioeconomics, Health Policy, & Law NEUROSURGERY® Publications Top Paper of the Year, Annual Congress of Neurological Surgeons Meeting, 2018
Journalistic and Academic Neurosurgical Excellence (J.A.N.E.) Award, 34th Spine Summit, 2018
First Place Socioeconomic E-poster Award, 85th American Association of Neurological Surgeons Annual Scientific Meeting, 2017
Charlie Kuntz IV Scholar Award, 32nd Spine Summit, 2016
Peter W. Carmel, MD, Award in Neurological Surgery, Outstanding Academic Achievement, 2014
Kenneth G. Swan, MD, Memorial Award, NJMS Student Affairs, 2014
Class of 1979 Scholarship, NJMS Alumni Association Grant, 2011
Armstrong Engineering Scholarship Award, Scholastic Merit Based Grant, 2007
Oval Society Award, Community Service Distinction, 2007

News Media Appearances: 2022-23:

"Scoliosis Dialogues: Episode 66," *Scoliosis Research Society Podcast*, June 14, 2023.
"AAPI Heritage Month Interview," Thieme, May 2023.
"Tips to Excel in Neurosurgery Residency," insidethematch.com, March 2023.
"Scoliosis Dialogues: Episode 55, Awards, Fellowships, and Scholarships," *Scoliosis Research Society Podcast*, January 11, 2023.
"The UFC's Dana White is Creating a Slap Fighting League. Doctors Have Concerns," *Washington Post*, November 12, 2022.
"Scoliosis Dialogues: Episode 51: Poster Award Winners," *Scoliosis Research Society Podcast*, November 16, 2022.
"10 Physician Memoirs that Offer Inspiring Accounts of Life in Medicine." AMA "Shadow Me" Specialty Series, October 27, 2022.
"Scoliosis Dialogues: Episode 44: 57th SRS Annual Meeting Preview," *Scoliosis Research Society Podcast*, September 7, 2022.

Nitin Agarwal, MD

Publications: 2022-23

• Refereed Articles:

Shabani S, Agarwal N, Ben-Natan AR, Huang J, Le VP, Chou D, Mummaneni PV. Technical Note: Hinged Table for Single-Position Navigated Lateral Surgery: 2-Dimensional Operative Video. *Oper Neurosurg* (Hagerstown) 24(6):e441, 2023.

Park C, Mummaneni PV, Gottfried ON, Shaffrey CI, Tang AJ, Bisson EF, Asher AL, Coric D, Potts EA, Foley KT, Wang MY, Fu KM, Virk MS, Knightly JJ, Meyer S, Park P, Upadhyaya C, Shaffrey ME, Buchholz AL, Tumialán LM, Turner JD, Sherrod BA, Agarwal N, Chou D, Haid RW, Bydon M, Chan AK. Which supervised machine learning algorithm can best predict achievement of minimum clinically important difference in neck pain after surgery in patients with cervical myelopathy? A QOD study. *Neurosurg Focus* 54(6):E5, 2023.

Shahrestani S, Chan AK, Bisson EF, Bydon M, Glassman SD, Foley KT, Shaffrey CI, Potts EA, Shaffrey ME, Coric D, Knightly JJ, Park P, Wang MY, Fu KM, Slotkin JR, Asher AL, Virk MS, Michalopoulos GD, Guan J, Haid RW, Agarwal N, Chou D, Mummaneni PV. Developing nonlinear k-nearest neighbors classification algorithms to identify patients at high risk of increased length of hospital stay following spine surgery. *Neurosurg Focus* 54(6):E7, 2023.

Elsayed GA, Lavadi RS, Pugazenthi S, Jaikumar V, Mitha R, Hafez DM, Ogunlade JO, Agarwal N. Spatial Computing for Preoperative Planning and Postoperative Evaluation of Single Position Lateral Approaches in Spinal Revision Surgery. *J Craniovertebr Junction Spine* 14(2):208-211, 2023.

Gohel P, Patel KP, Lavadi RS, Fields DP, Agarwal N, Alan N. Top-Ten Most-Cited Articles on Anterior Column Release in the Context of Minimally Invasive Lumbar Interbody Fusion. *J Craniovertebr Junction Spine* 14(2):127-136, 2023.

Campbell LJ, Mummaneni PV, Letchuman V, Langnas E, Agarwal N, Guan LS, Croci R, Vargas E, Reisner L, Bickler P, Chou D, Chang E, Guan Z. Mismatched opioid prescription in patients discharged after neurological surgeries: a retrospective cohort study. *Pain* [Online ahead of print], 2023.

Javeed S, Greenberg JK, Plog B, Zhang JK, Yahanda AT, Dibble CF, Khalifeh JM, Ruiz-Cardozo M, Lavadi RS, Molina CA, Santiago P, Agarwal N, Pennicooke BH, Ray WZ. Clinically meaningful improvement in disabilities of arm, shoulder, and hand (DASH) following cervical spine surgery. *Spine J* 23(6):832-840, 2023.

Raman AG, Parikh N, Gupta R, Lavadi RS, Gupta R, Heary RF, Kimmell K, Singer J, Agarwal N. Augmenting Career Longevity: An Analysis of Ergonomics Training Among 134 Neurological Surgeons. *World Neurosurg* 173:e11-e17, 2023.

Bisson EF, Mummaneni PV, Michalopoulos GD, El Sammak S, Chan AK, Agarwal N, Wang MY, Knightly JJ, Sherrod BA, Gottfried ON, Than KD, Shaffrey CI, Goldberg JL, Virk MS, Hussain I, Shabani S, Glassman SD, Tumialan LM, Turner JD, Uribe JS, Meyer SA, Lu DC, Buchholz AL, Upadhyaya C, Shaffrey ME, Park P, Foley KT, Coric D, Slotkin JR, Potts EA, Stroink AR, Chou D, Fu KG, Haid RW, Asher AL, Bydon M. Sleep Disturbances in Cervical Spondylotic Myelopathy: Prevalence and Postoperative Outcomes-an Analysis From the Quality Outcomes Database. *Clin Spine Surg* 36(3):112-119, 2023.

Habib A, Muthiah N, Alattar A, Hoppe M, Agarwal N, Alan N, Hamilton DK, Ozpinar A. Direct Iliac Screw vs Sacral-2-Alar-Iliac Screws Technique for Sacropelvic Fixation: Technical Nuances and a Review of the Literature. *Int J Spine Surg* [Online ahead of print], 2023.

Letchuman V, He L, Mummaneni PV, Agarwal N, Campbell LJ, Shabani S, Chan AK, Abrecht CR, Miller C, Sankaran S, Rambachan A, Croci R, Berven SH, Chou D, Holly LT, Guan Z. Racial Differences in Postoperative Opioid Prescribing Practices in Spine Surgical Patients. *Neurosurgery* 92(3):490-496, 2023.

Greenberg JK, Frumkin MR, Javeed S, Zhang JK, Dai R, Molina CA, Pennicooke BH, Agarwal N, Santiago P, Goodwin ML, Jain D, Pallotta N, Gupta MC, Buchowski JM, Leuthardt EC, Ghogawala Z, Kelly MP, Hall BL, Piccirillo JF, Lu C, Rodebaugh TL, Ray WZ. Feasibility and Acceptability of a Preoperative Multimodal Mobile Health Assessment in Spine Surgery Candidates. *Neurosurgery* 92(3):538-546, 2023.

Gupta A, Reddy V, Barpujari A, Lavadi RS, Agarwal P, Chang YF, Mooney J, Elsayed GA, Agarwal N. Current Trends in Subspecialty Fellowship Training for 1691 Academic Neurological Surgeons. *World Neurosurg* 171:e47-e56, 2023.

Chan AK, Bydon M, Bisson EF, Glassman SD, Foley KT, Shaffrey CI, Potts EA, Shaffrey ME, Coric D, Knightly JJ, Park P, Wang MY, Fu KM, Slotkin JR, Asher AL, Virk MS, Michalopoulos GD, Guan J, Haid RW, Agarwal N, Park C, Chou D, Mummaneni PV. Minimally invasive versus open transforaminal lumbar interbody fusion for grade I lumbar spondylolisthesis: 5-year follow-up from the prospective multicenter Quality Outcomes Database registry. *Neurosurg Focus* 54(1):E2, 2023.

Agarwal N, Wilkins TE, Nwachuku EL, Deng H, Algattas H, Lavadi RS, Chang YF, Puccio A, Okonkwo DO. Long-term Benefits for Younger Patients with Aggressive Immediate Intervention following Severe Traumatic Brain Injury: A Longitudinal Cohort Analysis of 175 Patients from a Prospective Registry. *Clin Neurol Neurosurg* 224:107545, 2023.

Fields D, McDowell M, Schulien A, Algattas H, Abou-Al-Shaar H, Agarwal N, Alan N, Costacou T, Wang E, Snyderman C, Gardner P, Zenonos G. Low Preoperative Prealbumin Levels Are a Strong Independent Predictor of Postoperative Cerebrospinal Fluid Leak Following Endoscopic Endonasal Skull Base Surgery. *World Neurosurg* 167:e110-e116, 2023.

Mallela AN, Beiriger J, Gersey ZC, Shariff RK, Gonzalez SM, Agarwal N, González-Martínez JA, Abou-Al-Shaar H. Targeting the Future: Developing a Training Curriculum for Robotic Assisted Neurosurgery. *World Neurosurg* 167:e770-e777, 2022.

Agarwal N, Aabedi AA, Chan AK, Letchuman V, Shabani S, Bisson EF, Bydon M, Glassman SD, Foley KT, Shaffrey CI, Potts EA, Shaffrey ME, Coric D, Knightly JJ, Park P, Wang MY, Fu KM, Slotkin JR, Asher AL, Virk MS, Haid RW, Chou D, Mummaneni PV. Leveraging machine learning to ascertain the implications of preoperative body mass index on surgical outcomes for 282 patients with preoperative obesity and lumbar spondylolisthesis in the Quality Outcomes Database. *J Neurosurg Spine* 38(2):182-191, 2022.

Sherrod BA, Michalopoulos GD, Mulvaney G, Agarwal N, Chan AK, Asher AL, Coric D, Virk MS, Fu KM, Foley KT, Park P, Upadhyaya CD, Knightly JJ, Shaffrey ME, Potts EA, Shaffrey CI, Gottfried ON, Than KD, Wang MY, Tumialán LM, Chou D, Mummaneni PV, Bydon M, Bisson EF. Development of new postoperative neck pain at 12 and 24 months after surgery for cervical spondylotic myelopathy: a Quality Outcomes Database study. *J Neurosurg Spine* 38(3):357-365, 2022.

Habib A, Jovanovich N, Muthiah N, Alattar A, Alan N, Agarwal N, Ozpinar A, Hamilton DK. 3D printing applications in spine surgery: an evidence-based assessment toward personalized patient care. *Eur Spine J* 31(7):1682-1690, 2022.

Walker CT, Agarwal N, Eastlack RK, Mundis GM, Alan N, Iannacone T, Akbarnia BA, Okonkwo DO. Surgical treatment of young adults with idiopathic scoliosis. *J Neurosurg Spine* 38(1):84-90, 2022.

Siddiqui N, Reddy VP, Rogers JL, Detchou DKE, Casubhoy I, Gopali R, Bhalla S, Janbahan M, Morris E, Peesapati MP, Agarwal N. Trends in Matriculation from Neurological Surgery Training Programs into Academic Versus Private Practice. *World Neurosurg* 165:e635-e642, 2022.

Chan AK, Shaffrey CI, Gottfried ON, Park C, Than KD, Bisson EF, Bydon M, Asher AL, Coric D, Potts EA, Foley KT, Wang MY, Fu KM, Virk MS, Knightly JJ, Meyer S, Park P, Upadhyaya C, Shaffrey ME, Buchholz AL, Tumialán LM, Turner JD, Michalopoulos GD, Sherrod BA, Agarwal N, Chou D, Haid RW, Mummaneni PV. Cervical spondylotic myelopathy with severe axial neck pain: is anterior or posterior approach better? *J Neurosurg Spine* 38(1):42-55, 2022.

Shlobin NA, Shahrestani S, Shabani S, Agarwal N, Tan L. Cerebrospinal fluid venous fistula: Illustrative case. *Surg Neurol Int* 13:374, 2022.

Chan AK, Letchuman V, Mummaneni PV, Burke JF, Agarwal N, Bisson EF, Bydon M, Foley KT, Shaffrey CI, Glassman SD, Wang MY, Park P, Potts EA, Shaffrey ME, Coric D, Knightly JJ, Fu KM, Slotkin JR, Asher AL, Virk MS, Kerezoudis P, Alvi MA, Guan J, Haid RW, DiGiorgio A. Inferior Clinical Outcomes for Patients with Medicaid Insurance After Surgery for Degenerative Lumbar Spondylolisthesis: A Prospective Registry Analysis of 608 Patients. *World Neurosurg* 164:e1024-e1033, 2022.

• Invited Papers:
Lavadi RS, Elsayed GA, Buell TJ, Hamilton DK, Agarwal N. Strategies for spine surgeons to enhance a clinical practice and research program: stepping stones for practice management. *J Neurosurg Spine* [Online ahead of print], 2023

Mitha R, Lavadi RS, Elsayed GA, Agarwal N. Book Review: The Neurosurgical Consult Book. *World Neurosurg* 173:94, 2023.

• Books:
Thomas J, Wagner P, Funahashi R, Agarwal N (eds), *Pre-Medicine: The Complete Guide for Aspiring Doctors*, Thieme Medical Publishers, 2023.

Agarwal N, Reddy V (eds), *Surviving Neurosurgery: Vignettes of Resilience*, Springer International Publishing, 2022.

• Book Chapters:
Muthiah N, Agarwal N, Hamilton DK. Antithrombotic Management in Spine Surgery in the Elderly. In: *Treatment of Spine Disease in the Elderly: Cutting Edge Techniques and Technologies*, Fu KM, Wang MY, Virk MS, Dimar JR, Mummaneni PV (eds), pp 19-49, Springer International Publishing, 2023.

Bai MY, Abou-Al-Shaar H, Gersey ZC, Fields DP, Agarwal N. Robotics in Neurosurgical Training. In: *Robotics in Neurosurgery*, Gonzalez-Martinez JA, Cardinale F (eds), pp 279-295, Springer International Publishing, 2022.

Research Activities
Dr. Agarwal's research concentrations as principal investigator or primary author have been dedicated to four main areas: neurotrauma outcomes after severe traumatic brain injury and acute spinal cord injury, spine outcomes, socioeconomic research, and patient education.

Nitin Agarwal, MD

Prior research support has been directed primarily at studies improving outcomes and at the development of neurotrauma biomarkers. These investigations have supported the unmet need to identify biomarkers to better predict prognosis after neurotrauma and tailored interventions to augment neurological recovery.

Improving outcomes following spine surgery is another component of Dr. Agarwal's efforts to blend my clinical practice and research endeavors. He has sought to critically analyze perioperative surgical and patient risk factors to improve outcomes. To this end, these studies have allowed for better preoperative planning and patient optimization for surgical intervention.

A subset of Dr. Agarwal's research interests includes examining socioeconomic policies that impact neurosurgical practice and the delivery of quality care to patients. These investigations stem from his involvement in organized neurosurgery societies whose mission statements center around these issues.

Dr. Agarwal's early investigations addressed deficiencies of patient education materials for neurosurgical patients. The culmination of this work resulted in a foundation award to further improve patient education and engagement through multimedia.

Sameer Agnihotri, PhD

Assistant Professor
Director, Brain Tumor Biology and Therapy Lab

Sameer Agnihotri, PhD, joined the faculty of the Department of Neurological Surgery at UPMC Children's Hospital of Pittsburgh in November of 2016. Dr. Agnihotri graduated from the University of Toronto in 2005 with a bachelor of science honors degree in biology, specializing in genetics. He earned his PhD in medical biophysics in 2011 from the University of Toronto where he used genetic screens to identify novel drivers of glioblastoma, an incurable brain tumor. He subsequently completed his post-doctoral fellowship at the Arthur and Sonia Labatt Brain Tumor Research Centre at the Hospital for Sick Children, in Toronto, and the Princess Margaret Cancer Centre, Division of Neuro-oncology Research, also in Toronto.

Specialized Areas of Interest
Pediatric and adult high-grade gliomas.

Professional Organization Membership
Children's Brain Tumor Consortium
Society of Neuro-Oncology

Professional Activities
Scientific Committee, Children's Brain Tumor Tissue Consortium
Membership Committee, Society of Neuro-oncology

Education & Training
BSc, Biology, University of Toronto, 2005
PhD, Medical Biophysics, University of Toronto, 2011
Fellowship, Hospital for Sick Children, Toronto, 2016
Fellowship, Princess Margaret Cancer Centre, Toronto, 2016

Honors & Awards
Sontag Distinguished Scientist Award, Sontag Foundation, 2022
Junior Scholar Award in Clinical/Translational Cancer Research, UPMC Hillman Cancer Center, 2022

Sameer Agnihotri, PhD

Children's Trust and Children's Hospital of Pittsburgh Young Investigator Award, 2017
Marlene Reimer Brain Star Award, 2016
Post-Doctoral Scholarship, Canadian Institute of Health Resources (CIHR), 2013-16
Trainee of the Year, Hospital for Sick Children, 2014
Young Investigator Award in Basic/Translational Research, Canadian Neuro-Oncology, 2014
Lucien J. Rubinstein Award, American Brain Tumor Association, 2013
Wolfgang Vogel Memorial Award, University of Toronto, 2013
Young Investigator Travel Award, Society of Neuro-Oncology, 2012
Graduate Student Scholarship, Ontario Institute for Cancer Research, 2009
Young Investigator Award in Pediatric Brain Tumour Research, Pediatric Brain Tumor Research Foundation, 2007

Edward Andrews, MD

Assistant Professor

Edward G. Andrews, MD, joined the University of Pittsburgh Department of Neurological Surgery in July of 2023 after completing his seven-year residency at the University of Pittsburgh. As a resident, Dr. Andrews helped found the Alba Tull Center for Neuro Imaging and Therapeutics, a developmental research center focusing on the advancement of augmented reality applications in the field of neurosurgery. He will continue his efforts in this field as a member of the university faculty. Dr. Andrews attended the University of Pennsylvania, graduating summa cum laude in 2009 with a degree in neuroscience and ancient Egyptian studies. He subsequently earned his medical degree from Sidney Kimmel Medical College at Thomas Jefferson University in 2016, graduating magna cum laude. During his medical school career, he directed the Future Docs High School Program, a pipeline program aimed at exposing underrepresented minority high school juniors and seniors to different career choices in healthcare fields. He also organized and participated in the primary tutoring services on campus, helping medical students struggling with course material and clinical rotations.

Specialized Areas of Interest
Neuro-oncologic neurosurgery; technology innovation in neurosurgery.

Professional Organization Membership
Alpha Omega Alpha
American Association of Neurological Surgeons
American Board of Neurological Surgery
American Medical Association
Congress of Neurological Surgeons
Gold Humanism Honor Society

Professional Activities
Executive Director, Surreality Lab, University of Pittsburgh
Executive Director, The Alba Tull Center for Neuroimaging and Therapeutics, University of Pittsburgh

Education & Training
BA, University of Pennsylvania, 2005-09
MD, Sidney Kimmel Medical College, 2012-16

Honors & Awards
Joseph Maroon Aequanimitas Award, University of Pittsburgh, 2023
e-Poster Award, Pediatric Neurosurgery, AANS Annual Meeting, 2018

Edward Andrews, MD

Physician Champion of Nursing Award, University of Pittsburgh, 2018
Magna Cum Laude, Sidney Kimmel Medical College, 2016
William F. Keller Prize, Sidney Kimmel Medical College, 2016
Gold Humanism Honor Society Inductee, Sidney Kimmel Medical College, 2016
McClellan Surgical Honor Society, Sidney Kimmel Medical College, 2016
Alpha Omega Alpha (Junior Inductee), Sidney Kimmel Medical College, 2015
Summa Cum Laude, University of Pennsylvania, 2009
Dean's List, University of Pennsylvania, 2006-09

Publications: 2022-23

• Refereed Articles:

Andrews EG, Khan T, Mallela A, Maroon JC, Biehl J, Fernandes-Cabral D, Gersey ZC, Abou-Al-Shaar H, Gardner PA, Zenonos GA. Streaming 2D-endoscopic video into an augmented reality headset display: a feasibility study. *J Neurol Surg B Skull Base* 83(S01):S1-270, 2022.

Katherine M. Anetakis, MD

Assistant Professor

Katherine M. Anetakis, MD joined the University of Pittsburgh Center of Clinical Neuro-physiology in July of 2017. She specializes in intraoperative neurophysiological monitoring for adult and pediatric neurosurgical, orthopedic, ENT, vascular, and interventional neuroradiology procedures, as well as motor and language mapping during awake craniotomies. Dr. Anetakis competed her pediatric neurology residency and clinical neurophysiology fellowship at UPMC Children's Hospital of Pittsburgh. Her fellowship concentrations included pediatric epilepsy as well as intraoperative neuromonitoring. In 2021, she was named fellowship director of the non-ACGME track IONM fellowship at UPMC.

Specialized Areas of Interest

Intraoperative neurophysiological monitoring; perioperative stroke; post-operative outcomes.

Board Certifications

American Board of Psychiatry and Neurology
American Board of Psychiatry and Neurology: Subspecialty in Clinical Neurophysiology

Hospital Privileges

JC Blair Memorial Hospital
Excela Health Hospital System
Indiana Regional Medical Center
Monongahela Valley Hospital
Trinity Health System
UPMC Altoona
UPMC Bedford
UPMC Children's Hospital of Pittsburgh
UPMC Cranberry
UPMC East
UPMC Greenville
UPMC Hamot
UPMC Harrisburg
UPMC Horizon
UPMC Jameson
UPMC Magee-Womens Hospital
UPMC McKeesport

Katherine M. Anetakis, MD

UPMC Mercy
UPMC Northwest
UPMC Passavant
UPMC Presbyterian
UPMC St. Margaret
UPMC Shadyside
UPMC Shenango
UPMC Somerset
UPMC Susquehanna

Professional Organization Membership
American Academy of Neurology
American Clinical Neurophysiology Society

Professional Activities
Course Lecturer, Principles and Practice of Intraoperative Monitoring, UPMC
Course Lecturer, Cardiovascular Neuromonitoring, UPMC

Education & Training
BS, Human Physiology, Michigan State University, 2007
MD, University of Pittsburgh School of Medicine, 2011
Residency, Pediatric Neurology, Children's Hospital of Pittsburgh, 2016
Fellowship, Clinical Neurophysiology, UPMC, 2017

Robert L. Bailey, MD

Clinical Assistant Professor

Robert L. Bailey, MD—an ABNS board-certified neurosurgeon—joined the University of Pittsburgh Department of Neurological Surgery in January of 2019 as a clinical assistant professor. He received his medical degree from the University of Pennsylvania and completed his residency training at the University of Pennsylvania. He completed fellowship training at Wellington Regional Hospital in Wellington, New Zealand. Dr. Bailey specializes in the surgical management of degenerative spine disease of the cervical, thoracic and lumbar spine, utilizing both traditional methods as well as the latest minimally invasive approaches. He also specializes in the surgical removal of both primary and secondary tumors of the spine. Dr. Bailey works with primary care physicians, neurologists, pain management specialists and other clinicians to formulate an individualized treatment plan for his patients. He provides spine care in the Wexford area of Pittsburgh and also participates in community based clinics in outlying communities including Butler, Pa. and Sewickley, Pa.

Specialized Areas of Interest
Back and spine care; minimally invasive spine surgery; robotic spine surgery.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Mercy
UPMC Passavant
UPMC Presbyterian
UPMC Shadyside

Robert L. Bailey, MD

Professional Organization Membership
American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons
Pennsylvania Neurological Society

Education & Training
BA, Brigham Young University, 2004
MD, University of Pennsylvania, 2009
Fellowship, Wellington Regional Hospital, New Zealand, 2014
Residency, University of Pennsylvania, 2016

Jeffrey Balzer, PhD

Associate Professor
Director, Clinical Services, Center for Clinical Neurophysiology
Director, Cerebral Blood Flow Laboratory

Jeffrey Balzer, PhD, is director of clinical operations and staff clinical neurophysiologist at the Center for Clinical Neurophysiology and director of the Cerebral Blood Flow Laboratory at the University of Pittsburgh Medical Center. His current research interests range from refining language testing during awake craniotomy procedures to the utilization of signal processing analysis during cerebrovascular procedures. Dr. Balzer received his undergraduate education at the University of Pittsburgh, where he also pursued a graduate education and a PhD in behavioral neuroscience. He is also the secretary/treasurer of the American Board of Neurophysiological Monitoring and is on the board of directors of the American Society of Neurophysiological Monitoring. He has published 130 refereed articles and 19 book chapters.

Specialized Areas of Interest
Intraoperative neurophysiological monitoring; subarachnoid hemorrhage; cerebral blood flow; SCS for restoration of function after stroke.

Board Certifications
American Board of Neurophysiological Monitoring

Hospital Privileges
Armstrong Regional Health System
Excela Health System
Indiana Regional Medical Center
Monongahela Valley Hospital
UPMC Altoona
UPMC Children's Hospital of Pittsburgh
UPMC Horizon
UPMC Jameson
UPMC McKeesport
UPMC Mercy
UPMC Passavant
UPMC Pinnacle
UPMC Presbyterian
UPMC St. Margaret's
UPMC Shadyside
UPMC Susquehanna
UPMC Western Maryland

Jeffrey Balzer, PhD

Professional Organization Membership
American Clinical Neurophysiology Society
American Society for Neurophysiological Monitoring (Fellow)
Pittsburgh Neuroscience Society

Professional Activities
Co-Course Director, Principles and Practice of Intraoperative Monitoring, UPMC
Secretary/Treasurer, American Board of Neurophysiologic Monitoring
Board of Directors, American Society of Neurophysiological Monitoring
Co-Editor, *Koht, Sloan, Toleikis's Monitoring the Nervous System for Anesthesiologist and Other Health Care Professionals*, 3rd Edition, Springer

Education & Training
BS, Behavioral Neuroscience, University of Pittsburgh, 1984
MS, Behavioral Neuroscience, University of Pittsburgh, 1989
PhD, Behavioral Neuroscience, University of Pittsburgh, 1994
Fellowship, Neurophysiology, University of Pittsburgh, 1994

Publications: 2022-23
• Refereed Articles:
Powell MP, Verma N, Sorensen E, Carranza E, Boos A, Fields DP, Roy S, Ensel S, Barra B, Balzer JR, Goldsmith J, Friedlander RF, Wittenberg GF, Fisher LE, Krakauer JW, Gerszten PC, Pirondini E, Weber DJ, Capogrosso M. Epidural stimulation of the cervical spinal cord for post-stroke upper-limb paresis. *Nat Med* 29(3):689-699 2023.

Sultan I, Brown JA, Serna-Gallegos D, Thirumala PD, Balzer JR, Paras S, Fleseriu C, Crammond DJ, Anetakis KM, Kilic A, Navid F, Gleason TG. Intraoperative neurophysiologic monitoring during aortic arch surgery. *J Thorac Cardiovasc Surg* 165(6):1971-1981, 2023.

Thirumala PD, Ahmad AI, Roy PP, Balzer JR, Crammond DJ, Anetakis KM, Fleseriu CM, Subramaniam K, Jadhav AP, Kilic A, Gleason T. Predictive value of multimodality intraoperative neurophysiological monitoring during cardiac surgery. *J Clin Neurophys* 40(2):180-186, 2023.

Adams GM, Crammond DJ, Shandal V, Gardner PA, Snyderman CH, Anetakis KM, Balzer JR, Thirumala PD. 2023. Minimally invasive extraocular cranial nerve electromyography. *J Neurosurg* [Online ahead of print], 2023.

Fleseriu CM, Sultan I, Brown JA, Mina A, Frenchman J, Crammond DJ, Balzer JR, Anetakis KM, Subramaniam K, Shandal V, Navid F, Thirumala PD. Role of intraoperative neurophysiological monitoring in preventing stroke after cardiac surgery. *Ann Thorac Surg* [Online ahead of print], 2023.

Stem CT. Ramgopal S, Hickey RW, Manole MD, Balzer JR. Effect of ketamine on transcranial Doppler gosling pulsatility index in children undergoing procedural sedation: A pilot study. *J Am Coll Emerg Physicians Open* 3(4):e12760, 2022.

Razumovsky AY, Jahangiri F, Balzer JR, Alexandrov AV. American Society of Neurophysiologic Monitoring (ASNM) and American Society for Neuroimaging (ASN) joint guidelines for transcranial Doppler (TCD) ultrasonic monitoring: update. *J Neuroimag* 32(5):781-797 2022.

James Cushing Bayley, MD

Assistant Professor

James Cushing Bayley, MD joined the University of Pittsburgh Department of Neurological Surgery in August of 2023 as an assistant professor specializing in spinal oncology and peripheral nerve disorders. A native of Boston, he attended Harvard College, earning a degree in applied mathematics, and received his medical degree from the University of Cincinnati College of Medicine Dr. Bayley completed his residency in neurological surgery at Baylor College of Medicine in 2023. During residency, he completed subspecialty training in neurosurgical oncology at MD Anderson Cancer Center with a focus on spinal oncology. Based on his experiences at MD Anderson, Dr. Bayley seeks to build a multidisciplinary center at UPMC, including practitioners from radiation oncology, medical oncology, radiology, pain management and rehab medicine, dedicated to providing comprehensive care for patients with spinal tumors. Additionally, he received specialized training on peripheral nerve tumors and surgical techniques for nerve reconstruction in cases of injury by trauma or tumors. As with spine tumors, Dr. Bayley will provide comprehensive, multidisciplinary care for peripheral nerve disorders at UPMC with his colleagues from neurology, neurophysiology and rehab medicine. During residency, Dr. Bayley performed NIH-funded research in meningiomas, the most common primary tumor of the brain and spine. Utilizing next-generation sequencing techniques, he identified molecular groups to advance our knowledge of the behavior and biology of these tumors. His research interest include using computational techniques to advance our understanding of spinal tumors, clinical outcomes in the treatment of spine and peripheral nerve tumors, as well as utilization of novel techniques in the treatment of challenging spinal tumors, including laser ablation. Outside of neurosurgery, Dr. Bayley is an accomplished oarsman, earning second-team All-Ivy honors during college and subsequently winning a U.S. Rowing Club National Championship in the single scull. His wife, Erin Bayley, MD, is a breast surgical oncologist at UPMC and together they have three young children.

Specialized Areas of Interest

Spine tumors, both primary and metastatic; minimally invasive spine surgery; peripheral nerve tumors; peripheral nerve injuries; nerve reconstruction.

Hospital Privileges

Excela Health
UPMC Mercy
UPMC Passavant
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership

Alpha Omega Alpha
American Association of Neurological Surgeons
Congress of Neurological Surgeons
Pennsylvania Neurosurgical Society
Society for Neuro-Oncology

Education & Training

AB, Applied Mathematics, Harvard College, 2009
MD, University of Cincinnati College of Medicine, 2016
Neurosurgery Residency, Baylor College of Medicine and MD Anderson Cancer Center, 2023

James Cushing Bayley, MD

Honors & Awards
Kinjiro Iwata Award for Academic Achievement, Baylor College of Medicine, 2022
Best Scientific Paper, Texas Association of Neurological Surgeons, 2021
Alpha Omega Alpha, University of Cincinnati College of Medicine, 2016
Richard Harris Gottesman Award, Harvard College, 2016

Publications: 2022-23
• Refereed Articles:
Huang-Hobbs E, Cheng YT, Ko Y, Luna-Figueroa E, Lozzi B, Taylor KR, McDonald M, He P, Chen HC, Yang Y, Maleki E, Lee ZF, Murali S, Williamson MR, Choi D, Curry R, Bayley J, Woo J, Jalali A, Monje M, Noebels JL, Harmanci AS, Rao G, Deneen B. Remote neuronal activity drives glioma progression through SEMA4F. *Nature* [Online ahead of print], 2023.

Khan AB, English CW, Chen WC, Athukuri P, Bayley JC 5th, Brandt VL, Shetty A, Hadley CC, Choudhury A, Lu HC, Harmanci AO, Harmanci AS, Magill ST, Raleigh DR, Klisch TJ, Patel AJ. Even heterozygous loss of CDKN2A/B greatly accelerates recurrence in aggressive meningioma. *Acta Neuropathol* 145(4):501-503, 2023.

Fomchenko EI, Bayley JC, Alvarez-Breckenridge C, Rhines LD, Tatsui CE. Spinal Metastases and the Evolving Role of Molecular Targeted Therapy, Chemotherapy, and Immunotherapy. *Neurospine* 19(4):978-993, 2022.

Gibbs D, Bayley J, Grossbach AJ, Xu DS. Lateral Retropleural Thoracic Diskectomy for a Calcified Herniated Disk: 2-Dimensional Operative Video. *Oper Neurosurg* (Hagerstown) 24(2):e107, 2023.

Keister A, Bayley J, Xu DS. Transdural Thoracic Discectomy and Dorsal Arachnoid Web Fenestration: 2-Dimensional Operative Video. *Oper Neurosurg* (Hagerstown) 24(4):e293, 2023.

J. Brad Bellotte, MD

Clinical Assistant Professor
Chief, Neurosurgery, UPMC Hamot

J. Brad Bellotte, MD, is chief of neurosurgery at UPMC Hamot in Erie, Pa. He joined the University of Pittsburgh Department of Neurosurgery as a clinical assistant professor in July of 2011. Dr. Bellotte is a leading expert in complex spine surgery, including minimally invasive surgeries. He earned his MD from West Virginia University School of Medicine and completed an internship in general surgery and a residency in neurosurgery at Allegheny General Hospital in Pittsburgh.

Specialized Areas of Interest
Complex spine surgery; brain surgery.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Hamot

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons
North American Spine Society
Pennsylvania State Neurosurgical Society

J. Brad Bellotte, MD

Education & Training
MD, West Virginia University, 1999
Residency, Neurosurgery, Allegheny General Hospital, 2005

Honors & Awards
Orthopedic Teaching Award, UPMC Hamot, 2011-12

Bryan Bolinger, DO

Clinical Assistant Professor

Bryan Bolinger, DO, received a bachelor's degree in neuroscience from the University of Pittsburgh in 2001. During his undergraduate years, he also participated in clinical and bench research at the Brain Trauma Research Center and the Safar Center for Resuscitation Research. Dr. Bolinger obtained his medical degree from the Philadelphia College of Osteopathic Medicine in 2007 and completed his neurosurgical residency through the Philadelphia College of Osteopathic Medicine Consortium of Hospitals in 2013. Dr. Bolinger returned to the University of Pittsburgh in 2013 to complete fellowship training in complex spine surgery under the direction of Adam Kanter, MD; David Okonkwo, MD, PhD, and Peter Gerszten, MD. Board certified in neurosurgery, and after years of practice in Pennsylvania, Dr. Bolinger joined the University of Pittsburgh Department of Neurological Surgery in April of 2020 as a clinical assistant professor.

Specialized Areas of Interest
Minimally invasive spine surgery; lateral access spine surgery; artificial disc technology; spinal cord stimulation; spinal cord injury; spine trauma; traumatic brain injury.

Board Certifications
American Osteopathic Board of Surgery, Neurosurgical Discipline

Hospital Privileges
UPMC Carlisle
UPMC Community Osteopathic
UPMC Hanover
UPMC Harrisburg
UPMC Lititz
UPMC Memorial
UPMC West Shore
UPMC Williamsport

Professional Organization Membership
American Association of Neurological Surgeons
American College of Osteopathic Surgeons
American Osteopathic Association
North American Spine Society

Education & Training
BS, Neuroscience, University of Pittsburgh, 2001
DO, Philadelphia College of Osteopathic Medicine, 2007
Neurosurgical Residency, Philadelphia College of Osteopathic Medicine, 2013
Fellowship, Complex Spine Surgery, University of Pittsburgh Medical Center, 2014

Honors & Awards
AANS/CNS Cahill Fellowship Award, 2013

Thomas J. Buell, MD

Assistant Professor

Thomas J. Buell, MD, joined the University of Pittsburgh Department of Neurological Surgery in January of 2022. A native of Texas, he attended the University of Texas at Austin where he earned a bachelor of science degree in electrical engineering, graduating with high honors and earning the W. C. Dusty and Doris Duesterhoeft Endowed Presidential Scholarship. His early engineering research focused on designing algorithms to advance parallel and distributed processing. After graduation, he worked as an electrical engineer before attending Baylor College of Medicine, earning his medical degree in 2013. He completed his neurological surgery residency at the University of Virginia in 2020. There he completed an enfolded CAST-accredited complex spine fellowship under Justin Smith, MD, an enfolded CAST-accredited endovascular fellowship, and an international fellowship at Auckland City Hospital in Auckland, New Zealand. He then attended Duke University for a combined orthopedic and neurosurgical AO Spine adult and pediatric complex spine and oncology fellowship training program under Isaac Karikari, MD, and Christopher Shaffrey, MD. Dr. Buell specializes in complex spinal reconstructive surgery for treatment of all spinal deformities of the cervical, thoracic, and lumbar regions. He is a high-volume surgeon, performing over 300 operations per year. His clinical philosophy is conservative believing, in many cases, non-operative treatment options improve patient symptoms. He provides individualized, patient-engaged, compassionate care and focuses on maximizing outcomes with the least invasive approach. Dr. Buell has been actively engaged in clinical research, both prospectively and retrospectively, to evaluate which treatments provide greatest clinical benefit while minimizing complications. His research interests focus on clinical outcomes after spinal surgery. He is a prolific academician, having published over 110 papers in peer-reviewed journals such as *Neurology, Neurosurgery, Journal of Neurosurgery, JNS Spine, Spine Deformity,* and *Stroke*. He is also an assistant editor for *Operative Neurosurgery* and has recently accepted an editorial board position for *Spine Deformity*. He has authored and edited over 20 textbook chapters. Dr. Buell is a new member of the International Spine Study Group, a multicenter non-profit research foundation that studies clinical and economic outcomes resulting in best practice guidelines for adult patients with spinal deformities. This is a consortium of spinal deformity specialists and researchers at over 20 top academic centers in the United States and Canada with collaborators in Europe and Japan. Since the inception in 2009, the International Spine Study Group has presented over 2000 scientific abstracts and has published over 300 peer reviewed manuscripts.

Specialized Areas of Interest

Adult spinal deformity; sagittal imbalance; flat back deformity; degenerative scoliosis; idiopathic scoliosis; congenital scoliosis; cervical deformity; spondylolisthesis; scheuermann's kyphosis; spinal fractures; failed spinal surgery; traumatic spinal cord injury; cranial trauma; spinal tumors; cervical myelopathy; diffuse idiopathic skeletal hyperostosis.

Hospital Privileges

UPMC Children's Hospital of Pittsburgh
UPMC Mercy
UPMC Passavant
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership

American Association of Neurological Surgeons
International Spine Study Group Foundation
North American Spine Society

Thomas J. Buell, MD

Professional Activities
Assistant Editor, *Operative Neurosurgery*
Editorial Board, *Spine Deformity*

Education & Training
BS, Electrical Engineering, University of Texas at Austin, 2005
MD, Baylor College of Medicine, 2013
Neurosurgery Residency, University of Virginia, 2020
Neuroendovascular Surgery Fellowship, University of Virginia Health System, 2017
Senior Registrar, Auckland Public Hospital in Auckland, New Zealand, 2019
Enfolded Fellowship, Adult & Pediatric Spine Deformity Surgery, University of Virginia, 2020
Clinical Associate, Fellow, Duke University, 2022

Honors & Awards
Finalist, Virginia Kaufman Pain Research Challenge, 2023
Resident & Fellow Research Award, North American Spine Society (NASS), 2020-2021
Nominated, Hibbs Award, Scoliosis Research Society (SRS) 55th Annual Meeting, 2020
Whitecloud Award for Best Clinical Abstract, International Meeting on Advanced Spine Techniques (IMAST), 2020
Best Abstract Presentation, AANS/CNS Joint Spine Section, Spine Summit, 2018
John A. Jane, Sr. Neuroanatomy Award, University of Virginia, 2017
Crutchfield, Cage & Thomson Award, Clinical Research, Neurosurgical Society of the Virginias, 2017
Crutchfield, Cage & Thomson Award, Basic Science, Neurosurgical Society of the Virginias, 2014
Mission Connect Neurotrauma Research Award, Institute for Rehabilitation and Research Foundation, 2011

Publications: 2022-23
• Refereed Articles:
Agarwal N, Roy S, Lavadi RS, Patel KP, Ozpinar A, Alan N, Buell TJ, Hamilton DK. The 'candy cane' technique for construct augmentation and correction of severe angular chin-on-chest kyphoscoliosis. *Spine Deform* 11(4):1027-1030, 2023.

Becerril-Gaitan A, Ding D, Ironside N, Buell TJ, Kansagra AP, Lanzino G, Brinjikji W, Kim L, Levitt MR, Abecassis IJ, Bulters D, Durnford A, Fox WC, Blackburn S, Chen PR, Polifka AJ, Laurent D, Gross B, Hayakawa M, Derdeyn C, Amin-Hanjani S, Alaraj A, van Dijk JMC, Potgieser ARE, Starke RM, Peterson EC, Satomi J, Tada Y, Abla AA, Winkler EA, Du R, Lai PMR, Zipfel GJ, Chen CJ, Sheehan JP; CONDOR investigators. The VEBAS score: a practical scoring system for intracranial dural arteriovenous fistula obliteration. *J Neurointerv Surg* [Online ahead of print], 2023.

Lavadi RS, Elsayed GA, Buell TJ, Hamilton DK, Agarwal N. Strategies for spine surgeons to enhance a clinical practice and research program: stepping stones for practice management. *J Neurosurg Spine* [Online ahead of print], 2023.

Durnford AJ, Akarca D, Culliford D, Millar J, Guniganti R, Giordan E, Brinjikji W, Chen CJ, Abecassis IJ, Levitt M, Polifka AJ, Derdeyn CP, Samaniego EA, Kwasnicki A, Alaraj A, Potgieser ARE, Chen S, Tada Y, Phelps R, Abla A, Satomi J, Starke RM, van Dijk JMC, Amin-Hanjani S, Hayakawa M, Gross B, Fox WC, Kim L, Sheehan J, Lanzino G, Kansagra AP, Du R, Lai R, Zipfel GJ, Bulters DO; CONDOR Investigators. Risk of Early Versus Later Rebleeding From Dural Arteriovenous Fistulas With Cortical Venous Drainage. *Stroke* 53(7):2340-2345, 2022.

Marco Capogrosso, PhD

Assistant Professor
Director, Spinal Cord Stimulation Laboratory

Marco Capogrosso, PhD, joined the University of Pittsburgh Department of Neurological Surgery as an assistant professor in January of 2020. He completed his doctoral studies in biomedical engineering and robotics at the Scuola Superiore Sant'Anna in Pisa, Italy. His doctorate work focused on the implementation of a computational framework to support the design of peripheral and central neural interfaces for sensory and motor applications. After the receiving his PhD, Dr. Capogrosso completed his post-doctoral training at the Ecole Polytechnique Fédérale de Lausanne, Switzerland, where he worked on the development of brain spinal interfaces for the restoration of voluntary motor control in animals and humans with spinal cord injury. Before joining the University of Pittsburgh, he directed his own research group as a research faculty at the primate center of the University of Fribourg, Switzerland and was a manager of the primate platform. He is now director of the Spinal Cord Stimulation Laboratory and part of the Rehab and Neural Engineering Labs of the University of Pittsburgh.

Specialized Areas of Interest
Neuroprosthetics; computer models of electrical stimulation; arm paralysis; spinal cord injury; brain computer interfaces; motor control.

Professional Organization Membership
Society for Neuroscience

Education & Training
BA, Physics (cum laude) Università di Pisa, Italy, 2007
MS, Applied Physics (cum laude) Università di Pisa, Italy, 2009
PhD, Engineering, Institute of Biorobotics, Scuola Superiore Sant'Anna, 2013
Post-Doc, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, 2016

Honors & Awards
Senior Vice Chancellor's Research Seminar Award, University of Pittsburgh 2023
Outstanding Reviewer Award, The Journal of Neural Engineering 2020
European Research Council Starting Grant Award, 2019
Career Award, Technological Advances in Spinal Cord Injury, Lupicaia Foundation 2018
MIT 10 Best Breakthrough Technologies, Wireless Brain-Spine Interface, 2017
Swiss National Science Foundation Ambizione Fellowship, 2016
Best Post-Doc Paper, NCCR Robotics, 2014, 2016
Finalist, Tomorrow's PI Prize, Swiss Life Science Annual Meeting, 2015

News Media Appearances: 2022-23
"Brain and spine implants enabled a paralyzed man to climb stairs and walk on rough terrain, study shows," nbcnews.com, May 24, 2023.
"From 'science fiction' to reality: Paralyzed man walks again thanks to brain and spine implants," USA Today, May 24, 2023.
"First-of-its-kind Pittsburgh study uses electrodes to restore stroke patients' mobility," WTAE-TV, May 10, 2023.
"'We Were All in Tears': Stroke Patient Sees Improved Motion With Experimental Device," NBC-TV 4 Washington, April 18, 2023.
"Hope for stroke patients: Spinal stimulation device increases mobility in Pitt-CMU trial," *Pittsburgh Post-Gazette*, March 5, 2023.

"Spinal implants: The experimental device electrically stimulates spinal cord," BBC *World News*, February 20, 2023.
"In Test, Zaps to Spine Help 2 Stroke Survivors Move Arms," *U.S. News & World Report*, February 20, 2023.
"Zaps to the Spinal Cord Improved Patients' Paralysis After Stroke," *Wall Street Journal*, February 20, 2023.
"'New frontier' in therapy helps 2 stroke patients move again – and gives hope for many more," *USA Today*, February 20, 2023.
"Helping Stroke Patients Regain Movement in their Hands," *New York Times*, February 20, 2023.
"With a little 'tickle,' a new technology gives hope to stroke patients with paralysis," CNN, February 20, 2023.
"A Stroke Paralyzed Her Arm. This Implant Let Her Use It Again," *Wired Magazine*, February 20, 2023.
"Stroke survivor moves hand for first time in nine years after spinal stimulation," *Daily Mail*, February 20, 2023.
"Spinal stimulation can improve arm and hand movement years after a stroke," NPR, February 20, 2023.
"Spinal stimulation could aid mobility after stroke," *AP News*, February 20, 2023.
"Incredible video shows the moment paralysed stroke victim is overjoyed at moving her hand for the first time in 9 years," *The Sun*, February 20, 2023.
"Ictus, dopo la stimolazione elettrica due donne ricominciano a utilizzare il braccio e in parte la mano," *Corriere Della Sera*, February 20, 2023.
"External Electrical Stimulation Restores Upper Limb Control of Paralyzed Monkeys," *The Science Times*, July 1, 2022.

Publications: 2022-23

• Refereed Articles:

Powell M, Verma N, Sorensen E, Carranza E, Boos A, Fields DP, Roy S, Ensel S, Barra B, Balzer J, Goldsmith J, Friedlander RM, Wittenberg GF, Fisher LE, Krakauer JW, Gerszten PC, Pirondini E Weber DJ, Capogrosso M. Epidural stimulation of the cervical spinal cord for post-stroke upper limb paresis. *Nature Med* 29(3):689-699 2023.

Dalrymple AN, Hooper CA, Kuriakose MG, Capogrosso M, Weber DJ. Using a high-frequency carrier does not improve comfort of transcutaneous spinal cord stimulation. *J Neural Eng* 20(1):016016, 2023.

Barra B, Conti S, Perich MG, Zhuang K, Schiavone G, Fallegger F, Galan K, James ND, Barraud Q, Delacombaz M, Kaeser M, Rouiller EM, Milekovic T, Lacour S, Bloch J, Courtine G, Capogrosso M. Epidural electrical stimulation of the cervical dorsal roots restores voluntary upper limb control in paralyzed monkeys. *Nat Neurosci* 25(7):924-934 2022.

Research Activities

In 2022-23, Dr. Capogrosso reported the initial results of his lab's first-in-human clinical trial testing the efficacy of spinal cord stimulation (SCS) to restore arm and hand function in people with chronic stroke that was approved by the University of Pittsburgh IRB (NCT04512690). This trial is performed in collaboration with Peter Gerzten, MD, and Robert Friedlander, MD, from the University of Pittsburgh Department of Neurological Surgery; Elvira Pirondini, PhD, and Lee Fisher, PhD, from the University of Pittsburgh Department of Physical Medicine and Rehabilitation; George Wittenberg, MD, from the University of Pittsburgh Department of Neurology; Douglas Weber, PhD, from Carnegie Mellon University; and John Krakauer, MD, from Johns Hopkins Medicine. The hypothesis is that SCS can support residual motor function in people with upper limb paralysis in consequence of stroke and significantly improve motor control. The team implanted four subjects and reported the results on the first two subjects.

Marco Capogrosso, PhD

Dr. Capogrosso observed unexpectedly large effect sizes that substantially improved strength, motor control and daily-life abilities of people with stroke. The results of this work were published in 2023 in *Nature Medicine*. Dr. Capogrosso believe that his lab's data shows that his technology has the potential of becoming the first effective therapy for permanent post-stroke upper limb hemiparesis. This work has received worldwide media coverage including the BBC, CNN, *Wall Street Journal* and *New York Times*.

In relation to this work, Dr. Capogrosso also published in *Nature Neuroscience* the foundational work for this trial executed in monkeys with a lesion of the cortico-spinal tract. This shows the unique value of pre-clinical research in monkeys which is the most relevant animal model for human motor control. Indeed, Dr, Capogrosso developed and tested this technology in monkeys which allowed his lab to rapidly translate the work to a human trial.

Finally, this year Dr. Capogrosso launched a new clinical trial supported by the venture branch of Roche: Genetech to explore the feasibility of using SCS to treat motor deficits and slow disease progress in people with spinal muscular atrophy, a genetic disease that progressively destroys spinal motoneurons leading to paralysis.

Diane L. Carlisle, PhD

Associate Professor

Diane Carlisle, PhD, joined the Department of Neurological Surgery in October 2010. She received her undergraduate degree in molecular biology from Washington and Jefferson College and her graduate degree in molecular and cellular oncology from George Washington University where she identified new signaling pathways involved in occupational causes of lung cancer. Dr. Carlisle came to the University of Pittsburgh after a postdoctoral fellowship at Johns Hopkins University under the mentorship of Robert Casero Jr., PhD, in drug development for lung cancer. She then developed an independent research program using stem cells to investigate adult disease. The mission of her laboratory is to use human pluripotent stem cells to model disease. She has an active program using stem cells generated from tissue samples donated by sporadic ALS patients and by Huntington's Disease patients. By differentiating these cells into mature neurons, she is able to identify neurologic disease specific changes in mitochondrial function. In addition, she uses her expertise in pluripotent stem cell methods and directed differentiation to collaborate in her department, and across the university, in cross disciplinary projects that use pluripotent stem cell technologies. Dr. Carlisle serves as faculty for the NIH-funded stem cell course, Frontiers in Stem Cells and Regeneration, which is held annually at the Marine Biological Laboratories in Woods Hole, Mass.

Specialized Areas of Interest

Fetal basis for adult disease; use of stem cells for developmental modeling and drug discovery; amyotrophic lateral sclerosis (ALS); Huntington's Disease.

Professional Activities

Faculty, Frontiers in Stem Cells and Regeneration course, Marine Bio Lab, Woods Hole, Mass.
Study Section, 2023 National Institutes of Health Neural Oxidative Metabolism, Mitochondria and Cell Death

Education & Training

BA, Biology, Washington & Jefferson College, 1994
PhD, Molecular and Cellular Oncology, George Washington University, 1999
Fellowship, Johns Hopkins University, 2001

Diane L. Carlisle, PhD

Publications: 2022-23

• Refereed Articles:

Suofu Y, Jauhari A, Nirmala ES, Mullins WA, Wang X, Li F, Carlisle DL, Friedlander RM. Neuronal melatonin type 1 receptor overexpression promotes M2 microglia polarization in cerebral ischemia/reperfusion-induced injury. *Neurosci Lett* 795:137043, 2023.

Research Activities

In the past year, Dr. Carlisle used patient-specific induced pluripotent stem cells (iPSCs) to investigate mitochondrial function of neural progenitors and neurons from Huntington's Disease patients. She differentiated iPSCs into neural progenitors and mature neurons and isolated mitochondria for analysis. Dr. Carlisle found proteomic and functional differences between neurons and controls from Huntington's Disease patients, with implications for neuroinflammatory regulation in the brain during neurodegeneration.

Shaun W. Carlson, PhD

Assistant Professor

Shaun Carlson, PhD, joined the faculty of the Department of Neurological Surgery at UPMC Children's Hospital of Pittsburgh in October of 2017. Dr. Carlson graduated from the University of Kansas in 2007 with a bachelor of science degree in cell biology. He earned his PhD in physiology in 2013 from the University of Kentucky, studying the effects of traumatic brain injury on hippocampal neurogenesis and the efficacy of a growth factor based therapeutic approach to promote neurogenic plasticity and functional recovery after brain injury. He continued his training in 2013 as a postdoctoral fellow at the University of Pittsburgh Department of Neurological Surgery.

Specialized Areas of Interest

Mechanisms of synaptic dysfunction and plasticity and the identification of therapeutic approaches to promote recovery following brain injury.

Professional Organization Membership

National Neurotrauma Society
Society for Neuroscience

Professional Activities

Membership Committee, National Neurotrauma Society
Training, Education and Mentoring (TEAM) Committee, National Neurotrauma Society

Education & Training

BSc, Cell Biology, University of Kansas, 2007
PhD, Physiology, University of Kentucky, 2013
Postdoctoral Fellowship, Neurological Surgery, University of Pittsburgh, 2017

Honors & Awards

Ruth L. Kirschstein National Research Service Award (NIH), 2015-17
Nancy Caroline Fellow Award, Safar Center for Resuscitation Research, 2016
Murray Goldstein Award of Excellence, National Neurotrauma Symposium, 2013
Anthony Marmarou Award of Excellence, National Neurotrauma Symposium, 2012
Brian J. Hardin Award for Research, Department of Physiology, University of Kentucky, 2008

Shaun W. Carlson, PhD

Publications: 2022-23

• Refereed Articles:

Svirsky SE, Ranellone NS, Parry M, Holets E, Henchir J, Li Y, Carlson SW, Dixon CE. All-trans Retinoic Acid has Limited Therapeutic Effects on Cognition and Hippocampal Protein Expression After Controlled Cortical Impact. *Neuroscience* 499:130-141, 2022.

Fronczak KM, Roberts A, Svirsky S, Parry M, Holets E, Henchir J, Dixon CE, Carlson SW. Assessment of behavioral, neuroinflammatory, and histological responses in a model of rat repetitive mild fluid percussion injury at 2 weeks post-injury. *Front Neurol* 13:945735, 2022.

Yue-Fang Chang, PhD

Research Associate Professor

Dr. Chang has worked in a variety of areas, such as brain tumor, traumatic brain injury, health outcome, neuroimaging study, women's health and diabetes epidemiology. She serves as the statistician in several epidemiological studies including Cardiovascular Health Study, Women's Health Initiative and Study of Women's Health Across the Nation. Over the years she has been involved in numerous grant preparations, providing statistical expertise in design, analysis and power/sample size calculations.

Specialized Areas of Interest

Longitudinal data analysis; survival analysis; statistical computing; research methodology; injury epidemiology.

Education & Training

BS, Statistics, National Chung-Hsing University, Taiwan, 1984
MS, Statistics, University of Illinois at Urbana-Champaign, 1987
PhD, Statistics, University of Illinois at Urbana-Champaign, 1991
MPH, Epidemiology, University of Pittsburgh, 1994

Publications: 2022-23

• Refereed Articles:

Gupta A, Reddy V, Barpujari A, Lavadi RS, Agarwal P, Chang YF, Mooney J, Elsayed GA, Agarwal N. Current Trends in Subspecialty Fellowship Training for 1691 Academic Neurological Surgeons. *World Neurosurg* 171:e47-e56, 2023.

Thurston RC, Wu M, Chang YF, Aizenstein HJ, Derby CA, Barinas-Mitchell EA, Maki P. Menopausal Vasomotor Symptoms and White Matter Hyperintensities in Midlife Women. *Neurology* 100(2):e133-e141, 2023.

Agarwal N, Wilkins TE, Nwachuku EL, Deng H, Algattas H, Lavadi RS, Chang YF, Puccio A, Okonkwo DO. Long-term Benefits for Younger Patients with Aggressive Immediate Intervention following Severe Traumatic Brain Injury: A Longitudinal Cohort Analysis of 175 Patients from a Prospective Registry. *Clin Neurol Neurosurg* 224:107545, 2023.

Kulimbet M, Glushkova N, Snitz B, Tsoy R, Adambekov S, Talbott E, Mereke A, Wu M, Zhumagaliuly A, Karaca F, Chang Y, Turuspekova S, Sekikawa A, Davletov K. Neuropsychological Assessment of Community-Dwelling Older Adults in Almaty, Kazakhstan. *Int J Environ Res Public Health* 19(23):16189, 2022.

Thurston RC, Chang Y. Menopausal vasomotor symptoms and adiponectin among midlife women. *Menopause* 29(10):1145-1149, 2022.

Yue-Fang Chang, PhD

Deng H, Nwachuku EL, Wilkins TE, Yue JK, Fetzick A, Chang YF, Beers SR, Okonkwo DO, Puccio AM. Time to Follow Commands in Severe Traumatic Brain Injury Survivors With Favorable Recovery at 2 Years. *Neurosurgery* 91(4):633-640, 2022.

Kuller LH, Snitz BE, Hughes TM, Chang Y, Cohen AD, Mathis CA, Aizenstein HJ, Lopez OL. Low untreated systolic blood pressure over 18 years is associated with survival free of dementia age 90. *Alzheimers Dement* 18(11):2176-2187, 2022.

Or Cohen-Inbar, MD, PhD

Clinical Associate Professor

Or Cohen-Inbar, MD, PhD, joined the faculty at the University of Pittsburgh Department of Neurological Surgery in 2019. He completed his medical degree at the Technion Israel Institute of Technology in Haifa, Israel, in 2008 and completed his residency in neurological surgery at Rambam Health Care in Haifa in 2014. He obtained his doctorate in immunology and tumor immunotherapy from Technion in 2014. Dr. Cohen-Inbar completed a two-year clinical fellowship in surgical oncology and stereotactic radiosurgery at the University of Virginia Department of Neurological Surgery in Charlottesville, Va. in 2016. His research has focused on developing new multi-modality approaches to battle benign and malignant brain tumors, with his basic research focusing on new immuno-therapeutical approaches to help battle malignant brain tumors. Dr. Cohen-Inbar completed several mini-fellowships encompassing a wide range of neurosurgical techniques, including those related to the different techniques in managing degenerative spine surgery and neuro-endoscopy. Dr. Cohen-Inbar has authored several books such as *Focused Neurosurgery* published by Jaypee Brothers Publishing House in 2016, and *Focused Neuro-Anatomy for Medical Students* published by Nova Science Publishers in 2015. He also has contributed chapters to many other books and publications, including the recently published edition of the renowned and famous *Youmans and Winn Neurological Surgery*, 8th Edition. Dr. Cohen-Inbar currently serves on the editorial boards of several leading neurosurgical and neuro-oncological journals.

Specialized Areas of Interest
Neuro-oncology; stereotactic radiosurgery; pituitary lesions; pain syndromes; psychiatric illnesses; neurotrauma; degenerative spine diseases.

Board Certifications
Israeli Board Certified in Neurosurgery

Hospital Privileges
UPMC Western Maryland

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons
European Association of Neurosurgical Societies
Foundation for International Education in Neurological Surgery
Israeli Neurosurgical Association

Professional Activities
Section Editor, *Youmans & Winn Neurological Surgery*, 8th Edition, Elsevier, 2022

Education & Training
MD, Technion Israel Institute of Technology, Haifa, Israel, 2008

Or Cohen-Inbar, MD, PhD

PhD, Technion Israel Institute of Technology, Haifa, Israel, Molecular Immunology, 2014
Residency, Rambam Health Care, Haifa, Israel, 2014
Fellowship, University of Virginia, Surgical Neuro-Oncology and Radiosurgery, 2016

Honors & Awards
Young Investigator Award, Clinical/Translational Research, Biennial Canadian Neuro-Oncology Meeting, 2016
Israeli-Cancer-Association Award, Cancer Research and Treatment, 2014
Rambam Knowledge Center Fellowship Grant, 2014
Best Poster Award, Third German-Israeli Cancer Research School, DKFZ-MOST, 2010
MD Thesis Cum Laude, Technion Institute of Technology, 2007
Magna Cum Laude Rector's Honor, University of Debrecen, Hungary, 2003

Donald J. Crammond, PhD

Associate Professor
Associate Director, Movement Disorder Surgery

Donald Crammond, PhD, joined the Center for Clinical Neurophysiology as a staff neurophysiologist in November 1997. Dr. Crammond received his undergraduate education in physiology at the University of Glasgow in Scotland and his graduate education in neurophysiology at the University of Toronto. After postdoctoral studies at the University of Wisconsin and later at the Université de Montréal, he was appointed visiting associate scientist at the National Institute of Mental Health in Bethesda, Md. Dr. Crammond specializes in intra-operative neurophysiological monitoring (IONM) and in systems-level, behavioral neurophysiology, examining the neuronal substrates of higher cognitive processes such as movement planning and speech and the functional interactions between, the cerebral cortex, thalamus and basal ganglia, and the mechanisms underlying motor control and movement disorders. Dr. Crammond is the associate director for microelectrode recording and subcortical mapping for the Movement Disorder Surgery Program at UPMC. Dr. Crammond is the vice-chair of the American Board of Neurophysiologic Monitoring (ABNM).

Specialized Areas of Interest
The application of neurophysiological mapping in the surgical treatment of movement disorders, functional localization in cerebral cortex; motor system physiology, peripheral nerve regeneration and intraoperative neurophysiological monitoring (IONM).

Board Certifications
American Board of Neurophysiological Monitoring

Hospital Privileges
Excela Health, Westmoreland and Latrobe Hospitals
Indiana Regional Medical Center
UPMC Altoona
UPMC Bedford
UPMC Children's Hospital of Pittsburgh
UPMC East
UPMC Horizon
UPMC Magee-Womens Hospital
UPMC McKeesport
UPMC Mercy
UPMC Muncy
UPMC Northwest

Donald J. Crammond, PhD

UPMC Passavant
UPMC Passavant, Cranberry
UPMC Pinnacle
UPMC Presbyterian
UPMC St. Margaret
UPMC Shadyside
UPMC Somerset
UPMC Susquehanna
UPMC Western Maryland

Professional Organization Membership
American Society for Neurophysiological Monitoring
Movement Disorder Society
Society for Neuroscience

Professional Activities
Vice-Chair, American Board of Neurophysiologic Monitoring
Education Committee, American Society of Neurophysiologic Monitoring
University of Pittsburgh IRB, DSMB
Carnegie Mellon University IRB, DSMB

Education & Training
BSc (Hons), Physiology, University of Glasgow, 1980
PhD, Neurophysiology, University of Toronto, 1988
Fellowship, Neurophysiology, University of Wisconsin, 1987
Fellowship, Neurophysiology, Université de Montreal, 1992
Fellowship, Clinical Neurophysiology, University of Pittsburgh, 1999

Publications: 2022-23
• Refereed Articles:
Fleseriu CM, Sultan I, Brown JA, Mina A, Frenchman J, Crammond DJ, Balzer J, Anetakis KM, Subramaniam K, Shandal V, Navid F, Thirumala PD. Role of Intraoperative Neurophysiological Monitoring in Preventing Stroke after Cardiac Surgery. *Ann Thorac Surg* [Online ahead of print], 2023.

Adams GM, Crammond DJ, Shandal V, Gardner P, Snyderman C, Anetakis K, Balzer JR, Thirumala PD. Minimally-Invasive Extraocular Cranial Nerve Electromyography. *J Neurosurg* [Online ahead of print], 2023.

Moehl K, Shandal V, Anetakis KM Paras S, Mina A, Crammond DJ, Balzer JR, Thirumala PD. Predicting Transient Ischemic Attack After Carotid Endarterectomy: The Role of Intraoperative Neurophysiological Monitoring. *Clin Neurophysiol* 141:1-8, 2022.

Research Activities
Dr. Crammond's major clinical research interest is the study of basal ganglia, thalamus and cerebral cortical interactions related to the control of movement in movement disorders including Parkinson's disease, Dystonia and Essential Tremor. This is accomplished by recording neurophysiological data from micro-electrode single-unit (MER) and local field potential (LFP) recordings in the basal ganglia simultaneously with Electrocorticography (ECoG) and LFP from sensorimotor cortex and by stimulating various structures, to examine the physiological relationship between basal ganglia and functional areas of cerebral cortex. His research examines how these cortical areas and subcortical nuclei are involved in different aspects of movement planning and movement execution during the performance of controlled behavioral tasks. Currently, two research

studies are ongoing. The first is examining the role of the motor thalamus facilitation of primary motor cortex to test if motor thalamus stimulation can facilitate corticospinal activation of arm and face muscles. This may be useful to use DBS therapy to treat patients with spinal lesions or subcortical strokes and is being actively tested in patients undergoing DBS implantation into motor thalamus to treat essential tremor. The plan is to soon study the use of motor thalamus DBS in stroke patients as a potential new therapy to enhance movement in these stroke patients who have impaired arm/hand and speech function. The second study is examining the potential use of DBS to treat addiction. Specifically, two patients have had DBS implanted into the limbic area of the globus pallidum who will be followed for over a year to examine if limbic pallidal DBS can reduce their alcohol addiction. As we understand more about basal ganglia physiology and cortical-basal ganglia interactions, we hope this will also help us to improve the targeting for optimal DBS placement within the basal ganglia and motor thalamus to be more specific to movement disorder patients' symptoms, to decrease the incidence of post-operative DBS side effects and to continue to explore new indications for DBS therapy. Related studies are examining how to better use brain imaging and potential electrophysiological biomarkers of PD, to improve DBS targeting.

Dr. Crammond's ongoing clinical research interest is to review clinical outcome data to determine the impact of various modalities of Intra-Operative Neurophysiological Monitoring (IONM) to prevent and/or reduce iatrogenic injury and to use neurophysiological mapping of the basal ganglia and cerebral cortex to map motor and language functions in various neurosurgical procedures in awake patients. For example, to map and locate eloquent cortical areas in tumor resection and to map the thalamus in epilepsy surgeries.

C. Edward Dixon, PhD

Neurotrauma Chair Professor
Vice Chair, Research
Director, Brain Trauma Research Center

C. Edward Dixon, PhD, received his PhD degree in physiological psychology from the Virginia Commonwealth University in 1985.That year, he was awarded a National Research Service Award for Postdoctoral Fellows by the National Institutes of Health and joined the Division of Neurological Surgery at the Medical College of Virginia. In 1986, he became a postdoctoral fellow in the Biomedical Science Department of the General Motors Technical Center in Warren, Mich. Dr. Dixon was named assistant professor in the Division of Neurosurgery at the Medical College of Virginia in 1987 and became an assistant professor in the Department of Neurological Surgery at the University of Texas Health Science Center in Houston in 1991. In 1995, he joined the Brain Trauma Research Center in the Department of Neurological Surgery at the University of Pittsburgh as associate professor. He became the director of the center in October 2002. Dr. Dixon received his adjunct faculty positions with the Department of Anesthesiology in 1995; the Department of Neurobiology in 2000 and the Department of Physical Medicine/Rehabilitation in 2003. In 2001, he became a co-director of the Safar Center for Resuscitative Research. In May of 2004, Dr. Dixon was named full professor of neurological surgery at the University of Pittsburgh and was later appointed vice chairman of research in the Department of Neurological Surgery in 2008. In 2011, Dr. Dixon was honored with one of the highest honors the university can present a faculty member when he was awarded The Neurotrauma Chair in Neurosurgery at the University of Pittsburgh. Dr. Dixon is a member of the advisory committee for PRE Clinical Interagency reSearch resourcE-TBI (PRECISE-TBI). As part of the PRECISE-TBI, he directs the Preclinical Model Catalogue Core and is a member of the working group for preclinical common data elements Dr. Dixon served as president of the National Neurotrauma Society for the 2002-03 term and continued as councilor of the society for terms 2004-07 and 2009-12. He also has continued as a study section participant of several public and private grant review panels. His research has

dealt primarily with mechanisms of post-traumatic memory deficits, rodent models of traumatic brain injury, and functional outcomes. Dr. Dixon has published 252 papers in refereed journals, two books (coeditor), 29 book chapters, and two editorials.

Specialized Areas of Interest
Mechanisms of induction and recovery of functional deficits following traumatic brain injury; neurotransmitter agonist therapies for recovery of post traumatic functional deficits; models of traumatic brain injury; clinical studies of pharmacotherapy.

Professional Organization Membership
American Association for the Advancement of Science
International Neurotrauma Society
National Neurotrauma Society (Charter Member)
Pittsburgh Chapter of Society for Neuroscience
Society for Neuroscience

Professional Activities
TBI Model Core Director, PRE Clinical Interagency reSearch resourcE-TBI
Scientific Board Member, Texas Institute for Rehabilitation Research
Grant Reviewer, Congressionally Directed Medical Research Programs (CDMRP)
Study Section Member, Kentucky Spinal Cord & Head Injury Study Section
Member Conflict Panel, National Institute of Health

Education & Training
BA, Psychology, Virginia Commonwealth University, 1981
MS, Physiology/Psychology, Virginia Commonwealth University, 1984
PhD, Physiology/Psychology, Virginia Commonwealth University, 1985
NIH-NHRSA Fellow, Medical College of Virginia, 1986
Fellowship, General Motor Research Laboratories, 1987

Publications: 2022-23
• Refereed Articles:
Cummings J, Wu YL, Dixon CE, Henchir J, Simard JM, Panigrahy A, Kochanek PM, Jha RM, Aneja RK. Abcc8 (sulfonylurea receptor-1) knockout mice exhibit reduced axonal injury, cytotoxic edema and cognitive dysfunction vs. wild-type in a cecal ligation and puncture model of sepsis. *J Neuroinflammatio*n 20(1):12, 2023.

Pu H, Wang Y, Yang T, Leak RK, Stetler RA, Yu F, Zhang W, Shi Y, Hu X, Yin KJ, Hitchens TK, Dixon CE, Bennett MVL, Chen J. Interleukin-4 mitigates anxiety-like behavior and loss of neurons and fiber tracts in limbic structures in a microglial PPARγ-dependent manner after traumatic brain injury. *Neurobiol Dis* 180:106078, 2023.

Zhao Y, Mu H, Huang Y, Li S, Wang Y, Stetler RA, Bennett MVL, Dixon CE, Chen J, Shi Y. Microglia-specific deletion of histone deacetylase 3 promotes inflammation resolution, white matter integrity, and functional recovery in a mouse model of traumatic brain injury. *J Neuroinflammation* 19(1):201, 2022.

Simon DW, Raphael I, Johnson KM, Dixon CE, Vagni V, Janesko-Feldman K, Kochanek PM, Bayir H, Clark RSB, McGeachy MJ. Endogenous Interleukin-17a Contributes to Normal Spatial Memory Retention but Does Not Affect Early Behavioral or Neuropathological Outcomes after Experimental Traumatic Brain Injury. *Neurotrauma Rep* 3(1):340-351, 2022.

Song S, Hasan MN, Yu L, Paruchuri SS, Bielanin JP, Metwally S, Oft HCM, Fischer SG, Fiesler VM, Sen T, Gupta RK, Foley LM, Hitchens TK, Dixon CE, Cambi F, Sen N, Sun D. Microglial-oligodendrocyte interactions in myelination and neurological function recovery after traumatic brain injury. *J Neuroinflammation* 19(1):246, 2022.

Svirsky SE, Ranellone NS, Parry M, Holets E, Henchir J, Li Y, Carlson SW, Dixon CE. All-trans Retinoic Acid has Limited Therapeutic Effects on Cognition and Hippocampal Protein Expression After Controlled Cortical Impact. *Neuroscience* 499:130-141, 2022.

Zhao Y, Ma C, Chen C, Li S, Wang Y, Yang T, Stetler RA, Bennett MVL, Dixon CE, Chen J, Shi Y. STAT1 contributes to microglial/macrophage inflammation and neurological dysfunction in a mouse model of traumatic brain injury. *J Neurosci* 42(39):7466–81, 2022.

Fronczak KM, Roberts A, Svirsky S, Parry M, Holets E, Henchir J, Dixon CE, Carlson SW. Assessment of behavioral, neuroinflammatory, and histological responses in a model of rat repetitive mild fluid percussion injury at 2 weeks post-injury. *Front Neurol* 13:945735, 2022.

Shawn R. Eagle, PhD

Research Assistant Professor

Shawn R. Eagle, PhD, joined the faculty of the Department of Neurological Surgery at the University of Pittsburgh in January of 2022. Dr. Eagle has collaborated on Department of Defense (DoD) funded research through the University of Pittsburgh since 2013. He began focusing on TBI in 2015 when he began his doctoral studies at the University of Pittsburgh's Neuromuscular Research Laboratory. Dr. Eagle extended his studies as a postdoctoral fellow in the UPMC Sports Medicine Concussion Clinic from 2019 to 2021. His research interests are currently focused on mitigating risk for long-term sequelae following traumatic brain injury, with a specific focus on mental health issues. Dr. Eagle has published over 110 papers in refereed journals and presented his research at local, national and international scientific conferences. He is an ad-hoc reviewer for 35 peer-reviewed journals.

Specialized Areas of Interest

Optimizing identification, assessment and management of traumatic brain injury using objective assessments and biological markers to improve long-term patient outcomes.

Board Certifications

Certified Athletic Trainer

Professional Organization Membership

National Athletic Trainers' Association
National Neurotrauma Society

Professional Activities

Traumatic Brain Injury Subject Matter Expert, Traumatic Brain Injury Center of Excellence in the Department of Defense.

Education & Training

BA, Athletic Training, Denison University, 2011
MAT, Athletic Training, Texas Tech University, 2013
PhD, Rehabilitation Science, University of Pittsburgh, 2019
Postdoctoral Fellowship, Department of Orthopaedic Surgery, University of Pittsburgh, 2021

Honors & Awards

Young Investigator Award Finalist, Military Health Sciences Research Symposium, 2020
Neuromuscular Plasticity Scholar Award, University of Florida, 2018
Doctoral Student Award, International Congress on Soldiers' Physical Performance, 2017
Mid-Atlantic Regional Doctoral Student Investigator Award, American College of Sports Medicine, 2016

News Media Appearances: 2022-23

"Obesity Could Slow Recovery From a Head Injury," *U.S. News & World Report*, June 28, 2023.
"Evaluating Media Attention on CTE," *CUBIST Podcast*, March 16, 2023.
"Brain injury foundation honors Noll's legacy, makes advances for the future," *Pittsburgh Business Times*, October 6, 2022.
"Concussion increases chances of attempted suicide in adolescents, Pitt study finds," *Denver Gazette*, July 17, 2022
"Concussion increases chances of attempted suicide in adolescents, Pitt study finds," *Pittsburgh Post-Gazette*, July 16, 2022.

Publications: 2022-23

• Refereed Articles:

Eagle SR, Okonkwo DO. Telling the whole story: bibliometric network analysis to evaluate impact of media attention on chronic traumatic encephalopathy research. *J Neurotrauma* 40(1-2):148-154, 2023.

Stephenson K, Womble MN, Eagle SR, Collins MW, Kontos AP, Elbin RJ. Symptom provocation following post-concussion computerized neurocognitive testing and its relationship to other clinical measures of concussion. *Arch Clin Neuropsychol* 38(4):548-556, 2023.

LaGoy AD, Conkright WR, Proessl F, Sinnott AM, Beckner ME, Jabloner L, Eagle SR, Sekel N, Roma PG, Dretsch MN, Flanagan SD, Mi Q, Nindl BC, Germain A, Connaboy C, Ferrarelli F. Less daytime sleepiness and slow wave activity contribute to better physical readiness in military personnel. *Sleep Health* 9(1):93-99, 2023.

Puccio DJ, Deng H, Eagle SR, Okonkwo DO, Nwachuku EL. Pilot biomarker analysis and decision tree algorithm modeling of patients with chronic subdural hematoma. *Neurotrauma Rep* 4(1): 184-196, 2023.

Sekel NM, Beckner ME, Conkright WR, LaGoy AD, Proessl F, Lovalekar M, Martin BJ, Jabloner LR, Beck AL, Eagle SR, Dretsch M, Roma PG, Ferrarelli F, Germain A, Flanagan SD, Connaboy C, Haufler A, Nindl BC. Military tactical adaptive decision making during simulated military operational stress is influenced by personality, resilience, aerobic fitness and neurocognitive function. *Front Psychol* 14:1102425, 2023.

Eagle SR, Nwachuku E, Elmer J, Deng H, Okonkwo DO, Pease M. Performance of CRASH and IMPACT Prognostic Models for Traumatic Brain Injury at 12- and 24-Months Post-Injury. *Neurotrauma Rep* 4(1):118-123, 2023.

Eagle SR, Puccio AM, Agoston DV, Mancinelli M, Nwafo R, McIntyre P, Agnone A, Tollefson S, Collins M, Kontos AP, Schneider W, Okonkwo DO, Soose RJ. Association of plasma biomarkers with sleep outcomes and treatment response following mild traumatic brain injury. *Neurotrauma Rep* 4(1):252-254, 2023.

Eagle SR, Puccio A, Agoston D, Soose R, Mancinelli M, Nwafo R, McINture P, Agnone A, Tollefson S, Collins M, Kontos A, Schneider W, Okonkwo DO. Evaluating targeted therapeutic response with predictive blood-based biomarkers in patients with chronic mild traumatic brain injury. *Neurotrauma Rep* 4(1):404-409, 2023.

Arefan D, Pease M, Eagle SR, Okonkwo DO, Wu S. Comparison of machine learning models to predict long-term outcomes after severe traumatic brain injury. *Neurosurg Focus* 54(6):E14, 2023.

Oyekan AA, Eagle SR, Trbovich AM, Shaw JD, Schneider M, Collins M, Lee JY, Kontos AP. Neck symptoms and associated clinical outcomes in patients following concussion. *J Head Trauma Rehabil* [Online ahead of print], 2023.

Sherry N, Kissinger-Knox A, Manderino L, Eagle S, Mucha A, Collins MW, Kontos AP. Evidence for a multidomain clinical assessment of mild traumatic brain injury in older adults. *Appl Neuropsychol Adult* [Online ahead of print], 2023.

Eagle SR, Puccio A, Nelson L, McCrea M, Giacino J, Diaz-Arrastia R, Conkright W, Jain S, Sun X, Manley G, Okonkwo DO, TRACK-TBI Investigators. Association of obesity with mild traumatic brain injury symptoms, inflammatory profile, quality of life, and functional outcomes: a TRACK-TBI study. *J Neurol Neurosurg Psych* [Online ahead of print], 2023.

Kontos AP, Eagle SR, Chrisman SPD, Putukian M, Manderino L, Holland C, Collins MW, Broglio SP, McAllister TW, McCrea MA, Pasquina P, Kaminski TW and the CARE Consortium Investigators. Incidence of concussion and associated risk factors in collegiate soccer: findings from the NCAA-DoD CARE Consortium. *Sci Med Foot* [Online ahead of print], 2023.

Kontos AP, Eagle SR, Braithwaite R, Preszler J, Manderino L, Turner R, Hickey R, Root J, Thomas DG, Trbovich A, Collins M, McCrea M, Nelson L. The effects of rest on concussion symptom resolution and recovery time: a meta-analytic review and subgroup analyses of 4,329 patients. *Am J Sports Med* [Online ahead of print], 2023.

Eagle SR, Pease M, Nwachuku E, Deng H, Okonkwo DO. Prognostic models for traumatic brain injury have good discrimination but poor accuracy for predicting mortality and unfavorable outcome at 6-months post-injury. *Neurosurg* [In Press], 2023.

Trbovich AM, Mucha A, Eagle SR, Mehmel BM, Kegel N, Fazio-Sumrok V, Collins M, Kontos AP. Preliminary evidence for the Vestibular Ocular Motor Screening tool-Child (VOMS-C) for concussion evaluation in ages 5-9. *J Neurosurg Peds* [In Press], 2023.

LaGoy AD, Sinnott AM, Eagle SR, Beckner ME, Conkright WR, Proessl F, Williams J, Dretsch MN, Flanagan SD, Nindl BC, Lovalekar M, Germain A, Ferrarelli F, Connaboy C. Combined effects of time-of-day and simulated military operational stress on perception-action coupling. *Chronobiol Int* 39(11):1485-1497, 2022.

Eagle SR, Mucha A, Trbovich A, Manderino L, Elbin RJ, Collins MW, Kontos AP. Association of multidomain assessment outcomes with referral for vestibular therapy following concussion. *J Athl Train* [Online Ahead of Print], 2022.

Matt El-Kadi, MD, PhD

Clinical Professor
Vice Chair
Chief, Neurosurgery, UPMC Passavant
Director, UPMC Passavant Spine Center

Matt El-Kadi, MD, PhD, FACS, joined the Department of Neurological Surgery as a clinical assistant professor in September of 1999. He became clinical associate professor in January 2003 and clinical professor in June 2006. He became vice chairman of the Department of Neurological Surgery in 2010 and has been chief of neurosurgery at UPMC Passavant since 2005. Dr. El-Kadi is also director of the UPMC Passavant Spine Center and is a member of the Tri-State Neurosurgical Associates. Dr. El-Kadi is board-certified in neurological surgery and has been nominated as one of Pittsburgh's best doctors in the region since 2012 and as one of the best doctors in America by Castle Connelly since 2009. He has also been honored since 2019 as one of Marquis *Who's Who in America*. He specializes in the treatment of complex spine disorders, including spinal fusion and instrumentation, and minimally invasive spinal surgery for both the cervical and lumbar spine, with a special interest in the removal of primary and secondary spinal tumors. He has authored seven books and book chapters and has over 100 publications in circulation. He is an active participant in professional societies. Before joining UPMC, Dr. El-Kadi received training in complex spinal surgery at Allegheny General Hospital in Pittsburgh. He completed his neurosurgery residency training at West Virginia University and a one-year clinical fellowship in neurosurgery at Hartford Hospital, University of Connecticut. Dr. El-Kadi began his surgical career doing brain surgery. The minimally invasive and microscopic techniques used then on the brain have served him well as a spine surgeon for minimally invasive approaches and has been reflected in his patients' shorter hospital stays and good outcome.

Specialized Areas of Interest
Minimally invasive spine surgery; complex spine disorders; spinal stabilization; spinal tumors.

Board Certifications
American Board of Neurological Surgeons

Hospital Privileges
Grove City Medical Center
Heritage Valley Hospital, Sewickley
UPMC Mercy
UPMC Passavant
UPMC Presbyterian
The Washington Hospital

Professional Organization Membership
Allegheny County Medical Society
American Academy of Anti-Aging Medicine
American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons
International Spinal Injections Society
North American Spine Society
Ohio County Medical Society
Pennsylvania Medical Society
Pennsylvania Neurosurgical Society

Matt El-Kadi, MD, PhD

Professional Activities
Board of Directors, UPMC Passavant and UPMC St. Margaret
Board of Directors, Passavant Foundation

Education & Training
MD, Second Moscow State Pirogov Medical Institute, 1983
Residency, Neurosurgery, Burdenko Neurosurgical Institute, 1989
Fellowship, Brain Tumor Research, LAC + USC Medical Center, 1992
Fellowship, Neurosurgery, University of Connecticut, 1994
Fellowship, Neurosurgery, Allegheny General Hospital, 1998
Residency, Neurosurgery, West Virginia University, 1999

Honors & Awards
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2012-23
Marquis *Who's Who in America*, 2019-20
Castle Connelly Top Doctors, 2009-2020
UPMC Passavant Legacy of Caring Award, 2014
UPMC Champion of Nursing Award, 2011

News Media Appearances: 2022-23
"UPMC Spine Center: Restoring Lives With a Comprehensive Approach," *North Hills Monthly*, January 2023.

Chikezie I. Eseonu, MD, FAANS

Clinical Assistant Professor

Chikezie Eseonu, MD, FAANS, is a clinical assistant professor at UPMC Central Pennsylvania. He received his undergraduate degree at Harvard University in biomedical engineering in 2007 and completed his medical education at Yale School of Medicine in 2011. Following medical school, Dr. Eseonu completed his neurosurgery residency at Johns Hopkins Hospital in Baltimore, Md., where he also completed an enfolded neuro-oncology/endoscopic/skull base fellowship. Dr. Eseonu's clinical interests embrace several aspects of brain tumor treatment, including open surgical, minimally invasive or radiosurgical techniques. He is also involved in the treatment of trigeminal neuralgia, Chiari malformation, hydrocephalus, and other general neurosurgical conditions including degenerative spine, spinal stenosis, and disc herniation. Dr. Eseonu's research has encompassed such areas as surgical technique and outcome studies for gliomas, pituitary adenomas, trigeminal neuralgia, and awake craniotomy for brain tumors, as well as cost efficacy studies in neurosurgery. He has published over 30 peer reviewed papers and book chapters and is a member of the American Association of Neurological Surgeons and the Facial Pain Association.

Specialized Areas of Interest
Brain tumors; radiosurgery; trigeminal neuralgia; Chiari malformation; spine surgery.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Central Pennsylvania

Professional Organization Membership
American Association of Neurological Surgeons
Facial Pain Association

Chikezie I. Eseonu, MD, FAANS

Education & Training
BA, Biomedical Engineering, Harvard University, 2007
MD, Yale School of Medicine, 2011
Neuro-oncology/Endoscopic/Skull Base Fellowship, Johns Hopkins Hospital, 2017
Neurosurgery Residency, Johns Hopkins Hospital, 2018

Research Activities
Dr. Eseonu is performing grant supported research evaluating quantitative analysis of white matter tractography during brain tumor surgery. He is developing quantitative metrics to correlate white matter tractography changes with clinical outcomes.

Robert M. Friedlander, MD

Chair, Walter E. Dandy Distinguished Professor
Head of Cerebrovascular Neurosurgery
Director, Complex Brain Surgery Program
Co-Director, UPMC Neurological Institute

Robert Friedlander, MD, MA, is the Walter E. Dandy Distinguished Professor, chair of the University of Pittsburgh Department of Neurological Surgery and co-director of the UPMC Neurological Institute, positions he has held since 2010. Before coming to the University of Pittsburgh, Dr. Friedlander was a professor at Harvard Medical School. He was also vice-chair of neurosurgery, associate director of cerebrovascular surgery and co-director of the Neuroscience Research Center at the Brigham and Women's Hospital in Boston. Dr. Friedlander has received a number of significant academic awards, most significantly an induction into the prestigious National Academy of Medicine in 2019. Election to the academy is considered one of the highest honors in the fields of health and medicine and recognizes individuals who have demonstrated outstanding professional achievement and commitment to service. He has also received the Bayer Cerebrovascular Award from the Joint Section of Cerebrovascular Surgery, the International Charcot Prize for Motor Neuron Diseases, the Award from the Academy of Neurological Surgeons, the H. Richard Winn Prize from the Society of Neurological Surgeons, and the Distinguished Chancellor University of Pittsburgh Research Award. Dr. Friedlander is an elected member of the prestigious American Society for Clinical Investigation, and the Association of American Physicians. As a sign of his prominence as a clinician and scientist, Dr. Friedlander is one of a very select group of authors to have been invited by the *New England Journal of Medicine* to write both a basic science review (mechanisms of neuronal cell death), as well as a clinical review (management of AVMs). Clinically, Dr. Friedlander focuses on the operative management of complex cerebrovascular disorders, brain tumors and Chiari malformations. Dr. Friedlander's major research interests lie in the study of the mechanistic pathways of the caspase apoptosis gene family. His work includes the evaluation of treatment strategies for neurodegenerative diseases (Huntington's and ALS), stroke, brain trauma, and spinal cord injury through the modulation of the caspase-family apoptotic pathways. He was first to demonstrate activation and a functional role of caspase cell death pathways in neurological diseases. His research has received significant media attention. His major work has been published in the highest impact journals, most notably four publications in *Nature,* two in *Science,* one in *Nature Medicine,* one in *Nature Neuroscience* and eight in *PNAS*. For over two decades, he has had continuous NIH support as a principal investigator, as well numerous foundation awards. He directs a busy and prolific laboratory. Dr. Friedlander served on the National Advisory Council of the National Institutes of Neurological Disorders and Stroke (NINDS). Additionally, a rewarding aspect of Dr. Friedlander's activities is his involvement in organized neurosurgery. He was a member of the executive committee of the Congress of Neurological Surgeons, as well as chair of the CNS Research Committee, the CNS Membership Committee, and the CNS Publications Committee. He directed the Society of Neurological Surgeons RUNN (Research Update in Neuroscience for Neurosurgeons) Course from 2004 to 2018

Robert M. Friedlander, MD

and served as chair of the Society of Neurological Surgeons research committee. He is a past chair of the AANS/CNS Joint Section of Cerebrovascular Surgery. A native of Caracas, Venezuela, Dr. Friedlander came to the United States in 1983 and earned a joint BA and MA in biochemistry from Brandeis University in 1987. In 1991, he graduated from Harvard Medical School and went on to fulfill his internship in general surgery and residency in neurosurgery at Massachusetts General Hospital.

Specialized Areas of Interest
Aneurysms; vascular malformations; brain tumors; carotid disease; cerebrovascular disease; Chiari malformation; spinal cord tumors. Research focuses on mechanisms of apoptosis, Huntington's disease, ALS and stroke.

Board Certifications
American Board of Neurological Surgeons

Hospital Privileges
UPMC Altoona
UPMC Children's Hospital of Pittsburgh
UPMC Hamot
UPMC Magee-Womens Hospital
UPMC Mercy
UPMC Passavant
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
American Academy of Neurological Surgeons
American Association for the Advancement of Science
American Association of Neurological Surgeons
American Association of Physicians
American Society for Clinical Investigation
Brain Aneurysm Foundation, Medical Advisory Board
Congress of Neurological Surgeons
Joint Section of Cerebrovascular Surgery
National Academy of Medicine
Pennsylvania Neurosurgical Society
Sociedad Venezolana de Neurocirugia
Society for Neurological Surgeons
Society for Neuroscience

Professional Activities
American Association of Neurological Surgeons:
- Annual Meeting Committee
- Research Committee

Congress of Neurological Surgeons:
- Publications Committee
- Executive Committee

NeuBase Therapeutics:
- Chair, Scientific Advisory Board
- Chief Scientific Officer

NINDS National Advisory Council:
Clinical Trials Subcommittee
Fellowships and Training Subcommittee
Basic Science Subcommittee
Chair, AANS/CNS Joint Cerebrovascular Section, American Academy of Neurological Surgery
NAM Nominating Committee, National Academy of Medicine
Research Committee, Society of Neurological Surgeons
Scientific Advisory Board, Brain Aneurysm Foundation
Scientific Advisory Board, Worldwide Syringomyelia and Chiari Taskforce
Scientific Advisory Board, DiFusion Technologies
Host, *Fridays with Friedlander*, neurosurgery.pitt.edu

Education & Training
BA, Brandeis University, 1987
MA, Biochemistry, Brandeis University, 1987
MD, Harvard Medical School, 1991

Honors & Awards
Distinguished Chancellor University of Pittsburgh Research Award, 2021
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2012-22
National Academy of Medicine induction, 2019
Honored Guest, HRH Crown Prince Alexander and HRH Crown Princess Katherine, Belgrade, Serbia, 2014
Honored Guest, US Ambassador, Belgrade, Serbia, 2013
America's Top Surgeons, 2013
Castle Connolly Top Doctor in the Field of Neurological Surgery, 2013
H. Richard Winn Prize for Neurosurgical Research, 2012

News Media Appearances: 2022-23
"Local family working to cure dementia nearly 10 years after father's death," WPXI-TV, December 27, 2022.
"Can a Brain Surgeon Operate an Excavator?" *Outdoors with the Morgans*, October 30, 2022.
"Robert Friedlander Discusses UPMC Neurosurgery," *Our Region's Business*, WPXI-TV, October 2, 2022.
"Republicans suggest John Fetterman is too sick to serve. Neurologists call attacks uninformed," abcnews.com," September 9, 2022.
"Fireside Chat with CNN Chief Medical Correspondent, Dr. Sanjay Gupta," GMIS America: Advancing Clogbal Industrialization and Net Zero, Pittsburgh, Pa., September 28, 2022.

Publications: 2022-23
• Refereed Articles:
Nowicki KW, Mittal AM, Abou-Al-Shaar H, Rochlin EK, Lang MJ, Gross BA, Friedlander RM. A Future Blood Test to Detect Cerebral Aneurysms. *Cell Mol Neurobiol* 43(6):2697-2711, 2023.

Plute T, Patel A, Mallela AN, Sefcik RK, Hamilton DK, Lunsford LD, Friedlander RM, Abou-Al-Shaar H. United States Neurosurgery Department Program Directors: A Cross-Sectional Evaluation of Current and Future Trends and Attributes. *World Neurosurg* 170:e550-e557, 2023.

Suofu Y, Jauhari A, Nirmala ES, Mullins WA, Wang X, Li F, Carlisle DL, Friedlander RM. Neuronal melatonin type 1 receptor overexpression promotes M2 microglia polarization in cerebral ischemia/reperfusion-induced injury. *Neurosci Lett* 795:137043, 2023.

Bin-Alamer O, Qedair J, Palmisciano P, Mallela AN, Nayar GM, Lu VM, Labib MA, Lang MJ, Gross BA, Langer DJ, Couldwell WT, Friedlander RM, Abou-Al-Shaar H. Dolichoectatic vertebrobasilar aneurysms: a systematic review and meta-analysis of management strategies and outcomes. *Neurosurg Focus* 54(5):E9, 2023.

Powell MP, Verma N, Sorensen E, Carranza E, Boos A, Fields DP, Roy S, Ensel S, Barra B, Balzer J, Goldsmith J, Friedlander RM, Wittenberg GF, Fisher LE, Krakauer JW, Gerszten PC, Pirondini E, Weber DJ, Capogrosso M. Epidural stimulation of the cervical spinal cord for post-stroke upper-limb paresis. *Nat Med* 29(3):689-699, 2023.

Zou H, Poore B, Brown EE, Qian J, Xie B, Asimakidou E, Razskazovskiy V, Ayrapetian D, Sharma V, Xia S, Liu F, Chen A, Guan Y, Li Z, Wanggou S, Saulnier O, Ly M, Fellows-Mayle W, Xi G, Tomita T, Resnick AC, Mack SC, Raabe EH, Eberhart CG, Sun D, Stronach BE, Agnihotri S, Kohanbash G, Lu S, Herrup K, Rich JN, Gittes GK, Broniscer A, Hu Z, Li X, Pollack IF, Friedlander RM, Hainer SJ, Taylor MD, Hu B. A neurodevelopmental epigenetic programme mediated by SMARCD3-DAB1-Reelin signalling is hijacked to promote medulloblastoma metastasis. *Nat Cell Biol* 25(3):493-507, 2023.

Hudson JS, McCarthy DJ, Alattar A, Mehdi Z, Lang MJ, Gardner PA, Zenonos GA, Friedlander RM, Gross BA. Increased prevalence of blister aneurysm formation during the COVID-19 pandemic. *Clin Neurol Neurosurg* 226:107613, 2023.

Golbourn BJ, Halbert ME, Halligan K, Varadharajan S, Krug B, Mbah NE, Kabir N, Stanton AJ, Locke AL, Casillo SM, Zhao Y, Sanders LM, Cheney A, Mullett SJ, Chen A, Wassell M, Andren A, Perez J, Jane EP, Premkumar DRD, Koncar RF, Mirhadi S, McCarl LH, Chang YF, Wu YL, Gatesman TA, Cruz AF, Zapotocky M, Hu B, Kohanbash G, Wang X, Vartanian A, Moran MF, Lieberman F, Amankulor NM, Wendell SG, Vaske OM, Panigrahy A, Felker J, Bertrand KC, Kleinman CL, Rich JN, Friedlander RM, Broniscer A, Lyssiotis C, Jabado N, Pollack IF, Mack SC, Agnihotri S. Loss of MAT2A compromises methionine metabolism and represents a vulnerability in H3K27M mutant glioma by modulating the epigenome. *Nat Cancer* 3(7):899, 2022.

Kim S, Nowicki KW, Ye S, Jang K, Elsisy M, Ibrahim M, Chun Y, Gross BA, Friedlander RM, Wagner WR. Bioabsorbable, elastomer-coated magnesium alloy coils for treating saccular cerebrovascular aneurysms. *Biomaterials* 290:121857, 2022.

Paul A. Gardner, MD

Peter J. Jannetta Professor
Neurosurgical Co-Director, Center for Cranial Base Surgery
Neurosurgical Co-Director, Pituitary Center of Excellence
Director, Surgical Neuroanatomy Lab
Co-Director, Endoscopic and Open Skull Base Fellowship

Paul A. Gardner, MD, joined the faculty at the University of Pittsburgh Department of Neurological Surgery in 2008 after completing his residency and fellowship training at the University of Pittsburgh. He completed his undergraduate studies at Florida State University, majoring in biochemistry, and received his medical degree from the University of Pittsburgh School of Medicine. Dr. Gardner completed a two-year fellowship in endoscopic endonasal pituitary and endoscopic and open skull base surgery. His research has focused on evaluating patient outcomes following these surgeries and more recently on genomic and molecular analysis of skull base tumors. Dr. Gardner has been the neurosurgical director of the Center for Cranial Base Surgery at the University of Pittsburgh Medical Center since April of 2008 and, along with Carl Snyderman, MD, of the University of Pittsburgh Department of Ophthalmology, leads a renowned course on en-

doscopic endonasal surgery three times a year. Dr. Gardner is co-author of the book *Skull Base Surgery*, part of the *Master Techniques in Otolaryngology: Head and Neck Surgery* series published by Wolters Kluwer. The book offers step-by-step expert instruction on more than 45 procedures, covering both open and minimally invasive approaches to the skull base. He is also the primary editor of the recently released book *Vascular Challenges in Skull Base Surgery*, described as an "essential multidisciplinary guide for the prevention and management of vascular injury from master skull base surgeons," published by Thieme. Dr. Gardner is an author on over 350 peer-reviewed articles.

Specialized Areas of Interest
Endoscopic endonasal and open skull base surgery; pituitary tumors; vascular surgery; cranial nerve disorders; minimally invasive surgery; peripheral nerve surgery.

Board Certifications
American Board of Neurological Surgeons

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Mercy
UPMC Presbyterian
UPMC Select Specialty
VA Pittsburgh Healthcare System

Professional Organization Membership
Acoustic Neuroma Association
American Academy of Neurological Surgeons
American Association of Neurological Surgeons
Congress of Neurological Surgeons
International Federation of Neuroendoscopy
North American Skull Base Society
Pituitary Network Society

Professional Activities
Skull Base Committee, AANS/CNS Tumor Section
Course Co-Director, Comprehensive Endoscopic Endonasal Course, UPMC
Course Co-Director, Complex Endoscopic Endonasal Course, UPMC
CNS Foundation Liaison, AANS/CNS Tumor Section
Member, Medical Advisory Board, Chordoma Foundation

Education & Training
AA, Okaloosa-Walton College, 1993
BS, Biochemistry, Florida State University, 1997 (Magna cum laude)
MD, University of Pittsburgh, 2001
Fellowship, Endoscopic and Open Skull Base Surgery, 2007
Residency, Neurosurgery, University of Pittsburgh, 2008

Honors & Awards
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2012-23
Pituitary Center of Excellence, Designated Physician

Paul A. Gardner, MD

News Media Appearances: 2022-23

"The Evolution of Endoscopic Endonasal Approach for Olfactory Groove Meningiomas," *CNS Journal Podcast*, January 17, 2023

Publications: 2022-23

• Refereed Articles:

Gendreau J, Jimenez A, Lozinsky S, Zenonos G, Gardner P, Raza S, Dea N, Gokaslan Z, Choby G, Van Gompel J, Redmond K, Gallia G, Bettegowda C, Rowan N, Kuo CC, Mukherjee D. Radiotherapy after gross total resection of skull base chordoma: a SEER database analysis of overall survival outcomes. *World Neurosurg* 172:e68-e76 2023.

Palmieri DE, Champagne PO, Valappil B, McDowell M, Gardner PA, Snyderman CH. Risk factors in a pediatric population for postoperative intracranial infection following endoscopic endonasal skull base surgery and the role of antibiotic prophylaxis. *Am J Rhinol Allergy* 37(1):13-18, 2023.

Agrawal N, Gersey ZC, Abou-Al-Shaar H, Gardner PA, Mantica M, Agnihotri S, Mahmud H, Fazeli PK, Zenonos GA. Major genetic motifs in pituitary adenomas: a practical literature update. *World Neurosurg* 169:43-50, 2023.

Champagne PO, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. The evolution of endoscopic endonasal approach for olfactory groove meningiomas. *Operative Neurosurgery* 24(2):121-130, 2023.

Gardner PA, McDowell MM, Orhorhoro O, Snyderman CH, Gonzalez-Martinez J. A novel sublabial anterior transmaxillary approach for medically refractory mesial temporal lobe epilepsy: a comparative anatomic study. *Operative Neurosurgery* 24(2):e92-e103, 2023.

Khiyami AM, Jokar TO, Abdallah HM, Gardner PA, Zenonos GA, Styker AK, Fazeli PK. Polycystic ovary syndrome preceding the diagnosis of acromegaly: a retrospective study in 97 reproductive-aged women. *Reprod Biol Endocrinol* 21(1):14, 2023.

Polster SP, Beale O, Patel VA, Abou-Al-Shaar H, Stefko ST, Gardner PA. The transcaruncular corridor of the medial transorbital approach to the frontal lobe: technical nuances and applications. *Oper Neurosurg* (Hagerstown) 24(6):e458-e462 2023.

Gonzalez-Martinez JA, Abou-Al-Shaar H, Mallela AN, McDowell MM, Henry L, Fernandes-Cabral D, Sweat J, Urban A, Fong J, Barot N, Castellano JF, Rajasekaran V, Bagic A, Snyderman CH, Gardner PA. The endoscopic anterior transmaxillary temporal pole approach for mesial temporal lobe epilepsies: a feasibility study. *J Neurosurg* 138(4):992-1001, 2023.

Hebert AM, Kuan EC, Wang MB, Snyderman CH, Gardner PA, Bergsneider M, Fernandez-Miranda JC, Wang EW. An algorithm for the use of free tissue graft reconstruction in the endoscopic endonasal approach for pituitary tumors. *World Neurosurg* 175:e465-e472 2023.

Shah S, Durkin J, Byers KE, Snyderman CH, Gardner PA, Shields RK. Microbiologic and clinical description of postoperative central nervous system infection after endoscopic endonasal surgery. *World Neurosurg* 175:e434-e438 2023.

Anstadt EE, Chen W, O'Brien J, Ickow I, Chow I, Bruce MK, Goldstein JA, Branstetter IV BF, Snyderman C, Wang EW, Gardner P, Schuster L. Characterization of the saddle nose deformity following endoscopic endonasal skull base surgery. *J Neurol Surg B Skull Base* 84:225-231, 2023.

John L, Smith H, Ilanchezhian M, Lockridge R, Reilly KM, Raygada M, Dombi E, Sandler A, Thomas BJ, Glod J, Miettinen M, Allen T, Sommer J, Levy J, Lozinsky S, Dix D, Bouffet E, MacDonald S, Mukherjee D, Snyderman CH, Rowan NR, Malyapa R, Park DM, Heery C, Gardner PA, Cote GM, Fuller S, Butman JA, Jackson S, Gulley JL, Widemann BC, Wedekind MF. The NIH pediatric/young adult chordoma clinic and natural history study: making advances in a very rare tumor. *Pediatr Blood Cancer* [Online ahead of print], 2023.

Plute T, Abou-Al-Shaar H, McDowell MM, Mallela AN, Snyderman CH, Gardner PA. Endoscopic endonasal resection of a recurrent pre-pontine neurenteric cyst: 2-dimensional operative video. *Oper Neurosurg* (Hagerstown) [Online ahead of print], 2023.

Adams GM, Crammond DJ, Shandal V, Gardner PA, Snyderman CH, Anetakis KM, Balzer JR, Thirumala PD. Minimally invasive extraocular cranial nerve electromyography. *J Neurosurg* [Online ahead of print], 2023.

Geltzeiler M, Choby GW, Ji KSY, Mace JC, Almeida JP, de Almeida J, Champagne PO, Chan E, Ciporen JN, Chaskes MB, Cornell S, Drozdowski V, Fernandez-Miranda J, Gardner PA, Hwang PH, Kalyvas A, Kong KA, McMillan RA, Nayek JV, Patel C, Patel ZM, Peris Celda M, Pinheiro-Neto C, Sanusi OR, Snyderman CH, Thorp BD, Van Gompel JJ, Zadeh G, Zenonos G, Zwagerman NT, Wang EW. Radiographic predictors of occult intracranial involvement in olfactory neuroblastoma patients. *Int Forum Allergy Rhinol* [Online ahead of print], 2023.

Jafari A, Adappa ND, Anagnos VJ, Campbell RG, Castelnuovo P, Chalian A, Chitguppi C, Dallan I, El Rassi E, Freitag SK, Fernandez-Miranda JC, Ferreira Jr M, Gardner PA, Gudis DA, Harvey RJ, Huang Q, Humphreys IM, Kennedy DW, Lee JYK, Lehmann AE, Locatelli D, McKinney K, Moreau A, Nyquist G, Palmer JN, Prepageran N, Pribitkin EA, Rabinowitz MR, Rosen MR, Sacks R, Sharma D, Snyderman CH, Stefko ST, Stokken JL, Wang EW, Workman AD, Wu AW, Yu JY, Zhang MM, Zhou B, Bleier BS. Orbital resection by intranasal technique (ORBIT): a new classification system for reporting endoscopically resectable primary benign orbital tumors. *Int Forum Allergy Rhinol* [Online ahead of print], 2023.

Lavigne P, Wang EW, Gardner PA, Snyderman CH. From research to clinical practice: long-term impact of randomized clinical trial examining the effect of lumbar drains on cerebrospinal fluid leak rates following endonasal skull base surgery. *J Neurol Surg B Skull Base* 83(4):339-342, 2022.

Patel VA, Polster SP, Abou-Al-Shaar H, Kalmar CL, Zenonos GA, Wang EW, Gardner PA, Snyderman CH. Trigeminal schwannoma: a retrospective analysis of endoscopic endonasal management, treatment outcomes, and neuropathic sequelae. *J Neurol Surg B Skull Base* [online ahead of print], 2022.

Borghei-Razavi H, Eguiluz-Melendez AG, Wenping X, Truong HQ, Fernandes-Cabral D, Najera E, Stefko ST, Fernandez-Miranda JC, Gardner PA. Surgical limitations of the microscopic transciliary supraorbital keyhole approach to the anterior and middle skull base. *World Neurosurg* 167:e1440-e1447, 2022.

Patel A, Abou-Al-Shaar H, Malella AN, Algattas H, McDowell MM, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Endoscopic techniques in vascular neurosurgery. *Neurosurg Clin N Am* 33(4):491-503, 2022.

Frederico SC, Darling C, Zhang X, Huq S, Agnihotri S, Gardner PA, Snyderman CH, Wang EW, Zenonos GA. Circulating tumor DNA – a potential aid in the management of chordomas. *Front Oncol* 12:1016385, 2022.

Fields DP, McDowell MM, Schulien AJ, Algattas H, Abou-Al-Shaar H, Agarwal N, Alan N, Costacou T, Wang EW, Snyderman CH, Gardner PA, Zenonos GA. Low preoperative prealbumin levels are a strong independent predictor of postoperative cerebrospinal fluid leak following endoscopic endonasal skull base surgery. *World Neurosurg* 167:e110-e116, 2022.

Mendez AA, McCarthy DJ, Tonetti DA, Desai SM, Mountz JM, Gardner PA, Jovin TG, Jadhav AP. Angiographic predictors of outcomes after balloon test occlusion. *Stroke Vasc Interv Neurol* 2(6):e000371, 2022.

Saleh S, Sullivan SE, Bellile E, Roxbury C, Das P, Abi Hachem R, Ackall F, Jang D, Celtikci E, Sahin MM, D'Souza G, Evans JJ, Nyquist G, Khalafallah A, Mukherjee D, Rowan NR, Camp S, Choby G, Van Gompel JJ, Ghiam MK, Levine CG, Field M, Adappa N, Locke TB, Rassekh C, Sweis AM, Goyal N, Zacharia B, Wilson MN, Patel S, Gardner PA, Snyderman CH, Wang EW, Glancz LJ, Bagchi A, Dow G, Robertson I, Rangarajan SJ, Michael II LM, McKean EL. Retrospective review of surgical site infections after endoscopic endonasal sellar and parasellar surgery: multicenter quality data from the North American Skull Base Society. *J Neurol Surg B Skull Base* 83(6):579-588, 2022.

Alsaadi N, Hassoune A, Haldeman S, Williamson KM, Plautz W, Hoteit L, Alvikas J, Andraska EA, Srinivasan AJ, Bonaroti J, Seshadri A, Mota-alvidrez R, Scott MJ, Gardner PA, Snyderman CH, Neal MD. Effect of irrigation fluid composition on hemostasis in mouse bleeding models. *Shock* 58(6):549-555, 2022.

Champagne PO, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Endoscopic endonasal anterior clinoidectomy: volumetric assessment, feasibility. *World Neurosurg* 168:e269-e277, 2022.

• Book Chapters:
Pinheiro-Neto CD, Snyderman CH, Gardner PA. Cranial base surgery. In: Rosen CA, Gray ST, Ha PK, Limb CJ, Park SS, Richter GT (eds), *Bailey's Head & Neck Surgery-Otolaryngology, 6th Edition*, pp 2377-2393, Wolters Kluwer Health, 2023.

Snyderman CH, Gardner PA. Necrotic nasal flap following endoscopic skull base surgery. In Narendrakumar V, Felix V, Mariappan V (eds), *100 Complications of Otorhinoloaryngology & Skull Base Surgery*, pp 107-111, Thieme, 2023.

• Published Abstracts:
Abou-Al-Shaar H, Plute TJ, McDowell MM, Snyderman CH, Gardner PA. Endoscopic endonasal transclival resection of a recurrent neurenteric cyst. *J Neurol Surg B Skull Base* 84(S 01):V008, 2023.

Algattas HN, Tadokoro K, Wang EW, Gardner PA. Endoscopic endonasal resection of infundibular hemangioblastoma. *J Neurol Surg B Skull Base* 84(S 01):V012, 2023.

Filimonov A, Gardner P, Snyderman C. Transoral endoscopic retropharyngeal lymph node dissection. *J Neurol Surg B Skull Base* 84(S 01):V015, 2023.

Fernandes DT, Agarwal P, Anand S, Snyderman CH, McDowell M, Gardner P. Endoscopic endonasal approach for craniopharyngioma resection in a pediatric patient. *J Neurol Surg B Skull Base* 84(S 01):V022, 2023.

Xie M, Zhang H, Witterick I, Monteiro E, Zadeh G, Snyderman C, Gardner P, Wang E, Valappil B, Fliss DM, Ringel B, Gil Z, Na'ara S, Ooi E, Goldstein DP, Gentili F, Kalyvas A, de Almeida JR. Sociodemographic factors and quality of life in skull base surgery. *J Neurol Surg B Skull Base* 84 (S 01):S104, 2023.

Ettyreddy A, McCall A, Gardner P. Combined petrosal approach for recurrent hemangiopericytoma. *J Neurol Surg B Skull Base* 84(S 01):V049, 2023.

Jani RH, Kim M, Shanker R, Raju S, Algattas H, Snyderman C, Gardner P, Patel C, Germanwala A. Endoscopic endonasal approach for residual and recurrent craniopharyngioma after transcranial approach. *J Neurol Surg B Skull Base* 84(S 01):P061, 2023.

Choby G, Geltzeiler M, Almeida JP, Champagne PO, Cetas J, Chan E, Ciporen J, Chaskes M, Fernandez-Miranda J, Gardner P, Gentili F, Hwang P, Ji KSY, Kalyvas A, Kong K, McMillan R, O'Byrne J, Patel C, Patel Z, Peris-Celda M, Pinheiro-Neto C, Sanusi O, Snyderman C, Thorp BD, Van Gompel JJ, Zenonos G, Zwagerman N, Wang EW. Olfactory neuroblastoma: a multicenter survival analysis and application of a staging modification incorporating Hyam's grade. *J Neurol Surg B Skull Base* 84(S 01):S076, 2023.

Ali MS, Zenonos G, Snyderman C, Wang E, Gardner P. Endoscopic endonasal posterior clinoidectomy: surgical anatomy and operative technique. *J Neurol Surg B Skull Base* 84(S 01):S085, 2023.

Tosi U, Jackson C, D'Souza G, Parsel S, Anand V, Nyquist G, Gardner P, Schwartz T. Endoscopic endonasal repair of encephaloceles of the lateral sphenoid sinus: a multi-institution experience. *J Neurol Surg B Skull Base* 84(S 01):P144, 2023.

Shah S, Durkin J, Byers KE, Snyderman CH, Gardner PA, Shields RK. Epidemiology and microbiologic characteristics of postoperative central nervous system infections following endoscopic endonasal surgery. *J Neurol Surg B Skull Base* 84(S 01):S145, 2023.

Alattar AA, Abou-Al-Shaar H, Fernandes-Cabral DT, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Patterns and management of intracranial recurrence of esthesioneuroblastoma. *J Neurol Surg B Skull Base* 84(S 01):P161, 2023.

Melder K, Choby G, Almeida J, Champagne PO, Cetas J, Chan E, Ciporen J, Chaskes MB, Fernandez-Miranda J, Gardner P, Gentili F, Hwang P, Ji KSY, Kalyvas A, Kong KA, McMillan R, O'Byrne J, Patel C, Patel Z, Peris-Celda M, Pinheiro-Neto C, Snyderman CH, Thorp BD, Van Gompel JJ, Zenonos G, Zwagerman NT, Sanusi O, Wang EW, Geltzeiler M. Recurrence morbidity of olfactory neuroblastoma. *J Neurol Surg B Skull Base* 84(S 01):S164, 2023.

Abdallah HM, Gersey ZC, Gray ZN, Fogg DN, Duehr JE, Abou-Al-Shaar H, Arani K, Stefko ST, Bonhomme GR, Fazeli P, Mahmud H, Wang EW, Snyderman CH, Gardner PA, Zenonos GA. Outcomes of redo endoscopic endonasal skull base surgery for recurrent or residual nonfunctioning pituitary adenomas: an analysis of 93 consecutive patients at the University of Pittsburgh Medical Center. *J Neurol Surg B Skull Base* 84(S 01):P181, 2023.

North LN, Daniels KE, Filimonov A, Ali MS, Zenonos G, Gardner PA, Snyderman CH, Wang EW. Visual outcomes for endoscopic endonasal orbital and optic nerve decompression for optic nerve sheath meningiomas prior to radiation therapy. *J Neurol Surg B Skull Base* 84(S 01):S187, 2023.

Daniels KE, Mocharnuk J, Balogun Z, Zenonos GA, Gardner PA, Wang EW, Snyderman CH. Long-term complications of extracranial pericranial flaps in skull base reconstruction. *J Neurol Surg B Skull Base* 84(S 01):S251, 2023.

Abou-Al-Shaar H, Bin-Alamer O, Mallela AN, Lunsford LD, Gardner PA. Acoustic neuromas with intratumor hemorrhage: incidence and management of a rare entity. *J Neurol Surg B Skull Base* 84(S 01):P255, 2023.

Ali MS, Gupta P, Zenonos G, Snyderman C, Wang E, Gardner P. Nasal chondrosarcoma: a separate entity? *J Neurol Surg B Skull Base* 84(S 01):P085, 2023.

Ali MS, Ramos Ferreira L, Gardner P, Tang Q. Role of IL-6-induced inflammation in cerebral aneurysm pathogenesis. *J Neurol Surg B Skull Base* 84(S 01):S120, 2023.

Geltzeiler M, Choby G, Ji KSY, Mace J, Almeida JP, Champagne PO, Cetas J, Chan E, Ciporen J, Chaskes MB, Fernandez-Miranda J, Gardner P, Gentilit F, Hwang P, Kalyvas A, Kong KA, McMillan R, Patel C, Drozdowski V, Patel Z, Peris-Celda M, Pinheiro-Neto C, Sanusi O, Snyderman C, Thorp BD, Van Gompel JJ, Zadeh G, Zenonos G, Zwagerman NT, Cornell S, Wang EW. Radiographic predictors of occult intracranial involvement in olfactory neuroblastoma patients. *J Neurol Surg B Skull Bas*e 84(S 01):S195, 2023.

Filimonov A, North L, Daniels K, Ali MS, Zenonos G, Gardner P, Snyderman CH, Wang EW. Sinonasal neuroendocrine carcinoma: is induction chemotherapy and definitive chemoradiation associated with worse outcomes? A case series. *J Neurol Surg B Skull Base* 84(S 01):P200, 2023.

Fernandes DT, Alattar A, Zenonos GA, Wang E, Snyderman CH, Gardner P. Risk factors for tumor residual and recurrence in first-time resection of craniopharyngioma through endoscopic endonasal approach. *J Neurol Surg B Skull Base* 84(S 01):S225, 2023.

Abou-Al-Shaar H, Wrigley R, Patel A, Mallela AN, Zenonos GA, Gardner PA. Skull base meningiomas as part of a novel meningioma syndrome associated with chronic depot medroxyprogesterone acetate use. *J Neurol Surg B Skull Base* 84(S 01):S231, 2023.

Algattas HN, Alattar AA, Wang EW, Snyderman CH, Okonkwo DO, Hamilton DK, Zenonos GA, Gardner PA. A novel classification of compressive craniocervical junction disorders. *J Neurol Surg B Skull Base* 84(S 01):S238, 2023.

Peter C. Gerszten, MD, MPH

Peter E. Sheptak Professor
Vice Chair, Quality Improvement
Director, Percutaneous Spine Service

Peter C. Gerszten, MD, MPH, is the Peter E. Sheptak Professor of Neurosurgery at the University of Pittsburgh. Dr. Gerszten joined the Department of Neurological Surgery and the UPMC Spine Services Division in 1999. He received his undergraduate degree from the University of Virginia and completed his medical degree at the Johns Hopkins School of Medicine. He completed his residency in neurological surgery at the University of Pittsburgh Medical Center. Dr. Gerszten obtained a master of public health degree from the University of Pittsburgh Graduate School of Public Health. He completed a fellowship in spinal surgery at the University of Pittsburgh Medical Center. Dr. Gerszten specializes in disorders of the spine. His areas of clinical interest within the field of neurosurgery include spinal tumors, failed back syndrome, stereotactic radiosurgery of spinal lesions, minimally invasive spine surgical techniques, sacroiliac dysfunction, compression fractures, and percutaneous techniques including neuromodulation. Dr. Gerszten's area of research is the application of outcomes research to spinal surgical interventions. He is a pioneer in the field of spine radiosurgery. His current clinical research involves the use of electrical spinal cord stimulation for a variety of neurological disorders including stroke, spinal cord injury, and spinal muscular atrophy. Dr. Gerszten currently serves on the editorial boards of *The Spine Journal*, the *Journal of the North American Spine Society, Neurosurgery*, the *Journal of the Congress of Neurological Surgery*, and *The International Journal of Spine Surgery*.

Peter C. Gerszten, MD, MPH

Specialized Areas of Interest
Neuromodulation; spinal cord stimulation for post-stroke paralysis; outcomes research applied to neurosurgical interventions; failed back syndrome; stereotactic radiosurgery of spinal lesions; minimally invasive spine surgical techniques; sacroiliac dysfunction; compression fractures and percutaneous cement augmentation techniques.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
Excela Health
UPMC Magee-Womens Hospital
UPMC Presbyterian
UPMC Shadyside
Veterans Affairs Pittsburgh Healthcare System

Professional Organization Membership
Allegheny County Medical Society
American Academy of Neurological Surgery
American Association of Neurological Surgeons
American Board of Neurological Surgery
American College of Surgeons
American Medical Association
Congress of Neurological Surgeons
Delta Omega Public Health National Honor Society
International Stereotactic Radiosurgery Society
Joint Section on Disorders of the Spine and Peripheral Nerves
North American Spine Society
Paleopathology Society
Pennsylvania Neurosurgical Society
Pennsylvania State Medical Society
The Radiosurgery Society

Professional Activities
Assistant Editor, *Neurosurgery*
Editorial Board, *The Spine Journal*
Senior Review Editor, *International Journal of Spine Surgery*
Associate Appointment, Carnegie Mellon University, The Neuroscience Institute
Course Lecturer, Principles and Practice of Gamma Knife Radiosurgery, UPMC
Course Lecturer, Spine Surgery Anatomy Course, University of Pittsburgh School of Medicine
Site Reviewer, Radiosurgery Accreditation Program, American College of Radiation Oncology and the Radiosurgery Society
UPMC Presbyterian Physician Unit Partner Program Leader, Unit 6D
Quality and Safety Leadership Committee, UPMC Presbyterian/Shadyside
Quality and Safety Committee Clinical Leader, UPMC Presbyterian/Shadyside

Education & Training
BA, University of Virginia, 1988
MD, Johns Hopkins School of Medicine, 1992
MPH, University of Pittsburgh Graduate School of Public Health, 1998
Residency, Neurological Surgery, University of Pittsburgh, 1999
Fellowship, Spine Surgery, University of Pittsburgh, 2000

Peter C. Gerszten, MD, MPH

Honors & Awards

Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2016-23

News Media Appearances: 2022-23

"Best Life: Neurotechnology instantly helps stroke patients move," Action News 5 (Memphis, Tenn.), June 29, 2023.

"Neurotechnology restoring mobility to stroke patients," WINK-TV (Fort Myers, Fla.), June 14, 2023.

"First-of-its-kind Pittsburgh study uses electrodes to restore stroke patients' mobility," WTAE-TV, May 10, 2023.

"'We Were All in Tears': Stroke Patient Sees Improved Motion With Experimental Device," NBC TV4, Washington, DC, April 18, 2023.

"In Test, Zaps to Spine Help 2 Stroke Survivors Move Arms," *U.S. News & World Report*, February 20, 2023.

"Spinal stimulation can improve arm and hand movement years after a stroke," NPR, February 20, 2023.

Publications: 2022-23

• Refereed Articles:

Mittal AM, Nowick KW, Fernandez-de Thomas RJ, Mayor JM, McEnaney RM, Gerszten PC. Interoperative ultrasound evidence of accidental simultaneous cannulation of the common carotid artery and internal jugular vein: Illustrative Case. *J Neurosurg Case Lessons* 4(10):CASE22286, 2022.

Ho JC, Liang L, Grigsby EM, Balaguer J-M, Karapetyan V, Schaeffer DJ, Silva AC, Hitchens TK, Capogroso M, Gerszten PC, Gonzalez-Martinez JA, Pirondini E. Robot assisted neurosurgery for high-accuracy, miminally invasive deep brain electrophysiology in monkeys. *Ann Int Conf IEEE Eng Med Biol Soc* 2022:3115-3118, 2022.

Andrews EG, Hect JL, Mittal AM, Nowicki KW, Agarwal V, Gerszten PC. Tetra-compartmental spinal infection with conus medullaris syndrome: illustrative case. *J Neurosurg Case Lessons* 5(6): CASE22447, 2023.

Powell MP, Verma N, Sorensen E, Carranza E, Boos A, Fields DP, Roy S, Ensel S, Barra B, Balzer J, Goldsmith J, Friedlander RM, Wittenberg GF, Fisher LE, Krakauer JW, Gerszten PC, Pirondini E, Weber DJ, Capogrosso M. Epidural stimulation of the cervical spinal cord for post-stroke upper-limb paresis. *Nat Med* 29(3):689-699, 2023.

Ho JC, Grigsby EM, Damiani A, Liang L, Balaguer JM, Kallakuri S, Barrios-Martinez J, Karepetyan V, Fields DP, Gerszten PC, Hitchens TK, Constantine T, Adams GM, Crammond D, Capogrosso M, Gonzalez-Martinez JA, Priondini E. Targeted deep brain stimulation of the motor thalamus facilitates voluntary motor control after cortico-spinal tract lesions. *medRxiv* 9:2023.03.08.23286720 [Preprint], 2023.

Ryu S, Deshmukh S, Timmerman RD, Movsas B, Gerszten P, Yin FF, Dicker A, Abraham CD, Zhong J, Shiao SL, Tuli R, Desai A, Mell LK, Iyengar P, Hitchcock YJ, Allen AM, Burton S, Brown D, Sharp HJ, Dunlap NE, Siddiqui MS, Chen TH, Pugh SL, Kachnic LA. Stereotactic Radiosurgery vs Conventional Radiotherapy for Localized Vertebral Metastases of the Spine: Phase 3 Results of NRG Oncology/RTOG 0631 Randomized Clinical Trial. *JAMA Oncol* [Online ahead of print], 2023.

• Book Chapters:

Alan N, Flickinger JC, Gerszten PC. Spinal Meningioma. In: *Adult CNS Radiation Oncology. Principles and Practice. Second Edition*, Chang EL, Brown PD, Lo SS, Sahgal A, Suh SH (eds), pp 175-125, Springer, 2023.

Peter C. Gerszten, MD, MPH

Research Activities

Dr. Gerszten has a research interest in spinal neuromodulation. His work explores the role of spinal cord electrical stimulation for a variety of clinical indications. Dr. Gerszten collaborates with members of the University of Pittsburgh Rehabilitation Neural Engineering Laboratory (RNEL) and the Neurosciences Institute of Carnegie Mellon University to conduct the first ever clinical trial to implant cervical spinal cord stimulators in patients with post-stroke upper limb paralysis in order to regain arm function. Epidural electrical stimulation is currently used to treat pain caused by damage or injury to the cervical spinal nerves. The implantation of electrodes over the cervical dorsal root ganglia allows for the selective engagement of hand and arm muscles by providing the surviving neural circuits with appropriate electrical signals. By adjusting the location of the cervical leads as well as modifying the electrical stimulation of the spinal cord stimulator, patients have regained the ability to use paralyzed limbs. The results of the first ever successful clinical experience were published this year in *Nature Medicine* and received national and international coverage. The team has also begun clinical trials to evaluate the effect of spinal cord stimulation in patients with spinal cord injury and Spinal Muscular Atrophy (SMA).

Dr. Gerszten also collaborates with members of RNEL on a variety of non-human primate investigations. The team has developed a technique for robot assisted neurosurgery for high-accuracy minimally-invasive deep brain electrophysiology in monkeys. This research focuses on better defining the neuronal pathways of motor and sensory transmission within the spinal cord. The work has led to a novel deep brain neuromodulation modality for post-stroke patients. These experiments also determined that proprioceptive pulses consistently produced neural trajectories in the network that were disrupted by concurrent cutaneous branch stimulation. This disruption propagated to the somatosensory cortex, suggesting that peripheral electrical stimulation can disrupt natural information processing across the neural axis.

Dr. Gerszten's clinical research focuses on the adoption of minimally invasive surgical treatments for disorders of the spine. Such minimally invasive techniques allow for decreased morbidity while improving outcomes in neurosurgical patients. Such techniques include the use radiosurgery and expanded radiofrequency ablative techniques for patients with spinal tumors. Dr. Gerszten was a co-principal investigator of the NRG Oncology/RTOG 0631 Clinical Trial comparing stereotactic radiosurgery versus conventional radiotherapy for localized vertebral metastases of the spine which was published this year in *JAMA Oncology*. Dr. Gerszten continues to expand and systematically analyze the clinical outcomes and safety profiles associated with the use of new spinal implant devices. Dr. Gerszten has a particular interest in documenting the safety and efficacy of minimally invasive sacroiliac joint fusions using titanium screw implants for sacroiliac joint dysfunction.

Finally, this year Dr. Gerszten has collaborated with other members of the department to develop and evaluate an augmented reality (AR)-based surgical guidance system.

Researchers hypothesize that headset-based AR platforms will be superior to current surgical techniques and image-guidance technologies in terms of accuracy, operative time, and use of radiation with fewer complications. Operative and procedural efficiency will be increased using augmented reality in comparison to standard surgical approaches.

Avniel Singh Ghuman, PhD

Associate Professor
Director, Cognitive Neurodynamics Lab

Avniel Singh Ghuman, PhD, joined the Department of Neurological Surgery in September of 2011. He received his undergraduate education in math and physics at The Johns Hopkins University and completed his doctoral education in biophysics at Harvard University. He completed his postdoctoral training at the National Institute of Mental Health prior to joining the faculty at the University of Pittsburgh. As director of MEG (Magnetoencephalography) Research, one of Dr. Ghuman's primary roles is to facilitate, develop, and advance clinical and basic neuroscience research using MEG. To this end, he is helping to develop new research applications for MEG in collaboration with researchers throughout the community. MEG is the most powerful functional neuroimaging technique for noninvasively recording magnetic fields generated by electrophysiological brain activity, providing millisecond temporal resolution and adequate spatial resolution of neural events. Dr. Ghuman's research focuses on how our brain turns what falls upon our eyes into the rich meaningful experience that we perceive in the world around us. Specifically, his lab studies the neural basis of the visual perception of objects, faces, words, and social and affective visual images in the real-world. His lab examines the spatiotemporal dynamics of how neural activity reflects the stages of information processing and how information flow through brain networks responsible for visual perception. To accomplish these research goals, Dr. Ghuman's lab records electrophysiological brain activity from humans using both invasive (intracranial EEG; iEEG — in collaboration with Taylor Abel, MD, and Jorge González-Martínez, MD, PhD) and non-invasive (magnetoencephalography; MEG) measures. In conjunction with these millisecond scale recordings they use multivariate machine learning methods, network analysis, and advanced signal processing techniques to assess the information processing dynamics reflected in brain activity. Additionally, his lab uses direct neural stimulation to examine how disrupting and modulating brain activity alters visual perception. This combination of modalities and analysis techniques allow Dr. Ghuman to ask fine-grained questions about neural information processing and information flow at both the scale of local brain regions and broadly distributed networks.

Specialized Areas of Interest
The dynamics of brain interactions; visual cognition; magnetoencephalography (MEG), intracranial EEG (iEEG); face recognition; reading; social and affective perception.

Professional Organization Membership
Cognitive Neuroscience Society
Organization for Human Brain Mapping
Society for Neuroscience
Vision Sciences Society

Education & Training
BA, Math and Physics, The John Hopkins University, 1998
PhD, Biophysics, Harvard University, 2007

Honors & Awards
Young Investigator Award, NARSAD, 2012
Award for Innovative New Scientists, National Institute of Mental Health, 2015

News Media Appearances: 2022-23
"Neuroscientists listened in on people's brains for a week. They found order and chaos," *MIT Technology Review*, February 7, 2023.

Avniel Singh Ghuman, PhD

Publications: 2022-23

• Refereed Articles:

Schwartz E, Alreja A, Richardson RM, Ghuman A, Anzellotti S. Intracranial Electroencephalography and Deep Neural Networks Reveal Shared Substrates for Representations of Face Identity and Expressions. *J Neurosci* 43(23):4291-4303, 2023.

Wang MB, Boring MJ, Ward MJ, Richardson RM, Ghuman AS. Deep brain stimulation for parkinson's disease induces spontaneous cortical hypersynchrony in extended motor and cognitive networks. *Cereb Cortex* 32(20):4480-4491, 2022.

Alreja A, Ward MJ, Ma Q, Russ BE, Bickel S, Van Wouwe NC, González-Martínez JA, Neimat JS, Abel TJ, Bagić A, Parker LS, Richardson RM, Schroeder CE, Morency LP, Ghuman AS. A new paradigm for investigating real-world social behavior and its neural underpinnings. *Behav Res Methods* [Online ahead of print], 2022.

Rupp K, Hect JL, Remick M, Ghuman A, Chandrasekaran B, Holt LL, Abel TJ. Neural responses in human superior temporal cortex support coding of voice representations. *PLoS Biol* 20(7):e3001675, 2022.

Research Activities

Over the past year, Dr. Ghuman's lab has made a number of new and ongoing discoveries. Using intracranial recordings in epilepsy patients the lab has illuminated how brain networks behave during real world behavior and how the brain codes for peoples' faces during natural real-world conversations.

During the course of a day, our brains must accomplish a wide range of tasks and demonstrate a remarkable amount of flexibility despite their anatomic stability. How do ecologically valid brain states balance the tension between these demands of flexibility and stability? To answer this question, Dr. Ghuman's team explored how the human functional connectome changes using continuous intracranial electroencephalography recordings in twenty epilepsy patients while they went about their day: eating, talking with visitors, reading, etc. over the course of a week. By tracking how the coherence between all pairs of the 100-120 electrodes implanted in each patient changes over each five second time window over the course of the entire week, he was able to use unsupervised autoregressive methods to identify the prevalent dynamic patterns of connectivity.

Two major patterns emerged. First, brain networks had a stable baseline state that the brain would consistently return to after individual subnetworks took excursions of various types throughout the day. This stable state was similar across all our subjects, consisting of elevated lower beta coherence and decreased theta and gamma coherence. His second finding was that there was a discrete set of probable ways to leave this baseline state. Different sub-networks of the brain were not activated or inactivated randomly to each other: they formed a specific set of patterns of which networks could be activated together over which frequencies. These patterns were well-preserved from day to day: if one network's beta activation were linked to another network's gamma inactivation in one day, the same would generally hold true in other days. Additionally, the length of the excursion (e.g. the autocorrelation of each dynamic pattern) was consistent from day-to-day.

These patterns show that, after perturbations, the brain's functional networks are pulled to return within a stable baseline dynamic range, which may represent an optimal homeostatic state for the functional connectome. Excursions from this state occur frequently, presumably to accomplish tasks such as sleep or heightened activity, but the excursions are always marked

by a return back to homeostasis. The day-to-day consistency of the largest excursions from homeostasis may indicate some underlying anatomic or energy limitation that forces departures from homeostasis to follow characteristic trajectories. Taken together, these results suggest a homeostasis-like mechanism by which the functional connectome achieves stability, while allowing for neurocognitive flexibility, through characteristic perturbations and return to this homeostatic state.

A fundamental goal of neuroscience is to understand how the brain processes information from the real world. While much has been learned from controlled laboratory experiments, we laboratory experiments cannot capture the full richness of real world environments. This is particularly problematic in the context of social perception, where passive viewing of static, unfamiliar, and isolated faces that are presented briefly on a screen bears little resemblance to rich and dynamic real-world social environments. In this study, we collected intracranial recordings from epilepsy patient-participants who wore eye-tracking glasses to capture everything they saw on a moment-to-moment basis during hours of natural unscripted interactions with friends, family, and experimenters. We used computer vision, machine learning, and artificial intelligence to address the core challenge with real world neuroscience – how to model the uncontrolled variability of the natural world. Computer vision models translated each face the person saw into a 227-dimensional model that represented distinct pose, shape, texture, and expression information. A bidirectional Canonical Component Analysis (CCA) model was used to reconstruct faces (including face motion) the participant saw at each fixation based on the neural activity alone and reconstruct the dynamics of brain activity based on the face the participant saw alone (d' effect size approximately 1.8 and correlation coefficients exceeding 0.4). Reconstructions were accurate when comparing across different identities (d' approximately 2.47), and also when comparing multiple fixations on faces of the same identity (d' approximately 1.02). Neurally, information about these faces was coded in occipital, temporal, frontal, and parietal regions involved in social visual processing, motion perception, and face processing. Individual Canonical Components of the model enable a more granular breakdown to examine which specific face features in the pose, shape, texture, and expression subspaces are coded by which aspects of neural activity. This approach will be used to assess the representational structure of the neural "face space" for real world face perception and determine how this space is modulated by natural social context.

These results demonstrate that studying the brain during real-world social behavior is not only feasible, but also can be done with high fidelity to learn important details about how the brain codes for the natural social environment.

Jorge A. González-Martínez, MD, PhD
Stuart Niles Rowe Professor
Vice-Chair, Department of Neurological Surgery
Director, Epilepsy & Movement Disorders Program
Co-Director, University of Pittsburgh Epilepsy Center
Director, Cortical Systems Laboratory

Jorge González-Martínez, MD, PhD, is a board-certified neurosurgeon subspecialized in epilepsy and functional neurosurgery. He is the director of the epilepsy/movement disorders surgery division and the current Stuart Niles Rowe Chair in Neurosurgery at the University of Pittsburgh. The University of Pittsburgh's Epilepsy, Movement Disorders and Psychiatry Surgical Program, under the direction of Dr. González-Martínez encompasses the treatment of medically intractable epilepsy, movement disorders and psychiatry disorders. These pathological neurological conditions are similar in that successful neurosurgical treatment requires an expert understanding of the involved brain networks and their potential for modulation by functional neurosur-

Jorge A. González-Martínez, MD, PhD

gical procedures, as well as multidisciplinary teams that deliver surgical care to these special groups of patients. Dr. González-Martínez has expertise in both adult and pediatric patients. Pediatric patients are treated at UPMC Children's Hospital of Pittsburgh, one of the best pediatric hospitals in the country, as noted in *U.S. News and World Report*. Dr. González-Martínez has the country's largest experience in SEEG procedures, SEEG guided resections and neuromodulation surgeries, with more than 3,000 successful surgical procedures performed. To promote an optimal safety profile and seizure outcome, many procedures are performed under robotic guidance. In addition to developing and implementing the SEEG method in North America, Dr. González-Martínez is also a pioneer in robotic surgery, having performed more than 1,000 procedures using this technique. The University of Pittsburgh has the largest experience in robotic neurosurgery in the country and was one of the first institutions in adopting the novel technology. In addition to clinical activities, The Epilepsy, Movement Disorders and Psychiatry Surgical Program is considered one the premier programs in the country regarding translational and basic science research, working in collaboration with the University of Pittsburgh Department of Neuroscience, Carnegie Mellon University Department of Biomedical Engineering, John Hopkins University and Aix Marseille University in France. The program's research activities are led by Dr. González-Martínez and his research team and conducted through the University of Pittsburgh Cortical Systems Laboratory. Combined, the clinical and basic science efforts have been guiding his academic and clinical pathway for safer and more efficient methods for treating patients with severe seizures and abnormal movement disorders, promoting the improvement of symptoms, in combination with better functional and quality of life outcomes. Dr González-Martínez has published more than 230 peer-reviewed articles and book chapters related to epilepsy surgery and methods of brain mapping for patients with medically intractable epilepsy and movement disorders. He has been serving on the executive committee of both the American Society of Stereotactic and the Functional Neurosurgery and the American Epilepsy Society for the last six years, developing high relevant projects and topics related to the field of functional neurosurgery and epilepsy.

Specialized Areas of Interest
Adult and pediatric epilepsy surgery; movement disorder surgery; neuro-oncology; general neurosurgery.

Board Certifications
American Board of Neurological Surgeons

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Hamot
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
American Association of Neurological Surgeons
American Epilepsy Society
American Society of Stereotactic and Functional Neurosurgery
Congress of Neurological Surgeons

Education & Training
MD, University of Sao Paulo Medical School, 1994
PhD, University of Sao Paulo Medical School, 2002
Neuro-oncology Fellowship, Wayne State University, 2001
Functional Neurosurgery Fellowship, Cleveland Clinic, 2002

Jorge A. González-Martínez, MD, PhD

Epilepsy Surgery Fellowship, Cleveland Clinic, 2003
Neurosurgery Residency, Cleveland Clinic, 2008
Epilepsy & Stereotactic Fellowship, University of Grenoble, France, 2009

Honors & Awards
Best Doctor in Pittsburgh, *Pittsburgh Magazine*, 2020-23
Legacy Award, Cleveland Epilepsy Association, 2017
Harvey Cushing Award, Congress of Neurological Surgeons, 2005
Preuss Award, National Brain Tumor Foundation, 2002

Publications: 2022-23
• Refereed Articles:
Faraji AH, Gersey ZC, Corson DM, Sweat JC, González-Martínez JA. Operative Technique and Nuances for the Stereoelectroencephalographic (SEEG) Methodology Utilizing a Robotic Stereotactic Guidance System. *J Vis Exp* 9;(196), 2023.

Sharma N, Mallela AN, Abou-Al-Shaar H, Aung T, González-Martínez JA. Trans-Interhemispheric Stereoelectroencephalography Depth Electrode Placement for Mesial Frontal Lobe Explorations in Medically Refractory Epilepsy: A Technical Note and Case Series. *Oper Neurosurg* (Hagerstown) 24(6):582-589, 2023.

Pease M, Mallela AN, Elmer J, Okonkwo DO, Shutter L, Barot N, González-Martínez JA, Castellano JF. Association of Posttraumatic Epilepsy With Long-term Functional Outcomes in Individuals With Severe Traumatic Brain Injury. *Neurology* 100(19):e1967-e1975, 2023.

Jirsa V, Wang H, Triebkorn P, Hashemi M, Jha J, González-Martínez JA, Guye M, Makhalova J, Bartolomei F. Personalised virtual brain models in epilepsy. *Lancet Neurol* 22(5):443-454, 2023.

Gardner PA, McDowell MM, Orhorhoro O, Snyderman CH, González-Martínez JA. A Novel Sublabial Anterior Transmaxillary Approach for Medically Refractory Mesial Temporal Lobe Epilepsy: A Comparative Anatomic Study. *Oper Neurosurg* (Hagerstown) 24(2):e92-e103, 2023.

Pease M, Elmer J, Shahabadi AZ, Mallela AN, Ruiz-Rodriguez JF, Sexton D, Barot N, González-Martínez JA, Shutter L, Okonkwo DO, Castellano JF. Predicting post-traumatic epilepsy using admission electroencephalography after severe traumatic brain injury. *Epilepsia* [Online ahead of print], 2023.

Abel TJ, Muthiah N, Hect JL, González-Martínez JA, Salehi A, Smyth MD, Smith KJ. Cost-effectiveness of invasive monitoring strategies in epilepsy surgery. *J Neurosurg* 139(1):222-228, 2022.

Mallela AN, Beiriger J, Gersey ZC, Shariff RK, Gonzalez SM, Agarwal N, González-Martínez JA, Abou-Al-Shaar H. Targeting the Future: Developing a Training Curriculum for Robotic Assisted Neurosurgery. *World Neurosurg* 167:e770-e777, 2022.

Gunnarsdottir KM, Li A, Smith RJ, Kang JY, Korzeniewska A, Crone NE, Rouse AG, Cheng JJ, Kinsman MJ, Landazuri P, Uysal U, Ulloa CM, Cameron N, Cajigas I, Jagid J, Kanner A, Elarjani T, Bicchi MM, Inati S, Zaghloul KA, Boerwinkle VL, Wyckoff S, Barot N, González-Martínez JA, Sarma SV. Source-sink connectivity: a novel interictal EEG marker for seizure localization. *Brain* 145(11):3901-3915, 2022.

Dickey CW, Verzhbinsky IA, Jiang X, Rosen BQ, Kajfez S, Eskandar EN, González-Martínez JA, Cash SS, Halgren E. Cortical ripples during NREM sleep and waking in humans. *J Neurosci* 42(42):7931-7946, 2022.

Jorge A. González-Martínez, MD, PhD

Liégeois-Chauvel C, Dubarry AS, Wang I, Chauvel P, González-Martínez JA, Alario FX. Inter-Individual Variability in Dorsal Stream Dynamics During Word Production. *Eur J Neurosci* 56(7):5070-5089, 2022.

Pease M, González-Martínez JA, Puccio A, Nwachuku E, Castellano JF, Okonkwo DO, Elmer J. Risk Factors and Incidence of Epilepsy after Severe Traumatic Brain Injury. *Ann Neurol* 92(4):663-669, 2022.

González-Martínez JA, Abou-Al-Shaar H, Mallela AN, McDowell MM, Henry L, Fernandes Cabral DT, Sweat J, Urban A, Fong J, Barot N, Castellano JF, Rajasekaran V, Bagic A, Snyderman CH, Gardner PA. The endoscopic anterior transmaxillary temporal pole approach for mesial temporal lobe epilepsies: a feasibility study. *J Neurosurg* 138(4):992-1001, 2022.

Ho JC, Liang L, Grigsby EM, Balaguer JM, Karapetyan V, Schaeffer DJ, Silva AC, Hitchens TK, Capogrosso M, Gerszten PC, González-Martínez JA, Pirondini E. Robot Assisted Neurosurgery for High-Accuracy, Minimally-Invasive Deep Brain Electrophysiology in Monkeys. *Eng Med Biol Soc* 2022:3115-3118, 2022.

Dickey CW, Verzhbinsky IA, Jiang X, Rosen BQ, Kajfez S, Stedelin B, Shih JJ, Ben-Haim S, Raslan AM, Eskandar EN, González-Martínez JA, Cash SS, Halgren E. Widespread ripples synchronize human cortical activity during sleep, waking, and memory recall. *Proc Natl Acad Sci U S A* 119(28):e2107797119, 2022.

Alsallom F, Alzahrany M, González-Martínez JA, Jehi L. Epilepsy Surgery Outcome of Traumatic Intradiploic Meningoencephalocele: A Case Report and Literature Review. *Clin EEG Neurosci* [Online ahead of print], 2022.

Alreja A, Ward MJ, Ma Q, Russ BE, Bickel S, Van Wouwe NC, González-Martínez JA, Neimat JS, Abel TJ, Bagić A, Parker LS, Richardson RM, Schroeder CE, Morency LP, Ghuman AS. A new paradigm for investigating real-world social behavior and its neural underpinnings. *Behav Res Methods* [Online ahead of print], 2022.

Stephanie Greene, MD

Professor
Vice Chair, Education
Director, Vascular Neurosurgery, UPMC Children's Hospital of Pittsburgh
Director, Perinatal Neurosurgery, UPMC Children's Hospital of Pittsburgh
Co-Director, Neurovascular Center of Excellence, UPMC Children's Hospital of Pittsburgh
Director, Pediatric Neurosurgery Fellowship
Site Program Director, CHP Neurosurgery Residency Program

Stephanie Greene, MD, is a nationally recognized expert in pediatric vascular neurosurgery and congenital neurosurgical disorders. She joined the faculty of the Department of Neurological Surgery in the pediatric neurosurgery division at UPMC Children's Hospital of Pittsburgh in 2009. She was the director of pediatric neurosurgery at Hasbro Children's Hospital, affiliated with Brown University, prior to accepting her position at UPMC Children's Hospital of Pittsburgh. She is the director of vascular neurosurgery and perinatal neurosurgery, and the co-director of the newly established Neurovascular Center of Excellence at UPMC Children's Hospital of Pittsburgh. Dr. Greene graduated from Dartmouth College in 1993 with a degree in biology and psychology, and a concentration in neuroscience. She earned her medical degree from Albany Medical College, and completed her neurosurgical residency at Harvard University in the Brigham & Women's and Children's Hospital Boston program. Dr. Greene received additional subspecialty

Stephanie Greene, MD

fellowship training in pediatric neurosurgery through the University of Washington at Seattle Children's Hospital in 2005. She is board certified in both adult and pediatric neurosurgery. She is a fellow of the American Association of Neurological Surgeons, and a member of the Congress of Neurological Surgeons and American Society of Pediatric Neurosurgeons. She is on the editorial board of the *Journal of Neurosurgery: Pediatrics*, and a regular guest examiner for the American Board of Neurological Surgeons. Her research focuses on the development of fetal neurosurgical technology, as well as on the clinical outcomes of a variety of pediatric neurosurgical conditions.

Specialized Areas of Interest
Arteriovenous malformation; moyamoya syndrome; cavernous malformation; Chiari malformation; myelomeningocele; congenital spinal dysraphism; brain tumor; fetal neurosurgery; peripheral nerve disorder.

Board Certifications
American Board of Neurological Surgery
American Board of Pediatric Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Magee-Womens Hospital

Professional Organization Membership
American Association of Neurological Surgeons
American Society of Pediatric Neurosurgeons
AANS/CNS Joint Section on Pediatric Neurosurgery
Congress of Neurological Surgeons
Women in Neurosurgery

Professional Activities
Editorial Board, Journal of Neurosurgery: Pediatrics
Resident Mentorship Program, American Association of Neurological Surgeons
Resident Mentorship Program, Women in Neurosurgery Resident Mentorship Program
CNS/AANS Joint Section on Pediatric Neurosurgery Executive Committee
Co-chair, Traveling Fellowship Subcommittee/Education Committee, Joint Section on Pediatric Neurosurgery
Steering Committee, North American Fetal Treatment Network
Oral Board Guest Examiner, American Board of Neurological Surgeons
Coordinating Committee, National Spina Bifida Patient Registry

Education & Training
AB, Biology/Psychology, Dartmouth College, 1993
MD, Albany Medical College, 1998
Residency, Neurological Surgery, Penn State University, 2000
Residency, Neurological Surgery, Harvard University, 2004
Fellowship, Pediatric Neurological Surgery, 2005

Honors & Awards
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2021-23
Castle Connolly Top Doctor, 2016-present
Marquis *Who's Who in the World*, 2018-present
Marquis *Who's Who in America*, 2018-present

Castle Connolly Exceptional Women in Medicine, 2017-present
American's Most Honored Professionals (American Registry), 2017-present
Castle Connolly Regional Top Doctor, 2017-present
Castle Connolly Metro Area Top Doctor, 2016-present
Top Ten Doctor – Metro Area, City, and State (Vitals.com), 2013-present
Patients' Choice 5-Year Honoree, 2013-present
America's Most Compassionate Doctors, 2011-present
Patients' Choice Award, 2008-present
Cambridge's *Who's Who 2011 America's Top Surgeons*, 2007, 2011, 2012

News Media Appearances: 2022-23

"Exploring the Ever-Advancing Field of Pediatric Neurosurgery with Dr. Stephanie Greene," *That's Pediatrics Podcast*, March 21, 2023.

"Bridging the Great Health Divide: UPMC Children's Hospital of Pittsburgh's Neurovascular Center of Excellence," WDTV-5 (Bridgeport, W.Va.), May 12, 2023.

Publications: 2022-23

• Refereed Articles:

Emery SP, Greene S, Elsisy M, Chung K, Ye SH, Kim S, Wagner WR, Hazen N, Chun Y. In vitro and in vivo assessment of a novel ultra-flexible ventriculoamniotic shunt for treating fetal hydrocephalus. *J Biomater Appl* 37(8):1423-1435 2023.

Aldana PR, Hanel RA, Piatt J,Han SH, Bansal MM, Schultz , Gauger C, Pederson JM, Lii JCW, Hulbert ML, Jordan LC, Qureshi A, Garrity K, Robert AP, Hatem A, Stein J, Beydler E, Adelson PD, Greene S, Grabb P, Johnston J, Lang SS, Leonard J, Magge SN, Scott A, Shah S, Smith ER, Smith J, Streahle J, Vadivelu S, Webb J, WRubel D. Cerebral revascularization surgery reduces cerebrovascular events in children with sickle cell disease and moyamoya syndrome: results of the stroke in sickle cell revascularization surgery retrospective study. *Pediatr Blood Cancer* 70(7):e30336 2023.

McDowell MM, Kim S, and S Greene. Clinical and radiographic features of pineal cysts in pediatric patients. *World Neurosurg* S1878-8750(23)00778-7, 2023.

Kuybu O, Mendez AA, Atchaneeyasakul K, Panigrahy A, Greene S, Narayanan S. Palliative Embolization on an Infantile Dural Sinus Malformation with Giant Lakes. *Stroke Vasc Interv Neurol* 03(S1):116, 2023.

Fields DP, Lavadi RS, McCarthy DJ, Hect J, Wawrose R, Agarwal N, McDowell MM, Simon D, Abel TJ, Greene S. Relationship of cervical soft tissue injury and surgical preeication following pediatric cervical spine trauma and its sequelae on long-term neurologic outcome. *World Neurosurg* [Online ahead of print], 2023.

• Letter to the Editor:

Greene S, Hect JL, Weaver K, McDowell MM. Letter to the Editor regarding "Comparison of Follow-Up Length-Matched Single-Center Myelomeningocele Postnatal Closure Cohort to the Management of Myelomeningocele Study (MOMS) Trial Results." *Pediatr Neurosurg* 58(1):61-64 2023.

Research Activities

Dr. Greene collaborates on translational research with a team developing a ventriculoamniotic shunt to treat fetal aqueductal stenosis. The team has obtained two patents, and published multiple studies on the topic. The study is moving toward an application to the Federal Drug Administration for a Humanitarian Use Device exemption allowing for compassionate use in humans.

Stephanie Greene, MD

Dr. Greene is the site principal investigator in multi-institutional prospective clinical studies on Chiari I malformation, moyamoya syndrome, myelomeningocele and aqueductal stenosis.

As the co-director of the newly formed Neurovascular Center of Excellence at UPMC Children's Hospital of Pittsburgh, Dr. Greene is developing a biorepository of tissue samples for future laboratory investigations.

Dr. Greene's clinical interests have generated projects analyzing outcomes of arteriovenous malformations, cavernous malformations, moyamoya syndrome, myelomeningocele, tethered cord syndrome, Chiari I and II malformation, and the neurosurgical aspects of various genetic syndromes.

Bradley Gross, MD

Associate Professor
Director, Endovascular Neurosurgery
Program Director, Endovascular Neurosurgery/Interventional Neurology Fellowship

Bradley Gross, MD, joined the Department of Neurological Surgery in July of 2016 specializing in cerebrovascular disease. His particular clinical and research interests include the comprehensive management of aneurysms, arteriovenous malformations, arteriovenous fistulas and cavernous malformations of the brain and spinal cord. He also performs embolization of brain and spinal cord tumors, revascularization for acute ischemic stroke as well as cervical, intracranial and venous stenting. Dr. Gross graduated Summa Cum Laude from Northwestern University and then earned his medical degree from Northwestern University Medical School. He completed his internship and neurosurgical residency at Brigham and Women's Hospital/Boston Children's Hospital/Harvard Medical School. He then had the privilege to serve as an endovascular fellow at the Barrow Neurological Institute.

Specialized Areas of Interest
Intracranial aneurysms; arteriovenous malformations; arteriovenous fistulas; cavernous malformations; brain tumors; carotid stenosis; intracranial stenosis; venous sinus stenosis; ischemic stroke.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Mercy
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
Alpha Omega Alpha
American Association of Neurological Surgeons
AANS/CNS Joint Section of Cerebrovascular Neurosurgery
Congress of Neurological Surgeons
Phi Beta Kappa

Professional Activities
Editorial Board, Associate Editor, *Stroke: Vascular and Interventional Neurology*
Editorial Board, Assistant Editor, *Neurosurgery*

Bradley Gross, MD

Education & Training

BA with Honors, Chemistry, Northwestern University, 2004
MD, Feinberg School of Medicine, Northwestern University, 2008
Internship, Harvard Medical School, 2009
Residency, Harvard Medical School, 2015
Fellowship, Endovascular Neurosurgery, Barrow Neurological Institute, 2016

Publications: 2022-23

• Refereed Articles:

Shah K, Fukuda KA, Desai SM, Gross BA, Jadhav AP. Utility of tPA administration in acute treatment of internal carotid artery occlusions. *Neurohospitalist* 13:40-45, 2023.

Hudson JS, McCarthy DJ, Alattar A, Mehdi Z, Lang MJ, Gardner PA, Zenonos GA, Friedlander RM, Gross BA. Increased prevalence of blister aneurysm formation during the COVID-19 pandemic. *Clin Neurol Neurosurg* 226:107613, 2023.

Mittal AM, Pease M, McCarthy D, Legarretta A, Belkhir R, Crago EA, Lang MJ, Gross BA. Hunt-Hess score at 48 hours improves prognostication in grade 5 aneurysmal subarachnoid hemorrhage. *World Neurosurg* 171:e874-e878, 2023.

Bounajem MT, Joyce E, Scoville JP, Seinfeld J, Hoffman J, Grossberg JA, Waiters V, White AC, Nerva J, Burkhardt JK, Tonetti DA, El Naamani K, Gooch MR, Jabbour P, Tjoumakaris S, Ortega Gutierrez S, Levitt MR, Lang M, Ares WJ, Desai S, Mascitelli JR, Killburg CJ, Budohoski KP, Couldwell WT, Gross BA, Grandhi R: Safety and efficacy of the pipeline flex embolization device with shield technology for the acute treatment of ruptured internal carotid artery pseudoaneurysms: a multi-institution case series. *Neurosurg Focus* 54(5):E4, 2023.

Bin-Alamer O, Qedair J, Palmisciano P, Mallela AN, Nayar GM, Lu VM, Labib MA, Lang MJ, Gross BA, Langer DJ, Couldwell WT, Friedlander RM, Abou-Al Shaar H. Dolichoectatic vertebrobasilar aneurysms: a systematic review and meta-analysis of management strategies and outcomes. *Neurosurg Focus* 54(5):E9, 2023.

Durnford AJ, Akarca D, Culliford D, Millar J, Guniganti R, Giordan E, Brinjikji W, Chen CJ, Abecassis IJ, Levitt M, Polifka AJ, Derdeyn CP, Samaniego EA, Kwasnicki A, Alaraj A, Potgieser ARE, Chen S, Tada Y, Phelps R, Abla A, Satomi J, Starke RM, van Dijk JMC, Amin-Hanjani S, Hayakawa M, Gross B, Fox WC, Kim L, Sheehan J, Lanzino G, Kansagra AP, Du R, Lai R, Zipfel GJ, Bulters DO. Risk of early versus later rebleeding from dural arteriovenous fistulas with cortical venous drainage. *Stroke* 53:2340-2345, 2022.

Salem MM, Kvint S, Hendrix P, Al Saiegh F, Gajjar AA, Choudhri O, Jankowitz BT, Goren O, Gross BA, Jabbour P, Lang M, Schirmer CM, Tjoumakaris SI, Griessenauer CJ, Burkhardt JK. The Pennsylvania postmarket multicenter experience with flow redirection endoluminal device. *Neurosurgery* 91:280-285, 2022.

Tonetti DA, Desai SM, Perez J, Casillo S, Gross BA, Jadhav AP. Predictors of first pass effect and effect on outcomes in mechanical thrombectomy for basilar artery occlusion. *J Clin Neurosci* 102: 49-53, 2022.

Lai PMR, Ryu JY, Park SC, Gross BA, Dickinson LD, Dagen S, Aziz-Sultan MA, Boulos AS, Barrow DL, Batjer HH, Blackburn S, Chang EF, Chen PR, Colby GP, Cosgrove GR, David CA, Day AL, Frerichs KU, Niemela M, Ojemann SG, Patel NJ, Shi X, Valle-Giler EP, Wang AC, Welch BG, Zusman EE, Weiss ST, Du R. Somatic variants in SVIL in cerebral aneurysms. *Neurol Genet* 8:e200040, 2022.

Mohammeden MH, Haussen DC, Al-Bayati AR, Hassan A, Tekle W, Fifi J, Matsoukas S, Kuybu O, Gross BA, Lang MJ, Narayanan S, Cortez GM, Hanel RA, Aghaebrahim A, Sauvageau E, Farooqui M, Ortega-Gutierez S, Zevallos C, Galecio-Castillo M, Sheth SA, Nahhas M, Salazar-Marioni S, Nguyen TN, Abdalkader M, Klein P, Hafeez M, Kan P, Tanweer O, Khaldi A, Li H, Jumaa M, Zaidi S, Oliver M, Salem MM, Burkhardt JK, Pukenas BA, Alaraj A, Peng S, Kumar R, Lai M, Siegler J, Nogueira RG. Stenting and angioplasty in neurothrombectomy: matched analysis of rescue intracranial stenting versus failed thrombectomy. *Stroke* 53:2779-2788, 2022.

Li Y, Chen SH, Guniganti R, Kansagra AP, Piccirillo JF, Chen CJ, Buell T, Sheehan JP, Ding D, Lanzino G, Brinjikji W, Kim LJ, Levitt MR, Abecassis IJ, Bulters DO, Durnford A, Fox WC, Polifka AJ, Gross BA, Sur S, McCarthy DJ, Yavagal DR, Peterson EC, Hayakawa M, Derdeyn C, Samaniego EA, Amin-Hanjani S, Alaraj A, Kwasnicki A, Charbel FT, van Dijk MJC, Potgieser AR, Satomi J, Tada Y, Abla A, Phelps R, Du R, Lai PMR, Zipfel GJ, Starke RM. Onyx embolization for dural arteriovenous fistulas: a multi-institutional study. *J Neurointerv Surg* 14:57-62, 2022.

Kim S, Nowicki KW, Ye S, Jang K, Elsisy M, Ibrahim M, Chun Y, Gross BA, Friedlander RM, Wagner WR: Bioabsorbable, elastomer-coated magnesium alloy coils for treating saccular cerebrovascular aneurysms. *Biomaterials* 290:121857, 2022.

Gross BA. Cerebral dural arteriovenous fistulas. *Stroke Vasc Interv Neurol* 2:e000532, 2022.

Research Activities

• Embolization of the Middle Meningeal Artery With Onyx Liquid Embolic System for Subacute and Chronic Subdural Hematoma (EMBOLISE):

Embolise is a multicenter randomized control trial evaluating the safety and efficacy of embolization of the middle meningeal artery with Onyx liquid embolisate in the management of chronic subdural hematoma. Dr. Gross is the UPMC principal investigator on this multicenter study.

• US IDE Study of the Contour Neurovascular System for Intracranial Aneurysm Repair (NECC Trial):

The Contour Neurovascular System is a novel agent used in the intrasaccular treatment of intracranial aneurysms. UPMC is part of an initial multicenter effort employing this system. Dr. Gross is the UPMC principal investigator on this multicenter study.

• A Randomized, Controlled Trial to Evaluate the Safety and Efficacy of the Route 92 Medical Reperfusion System (SUMMIT MAX):

The Route 92 system is a novel acute stroke embolectomy system that utilizes an ultra-large bore catheter to remove clot. This randomized controlled trial will compare this system to standard systems currently employed for stroke embolectomy. Dr. Gross is the UPMC principal investigator on this multicenter study.

Constantinos G. Hadjipanayis, MD, PhD

Professor and Executive Vice Chair
Director, Center for Image-Guided Neurosurgery
Co-Director, UPMC Brain Tumor Center at the Hillman Cancer Center
Director, Brain Tumor Nanotechnology Laboratory

Constantinos G. Hadjipanayis, MD, PhD, is a board-certified neurosurgeon-scientist who has devoted his entire career to the treatment of brain tumor patients. He completed his neurosurgical residency and graduate PhD training at the University of Pittsburgh School of Medicine with additional neurosurgical oncology training at the University of California San Francisco. Dr. Hadjipanayis is executive vice-chair for the University of Pittsburgh Neurological Surgery, director of the UPMC Center for Image-Guided Neurosurgery (CIGNS) and serves as co-director

Constantinos G. Hadjipanayis, MD, PhD

of the newly formed UPMC Brain Tumor Center at the Hillman Cancer Center. Dr. Hadjipanayis also directs the Brain Tumor Nanotechnology Laboratory in the Hillman Cancer Center and has been the principal investigator of multiple clinical trials and university, private foundation, and NIH-funded grants focused on brain tumors. He was recently recruited back to UPMC in October of 2022 from the Icahn School of Medicine at Mount Sinai in New York City where he served as the chair of neurosurgery at Mount Sinai Union Square/Beth Israel and the director of neurosurgical oncology for the Mount Sinai Health System. Dr. Hadjipanayis has focused much of his career on innovation, translational research, and intraoperative technology development. In 2011, Dr. Hadjipanayis was the first to use 5-ALA (Gleolan) and perform fluorescence-guided surgery (FGS) in the US and helped lead the FDA approval of Gleolan for glioma surgery in June 2017. Dr. Hadjipanayis and his lab are actively studying the development and use of magnetic hyperthermia therapy (MHT) for treatment of glioblastoma in combination with adjuvant therapies. This collaborative research involves Johns Hopkins University and Penn State University. Dr. Hadjipanayis is the current secretary/treasurer of the American Association of Neurological Surgeons (AANS)/Congress of Neurological Surgeons (CNS) Tumor Section. He will become chair of the AANS/CNS Tumor Section in 2024 leading the largest group of neurosurgical oncologists in the world. He is an elected member of the American Academy of Neurological Surgeons and the Society of Neurological Surgeons (SNS). He currently serves as the chair of the research subcommittee for the SNS. Dr. Hadjipanayis has been a tireless brain tumor advocate serving on the nonprofit boards of the Southeastern Brain Tumor Foundation (SBTF) and StacheStrong. Since returning to UPMC, Dr. Hadjipanayis has been actively involved with the initiation of novel brain tumor clinical trials for the intraoperative visualization and intraoperative photodynamic therapy (PDT) of malignant brain tumors. Under his existing IND, a multicenter pediatric neurosurgical oncology trial will also be launched in 2023 for the visualization and detection of pediatric brain tumors. This will be the first multicenter pediatric clinical trial focused on 5-ALA fluorescence-guided surgery (FGS). Dr. Hadjipanayis is also developing novel prospective stereotactic radiosurgery trials with his partners in the CIGNS for brain metastases and high-grade gliomas. Dr. Hadjipanayis has brought new intraoperative technologies to UPMC for the first time that include the use of a voice-controlled, robotic-assisted exoscope for FGS of malignant brain tumors. Dr. Hadjipanayis was the first in the world to use this technology for resection of a brain tumor in 2023 at UPMC Presbyterian. He also reinstituted laser interstitial thermal therapy (LITT) for brain tumors at UPMC Presbyterian in 2023. Dr. Hadjipanayis is developing important infrastructure for clinical research in the Department of Neurological Surgery that will permit more effective initiation of trials that are investigator-initiated and industry sponsored. As director of the Brain Tumor Nanotechnology Laboratory, important collaborations have been established with the Department of Radiation Oncology at the UPMC Hillman Cancer Center. In addition, his current R01 focuses on the development of magnetic hyperthermia therapy (MHT) for treatment of GBM in combination with adjuvant therapies (chemoradiation). This multidisciplinary and multi-institutional effort includes both the Department of Neurological Surgery, Johns Hopkins University, and Penn State University. As part of this R01, a new collaboration has also been established at the Blue Pearl Pet Hospital in Pittsburgh. This large veterinary hospital will permit the study and MHT treatment of canines with spontaneous gliomas. As chair of the research subcommittee for the SNS, Dr. Hadjipanayis and Linda Liau, MD, of UCLA launched the Neurosurgeon-Scientist Training Program (NSTP). This new program provides select research funding to neurosurgery residents from across the country who have demonstrated productive research in a mentored setting.

Specialized Areas of Interest

Surgical management of brain and spinal cord tumors (astrocytoma, brain metastasis, colloid cyst, and other intracranial cysts (arachnoid), ependymoma, ganglioglioma, glioblastoma, glioma, medulloblastoma, meningioma, oligodendroglioma, pineal cyst, pineocytoma, pineal tumor, trigeminal neuralgia, vestibular schwannoma); awake/cortical mapping intraoperative tech-

Constantinos G. Hadjipanayis, MD, PhD

niques; fluorescence-guided neurosurgery; laser-interstitial thermal therapy (LITT); neuro-endoscopy (colloid cysts, intraventricular cysts/tumors, and hydrocephalus); robotic-assisted exoscope neurosurgery; stereotactic biopsy; stereotactic radiosurgery (Gamma Knife and LINAC-based).

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Magee-Womens Hospital
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
American Academy of Neurological Surgeons
American Board of Neurological Surgery
American Association of Neurological Surgeons
Congress of Neurological Surgeons
Neurosurgery Research Education Fund
Society of Neuro-Oncology
Society of Neurological Surgeons

Professional Activities
Secretary/Treasurer, AANS/CNS Tumor Section
Chair, Research Subcommittee, Society of Neurological Surgeons

Education & Training
BA, Medical Scholar's Program, University of Delaware, 1994
MD, Sydney Kimmel Jefferson Medical College, 1998
General Surgery, University of Pittsburgh, 1999
Gamma Knife radiosurgery fellowship, University of Pittsburgh, 2004
PhD, Biochemistry/Molecular Genetics, University of Pittsburgh, 2005
Neurological surgery residency, University of Pittsburgh, 2006
Surgical neuro-oncology fellowship, University of California San Francisco, 2006

Honors & Awards
Top Doctor, Castle Connolly, 2018-23
Super Doctor, superdoctor.com, 2021-23
Leica Award, AANS Annual Meeting, Philadelphia, 2022
Cullman Family Award For Excellence in Physician Communication, Mount Sinai Health System, 2019
Distinguished Physician of the Year, Hellenic Medical Society, 2019
Inaugural Brain Tumor Biotech Young Innovator Award, Weill Cornell Medicine, 2013
Health Care Hero Award Winner, Atlanta Business Chronicle, 2013
Young Investigator Award, American Brain Tumor Association, 2011
Translational Research Award, Winship Cancer Institute, Emory University, 2010
Robbins Scholar Award, Winship Cancer Institute, Emory University, 2010
Robert Ginsberg Surgical Oncology Award, Radiation Therapy Oncology Group, 2009
Philip Jory Award, Southeastern Brain Tumor Foundation, 2009
Distinguished Cancer Clinician and Scientist, Georgia Cancer Coalition, 2007
Basic Research Fellowship Award, American Brain Tumor Association, 2006
Mentored Clinical Scientist Development Award (K08), National Institute of Health, 2005

Constantinos G. Hadjipanayis, MD, PhD

Inaugural Stuart Rowe Society Presentation Award, University of Pittsburgh, 2005
Ruth L. Kirschstein National Research Service Award (T32), National Institutes of Health, 2003
Resident Teacher of the Year Award, Department of Neurological Surgery, University of Pittsburgh, 1999
Alpha Omega Alpha, Jefferson Medical College, 1997
Benjamin and Mary Siddons Measey Award, Jefferson Medical College, 1997
Hobart Amory Hare Medical Student Honor Society, Jefferson Medical College, 1996
Honor Society Award, Association of Pathology Chairs, 1996
Bernard B. Rotko Scholarship, Jefferson Medical College, 1996
Nicholas T. Padis Award, Hellenic University Club of Philadelphia, 1995
Golden Key National Honor Society, University of Delaware, 1994
Phi Beta Kappa, University of Delaware, 1994

Publications: 2022-23

• Refereed Articles:

Ohadi MAD, Iranmehr A, Chavoshi M, Fatollahi MA, Aleyasin MS, Hadjipanayis CG. Stereotactic radiosurgery outcome for deep-seated cerebral arteriovenous malformations in the brainstem and thalamus/basal ganglia: systematic review and meta-analysis. *Neurosurg Rev* 46(1):148, 2023.

Schupper AJ, Eskandari R, Kosnik-Infinger L, Olivera R, Nangunoori R, Patel S, Williamson R, Yu A, Hadjipanayis CG. A Multicenter Study Investigating the Surgeon Experience with a Robotic-Assisted Exoscope as Part of the Neurosurgical Armamentarium. *World Neurosurg* 173:e571-e577, 2023.

Chan M, Tatter S, Chiang V, Fecci P, Strowd R, Prabhu S, Hadjipanayis C, Kirkpatrick J, Sun D, Sinicrope K, Mohammadi AM, Sevak P, Abram S, Kim AH, Leuthardt E, Chao S, Phillips J, Lacroix M, Williams B, Placantonakis D, Silverman J, Baumgartner J, Piccioni D, Laxton A. Efficacy of laser interstitial thermal therapy for biopsy-proven radiation necrosis in radiographically recurrent brain metastases. *Neurooncol Adv* 28;5(1):vdad031, 2023.

Rivera D, Schupper AJ, Bouras A, Anastasiadou M, Kleinberg L, Kraitchman DL, Attaluri A, Ivkov R, Hadjipanayis CG. Neurosurgical Applications of Magnetic Hyperthermia Therapy. *Neurosurg Clin N Am* 34(2):269-283, 2023.

Frederico SC, Darling C, Bielanin JP, Dubinsky AC, Zhang X, Hadjipanayis CG, Kohanbash G. Neoadjuvant immune checkpoint inhibition in the management of glioblastoma: Exploring a new frontier. *Front Immunol* 14:1057567, 2023.

Chiu D, Qi J, Thin TH, Garcia-Barros M, Lee B, Hahn M, Mandeli J, Belani P, Nael K, Rashidipour O, Ghatan S, Hadjipanayis CG, Yong RL, Germano IM, Brody R, Tsankova NM, Gnjatic S, Kim-Schulze S, Hormigo A. A Phase I Trial of VEGF-A Inhibition Combined with PD-L1 Blockade for Recurrent Glioblastoma. *Cancer Res Commun* 3(1):130-139, 2023.

Sharma A, Jangam A, Shen JLY, Ahmad A, Arepally N, Rodriguez B, Borrello J, Bouras A, Kleinberg L, Ding K, Hadjipanayis C, Kraitchman DL, Ivkov R, Attaluri A. Validation of a Temperature-Feedback Controlled Automated Magnetic Hyperthermia Therapy Device. *Cancers* (Basel) 15(2):327, 2023.

Skandalakis GP, Kalyvas A, Lani E, Komaitis S, Manolakou D, Chatzopoulou D, Pantazis N, Zenonos GA, Hadjipanayis CG, Stranjalis G, Koutsarnakis C. Effectiveness of pharmacologic interventions for prevention of cerebral hyperperfusion syndrome following bypass surgery. *Brain Circ* 8(4):207-214, 2022.

Constantinos G. Hadjipanayis, MD, PhD

Schupper AJ, Hadjipanayis CG. Novel approaches to targeting gliomas at the leading/cutting edge. *J Neurosurg* [Online ahead of print], 2023.

Palmer JD, Klamer BG, Ballman KV, Brown PD, Cerhan JH, Anderson SK, Carrero XW, Whitton AC, Greenspoon J, Parney IF, Laack NNI, Ashman JB, Bahary JP, Hadjipanayis CG, Urbanic JJ, Barker FG 2nd, Farace E, Khuntia D, Giannini C, Buckner JC, Galanis E, Roberge D. Association of Long-term Outcomes With Stereotactic Radiosurgery vs Whole-Brain Radiotherapy for Resected Brain Metastasis: A Secondary Analysis of The N107C/CEC.3 (Alliance for Clinical Trials in Oncology/ Canadian Cancer Trials Group) Randomized Clinical Trial. *JAMA Oncol* 8(12):1809-1815, 2022.

Huntoon K, Anderson SK, Ballman KV, Twohy E, Dooley K, Jiang W, An Y, Li J, von Roemeling C, Qie Y, Ross OA, Cerhan JH, Whitton AC, Greenspoon JN, Parney IF, Ashman JB, Bahary JP, Hadjipanayis C, Urbanic JJ, Farace E, Khuntia D, Laack NN, Brown PD, Roberge D, Kim BYS. Association of Circulating Markers with Cognitive Decline After Radiation Therapy for Brain Metastasis. *Neuro Oncol* 25(6):1123-1131, 2022.

McCracken DJ, Schupper AJ, Lakomkin N, Malcolm J, Painton Bray D, Hadjipanayis CG. Turning on the light for brain tumor surgery: A 5-aminolevulinic acid story. *Neuro Oncol* 24(Supplement_6):S52-S61, 2022.

Schupper AJ, Chanenchuk T, Racanelli A, Price G, Hadjipanayis CG. Laser hyperthermia: Past, present, and future. *Neuro Oncol* 24(Supplement_6):S42-S51, 2022.

McCarthy L, Verma G, Hangel G, Neal A, Moffat BA, Stockmann JP, Andronesi OC, Balchandani P, Hadjipanayis CG. Application of 7T MRS to High-Grade Gliomas. *Am J Neuroradiol* 43(10):1378-1395, 2022.

D. Kojo Hamilton, MD

Professor
Director and Chief UPMC Neurosurgical Spine Services
Director, Residency Training Program
Co-Director, Spine Fellowship Program

D. Kojo Hamilton, MD, is a recognized leader in scoliosis, adult spinal deformity and trauma. He is also renowned for neurological surgery education and mentoring. He received his medical degree and residency training from the University of Virginia in Charlottesville, Va. He underwent further subspecialty training in complex spine, spinal deformity, scoliosis and spine surgical oncology, with a combined neurosurgical and orthopedic (AOSpine) fellowship, at the University of Virginia. Dr. Hamilton further received subspecialty cranial training in Auckland City Hospital in Auckland, New Zealand. He is board certified in neurological surgery, a member of the Society of Neurological Surgeons, a fellow of the American Association of Neurological Surgeons and a member of the Scoliosis Research Society. After training, Dr. Hamilton received appointments at the University of Maryland School of Medicine and Maryland Shock Trauma Hospital where he treated patients with complex spine deformity, severe spine and brain trauma. Before joining UPMC, Dr. Hamilton was at the Oregon Health and Science University Spine Center where he treated patients with neurological trauma as well as spinal deformity conditions including adult idiopathic scoliosis, spondylolisthesis and general back and neck pain. Dr. Hamilton is nationally involved in teaching advanced and current techniques in scoliosis and adult spine deformity. He has an extensive research background in spine surgery and has presented nationally and internationally on the subject. Dr. Hamilton has received several awards and accolades from his patients, nurses and peers, including best doctor awards—locally and nationally, nine years in a row—since his first year at the University of Pittsburgh School of Medicine.

D. Kojo Hamilton, MD

Specialized Areas of Interest
Scoliosis; adult and pediatric spinal deformity; cranial and spine trauma; degenerative conditions of the spine; revision and reconstructive spine surgery.

Board Certifications
American Board of Neurological Surgery
Fellow of the American Association of Neurological Surgeons

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Hamot Medical Center
UPMC Magee-Womens Hospital
UPMC Mercy
UPMC Presbyterian

Professional Organization Membership
American Association of Neurological Surgeons (AANS)
AANS/CNS Joint Section of Disorders of the Spine and Peripheral Nerves
AANS/CNS Joint Section of Neurotrauma and Critical Care
AOSpine North America (AOSNA)
International Spine Study Group
Lumbar Spine Research Society
Society of Neurological Surgeons
Scoliosis Research Society

Professional Activities
IMAST Committee, Scoliosis Research Society
MOC/CME Committee, American Association of Neurological Surgeons
Executive Committee, AANS/CNS Joint Section Spine and Peripheral Nerves
Scientific Program Committee, AANS/CNS Joint Section Spine and Peripheral Nerves
DSPN Drugs & Devices Committee, AANS/CNS Joint Section Spine and Peripheral Nerves
ABNS Exam/Extra-Mural Writing Committee, American Board of Neurological Surgery

Education & Training
BS (High Honors), Biochemistry, University of Maryland, 1998
MD, University of Virginia, 2003
Fellowship, Brain and Spine, Auckland City Hospital, 2008
Residency, University of Virginia, 2009
Fellowship, Complex Spine, University of Virginia, 2010

Honors & Awards
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2016-23
Faculty Teaching Award, Department of Neurological Surgery, 2020
Distinguished Alumni, University of Virginia Summer Medical and Dental Education Program

Publications: 2022-23
• Refereed Articles:
McDonald CL, Berreta RAS, Alsoof D, Homer A, Molino J, Ames CP, Shaffrey CI, Hamilton DK, Diebo BG, Kuris EO, Hart RA, Daniels AH. Treatment of Adult Deformity Surgery by Orthopedic and Neurological Surgeons: Trends in Treatment, Techniques, and Costs by Specialty. *Spine J* [Online ahead of print], 2023.

Alan N, Deng H, Muthiah N, Vodovotz L, Dembinski R, Guha D, Agarwal N, Ozpinar A, Hamilton DK, Kanter AS, Okonkwo DO. Graft subsidence and reoperation after lateral lumbar interbody fusion: a propensity score-matched and cost analysis of polyetheretherketone versus 3D-printed porous titanium interbodies. *J Neurosurg Spine* [Online ahead of print], 2023.

Lavadi RS, Elsayed GA, Buell TJ, Hamilton DK, Agarwal N. Strategies for spine surgeons to enhance a clinical practice and research program: stepping stones for practice management. *J Neurosurg Spine* [Online ahead of print], 2023.

Agarwal N, Roy S, Lavadi RS, Patel KP, Ozpinar A, Alan N, Buell TJ, Hamilton DK. The 'candy cane' technique for construct augmentation and correction of severe angular chin-on-chest kyphoscoliosis. *Spine Deform* [Online ahead of print], 2023.

Agarwal N, White MD, Roy S, Ozpinar A, Alan N, Lavadi RS, Okonkwo DO, Hamilton DK, Kanter AS. Long-Term Durability of Stand-Alone Lateral Lumbar Interbody Fusion. *Neurosurgery* [Online ahead of print], 2023.

Habib A, Muthiah N, Alattar A, Hoppe M, Agarwal N, Alan N, Hamilton DK, Ozpinar A. Direct Iliac Screw vs Sacral-2-Alar-Iliac Screws Technique for Sacropelvic Fixation: Technical Nuances and a Review of the Literature. *Int J Spine Surg* [Online ahead of print], 2023.

Smith JS, Elias E, Sursal T, Line B, Lafage V, Lafage R, Klineberg E, Kim HJ, Passias P, Nasser Z, Gum JL, Eastlack R, Daniels A, Mundis G, Hostin R, Protopsaltis TS, Soroceanu A, Hamilton DK, Kelly MP, Lewis SJ, Gupta M, Schwab FJ, Burton D, Ames CP, Lenke LG, Shaffrey CI, Bess S; International Spine Study Group. How Good Are Surgeons at Achieving Their Preoperative Goal Sagittal Alignment Following Adult Deformity Surgery? *Global Spine J* [Online ahead of print], 2023.

Bayoglu R, Witt JP, Chatain GP, Okonkwo DO, Kanter AS, Hamilton DK, Puccio LM, Alan N, Ignasiak D. Clinical Validation of a Novel Musculoskeletal Modeling Framework to Predict Postoperative Sagittal Alignment. *Spine* (Phila Pa 1976) 48(8):E107-E115, 2023.

Yeramaneni S, Wang K, Gum J, Line B, Jain A, Kebaish K, Shaffrey C, Smith JS, Lafage V, Schwab F, Passias P, Hamilton DK, Klineberg E, Ames C, Burton D, Bess S, Hostin R. Diagnosis-Related Group-Based Payments for Adult Spine Deformity Surgery Significantly Vary across Centers: Results from a Multicenter Prospective Cohort Study. *World Neurosurg* 171:e153-e161, 2023.

Plute T, Patel A, Mallela AN, Sefcik RK, Hamilton DK, Lunsford LD, Friedlander RM, Abou-Al-Shaar H. United States Neurosurgery Department Program Directors: A Cross-Sectional Evaluation of Current and Future Trends and Attributes. *World Neurosurg* 170:e550-e557, 2023.

Neuman BJ, Wang KY, Harris AB, Raad M, Hostin RA, Protopsaltis TS, Ames CP, Passias PG, Gupta MC, Klineberg EO, Hart R, Bess S, Kebaish KM, International Spine Study Group. Return to work after adult spinal deformity surgery. *Spine Deform* 11(1):197-204, 2023.

Muthiah N, Yolcu YU, Alan N, Agarwal N, Hamilton DK, Ozpinar A. Evolution of polyetheretherketone (PEEK) and titanium interbody devices for spinal procedures: a comprehensive review of the literature. *Eur Spine J* 31(10):2547-2556, 2023.

Passias PG, Ahmad W, Oh C, Imbo B, Naessig S, Pierce K, Lafage V, Lafage R, Hamilton DK, Protopsaltis TS, Klineberg EO, Gum J, Schoenfeld AJ, Line B, Hart RA, Burton DC, Bess S, Schwab FJ, Smith JS, Shaffrey CI, Ames CP, International Spine Study Group. Development of Risk Stratification Predictive Models for Cervical Deformity Surgery. *Neurosurgery* 91(6):928-935, 2022.

Durand WM, Daniels AH, DiSilvestro K, Lafage R, Diebo BG, Passias PG, Kim HJ, Protopsaltis T, Lafage V, Smith JS, Shaffrey CI, Gupta MC, Klineberg EO, Schwab F, Gum JL, Mundis GM, Eastlack RK, Kebaish K, Soroceanu A, Hostin RA, Burton D, Bess S, Ames CP, Hart RA, Hamilton DK, International Spine Study Group. Patient satisfaction after multiple revision surgeries for adult spinal deformity. *J Neurosurg Spine* 38(1):75-83, 2022.

Habib A, Jovanovich N, Muthiah N, Alattar A, Alan N, Agarwal N, Ozpinar A, Hamilton DK. 3D printing applications in spine surgery: an evidence-based assessment toward personalized patient care. *Eur Spine J* 31(7):1682-1690, 2022.

Operative treatment outcomes for adult cervical deformity: a prospective multicenter assessment with mean 3-year follow-up. Elias E, Bess S, Line BG, Lafage V, Lafage R, Klineberg E, Kim HJ, Passias P, Nasser Z, Gum JL, Kebaish K, Eastlack R, Daniels AH, Mundis G, Hostin R, Protopsaltis TS, Soroceanu A, Hamilton DK, Kelly MP, Gupta M, Hart R, Schwab FJ, Burton D, Ames CP, Shaffrey CI, Smith JS, International Spine Study Group. *J Neurosurg Spine* 37(6):855-864, 2022.

Passias PG, Krol O, Moattari K, Williamson TK, Lafage V, Lafage R, Kim HJ, Daniels A, Diebo B, Protopsaltis T, Mundis G, Kebaish K, Soroceanu A, Scheer J, Hamilton DK, Klineberg E, Schoenfeld AJ, Vira S, Line B, Hart R, Burton DC, Schwab FA, Shaffrey C, Bess S, Smith JS, Ames CP, International Spine Study Group. Evolution of Adult Cervical Deformity Surgery Clinical and Radiographic Outcomes Based on a Multicenter Prospective Study: Are Behaviors and Outcomes Changing With Experience? *Spine* (Phila Pa 1976) 47(22):1574-1582, 2022.

Passias PG, Kummer N, Williamson TK, Moattari K, Lafage V, Lafage R, Kim HJ, Daniels AH, Gum JL, Diebo BG, Protopsaltis TS, Mundis GM Jr, Eastlack RK, Soroceanu A, Scheer JK, Hamilton DK, Klineberg EO, Line B, Hart RA, Burton DC, Mummaneni P, Chou D, Park P, Schwab FJ, Shaffrey CI, Bess S, Ames CP, Smith JS, International Spine Study Group. Highest Achievable Outcomes for Patients Undergoing Cervical Deformity Corrective Surgery by Frailty. *Neurosurgery* 91(5):693-700, 2022.

Passias PG, Kummer NA, Williamson TK, Ahmad W, Lebovic J, Lafage V, Lafage R, Kim HJ, Daniels AH, Gum JL, Diebo BG, Gupta MC, Soroceanu A, Scheer JK, Hamilton DK, Klineberg EO, Line B, Schoenfeld AJ, Hart RA, Burton DC, Eastlack RK, Mundis GM Jr, Mummaneni P, Chou D, Park P, Schwab FJ, Shaffrey CI, Bess S, Ames CP, Smith JS, International Spine Study Group. The Additional Economic Burden of Frailty in Adult Cervical Deformity Patients Undergoing Surgical Intervention. *Spine* (Phila Pa 1976) 47(20):1418-1425, 2022.

Jack AS, Hayman E, Pierre C, Ramey WL, Witiw CD, Oskouian RJ, Daniels AH, Pugley A, Hamilton K, Ames CP, Chapman JR, Ghogawala Z, Hart RA. Cervical Spine Research Society-Cervical Stiffness Disability Index (CSRS-CSDI): Validation of a Novel Scoring System Quantifying the Effect of Postarthrodesis Cervical Stiffness on Patient Quality of Life. *Spine* (Phila Pa 1976) 47(18):1263-1269, 2022.

Research Activities

Dr. Hamilton—as director and chief of spine—is actively engaged in clinical research and trials focusing on adult spinal deformity and degenerative spinal disorders. He is currently principal investigator in four clinical studies and co-investigator in seven other multicentered trials in various stages of completion. One of these studies includes a multicenter prospective evaluation of complex adult deformity surgery with the International Spine Study Group. Another includes a study evaluating the safety and performance of interbody implants for the treatment of patients with degenerative disease conditions of the thoracic and/or lumber spine.

D. Kojo Hamilton, MD

In spinal cord injury research, two multinational studies include a spinal cord perfusion and biomarker study and a phase 2a, randomized, double-blind, placebo-controlled study to assess the efficacy and safety of a novel humanized immunoglobulin G1 (IgG1) monoclonal antibody that binds to repulsive guidance molecule A(RGMa) for the treatment of spinal cord injury in subjects with acute traumatic cervical spinal cord injury. All outcomes are reported in national and international forums and journals.

Dr. Hamilton also continues to be a research advisor/mentor to University of Pittsburgh School of Medicine students as well as current and former residents and fellows.

Luke C. Henry, PhD

Assistant Professor

Luke Henry, PhD, joined the Department of Neurological Surgery in November of 2015. Dr. Henry completed his doctorate in clinical neuropsychology, specializing in research and intervention, at the Université de Montréal in 2011. He then moved to Pittsburgh where he completed a post-doctoral fellowship at the UPMC Sports Concussion Program. Dr. Henry worked for two years as a clinical instructor within the concussion program before joining the Department of Neurological Surgery. In his current role, Dr. Henry is responsible for pre- and post-operative neuropsychological testing for a variety of pathologies/conditions including movement disorders, epilepsy, Chiari malformations, brain tumors and post-TBI assessments. He is also actively involved with various research endeavors with other faculty members within the department. Dr. Henry is the lead neuropsychologist in the department, overseeing the growth of neuropsychological services within the department and in collaboration with other departments. He is also involved with doctoral-level training for clinical psychology students from the University of Pittsburgh and Chatham University. Additionally, he is the instructor for the graduate-level cognitive assessment class at the University of Pittsburgh where he is an adjunct professor.

Specialized Areas of Interest
Neuropsychological function; clinical outcomes.

Hospital Privileges
UPMC Mercy
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
American Psychological Association
International Neuropsychological Society
National Academy of Neuropsychology

Professional Activities
Adjunct Professor, Department of Psychology, University of Pittsburgh
Advisor, pre-doctoral psychology interns and graduate students, University of Pittsburgh and Chatham University

Education & Training
BS, Psychology, University of Calgary, 2003
MS, Behavioral Neuroscience, University of Calgary, 2006
PhD, Clinical Neuropsychology, Université de Montréal, 2011
Fellowship, Clinical Neuropsychology, UPMC, 2013

Luke C. Henry, PhD

Publications: 2022-23

• Refereed Articles:

Gonzalez-Martinez JA, Abou-Al-Shaar H, Mallela AN, McDowell MM, Henry L, Fernandes Cabral DT, Sweat J, Urban A, Fong J, Barot N, Castellano JF, Rajasekaran V, Bagic A, Snyderman CH, Gardner PA. The endoscopic anterior transmaxillary temporal pole approach for mesial temporal lobe epilepsies: a feasibility study. *J Neurosurg* 138(4):992-1001, 2022.

Research Activities

Dr. Henry is involved in Chiari-I malformation research with ongoing data collection and a manuscript in preparation. He is also a part of the deep brain stimulation research group within the University of Pittsburgh Department of Neurological Surgery, and he remains involved in research looking into the cognitive effects of meningiomas pre- and post-operatively. Finally, he is also involved in epilepsy research, working closely with Jorge Gonzalez-Martinez, MD, PhD, and Brad Mahon, PhD, of Carnegie Mellon University.

Kathryn Hoes, MD, MBS

Clinical Assistant Professor

Kathryn Hoes, MD, MBS, received her bachelors of science degree from the University of Pittsburgh in 2006 with a full academic scholarship. In addition to her dedicated science studies and pre-medical preparatory courses, she obtained a certificate in Latin American Studies during her time as an undergraduate. Spanish language proficiency was a part of this certification. She completed an accelerated masters of biomedical science degree at Rutgers University prior to medical school in order to obtain a deeper foundation in biomedical research which would play a vital role in her planned academic medical practice. Following her initial medical training at Rutgers University (formerly Robert Wood Johnson Medical School) Dr. Hoes went on to neurosurgery residency at University of Texas Southwestern Medical Center. She served as chief resident in her final year of training. For additional expertise. Dr. Hoes completed a CAST certified fellowship in complex spinal surgery at Indiana University School of Medicine as part of Goodman Campbell Brain and Spine. The training consisted of complex spinal and minimally invasive procedures, spinal oncology, peripheral nerve disorders, spinal deformity, degenerative spinal disease, pediatric spinal disorders, and disc arthroplasty. The type of care that is patient centered, humanistic, and collaborative is important to Dr. Hoes. She integrates the breadth of her multifaceted training in an approach to brain, spine and peripheral nerve disorders with the patient's health goals as her primary consideration. Dr. Hoes prefers conservative care and the least invasive strategies possible to return her patients back to the lifestyle they are seeking. Medical education remains her priority.

Specialized Areas of Interest

Spinal tumors; degenerative spinal disorders; complex spine surgery; spinal instrumentation; peripheral nerve surgery; brain and spine trauma.

Board Certifications

American Board of Neurological Surgery

Hospital Privileges

UPMC Mercy
UPMC Passavant
UPMC Presbyterian
UPMC Shadyside

Kathryn Hoes, MD, MBS

Professional Organization Membership
American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons
North American Spine Society

Education & Training
BS, University of Pittsburgh, 2006
Masters, Biomedical Sciences, University of Medicine and Dentistry of New Jersey (Rutgers University), 2007
MD, University of Medicine and Dentistry of New Jersey (Rutgers University), 2011
Residency, University of Texas Southwestern Medical Center, 2018
Fellowship, Complex Spine Neurosurgery, Indiana University with Goodman Campbell Brain and Spine, 2019

Honors & Awards
Best Doctor, *Dallas 'D' Magazine*, 2022
Post Residency Clinical Fellowship Grant, Neurosurgery Research and Education Foundation, 2018-19
Alumni Award, Robert Wood Johnson Foundation, Rutgers University, 2011
Gold Humanism Honor Society, Arnold P. Gold Foundation, Rutgers University, 2010.
Graduation with Honors, Cum Laude, University of Pittsburgh, 2006
Helen Faison Scholarship, University of Pittsburgh, 2002-06.

News Media Appearances: 2022-23
"UPMC Spine Center: Restoring Lives With a Comprehensive Approach," *North Hills Monthly*, January 2023.

Publications: 2022-23
• Refereed Articles:
Payne R, Azam F, Pernik M, Hicks WH, Hoes K. Retropharyngeal Blastomycosis Abscess Causing Osteomyelitis, Diskitis, Cervical Deformity, and Cervical Epidural Abscess: A Case Illustration and Review of the Literature. *World Neurosurg* [In press], 2023.

Baoli Hu, PhD

Assistant Professor
Director, Brain Tumor Evolution & Therapy Lab

Baoli Hu, PhD, joined the faculty of the University of Pittsburgh Department of Neurological Surgery at UPMC Children's Hospital of Pittsburgh in July of 2017. Dr. Hu received his bachelor's and master's degrees from the Northwest A&F University in Yangling, China in 2001. He earned his PhD degree in microbiology from Wuhan University in Wuhan, China in 2004 and completed his postdoctoral training in molecular oncology at H. Lee Moffitt Cancer Center and Research Institute in Tampa, Fla. in 2007. Prior to joining the faculty at the University of Pittsburgh School of Medicine, Dr. Hu was a senior research scientist in the Department of Genomic Medicine and Cancer Biology at the University of Texas, MD Anderson Cancer Center from 2011-17, working in the lab of Ronald DePinho, MD. From 2007-11 he worked with Dr. DePinho as a research scientist in the Department of Medical Oncology and Belfer Institute for Applied Cancer Science at Dana-Farber Cancer Institute at the Harvard Medical School. Dr. Hu's research is focused on understanding the molecular mechanisms of brain tumor evolution, including tumor development, progression, and recurrence after the treatment; and developing new strategies for the treatment of these devastating diseases.

Baoli Hu, PhD

Specialized Areas of Interest
Oncobiology of glioma and medulloblastoma; cancer stem cells; functional cancer genomics; mechanisms of tumor initiation, progression, treatment resistance, and recurrence; translational research in druggable targets and biomarkers discovery.

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Hillman Cancer Center

Professional Organization Membership
American Association for Cancer Research
Society for Neuro-Oncology
Children's Brain Tumor Network
Pediatric Brain Tumor Consortium

Professional Activities
Ad Hoc Reviewer, Children's Brain Tumor Network (CBTN)
Ad Hoc Reviewer, The Walter L. Copeland Fund, The Pittsburgh Foundation
Cell Image Core Advisory Committee, UPMC Children's Hospital of Pittsburgh

Education & Training
BS, Animal Science and Technology, Northwest A&F University, 1998
MS, Animal Breeding and Genetics, Northwest A&F University, 2001
PhD, Microbiology, Wuhan University, 2004
Fellow, Molecular Oncology, Moffitt Cancer Center & Research Institute, 2007

Honors & Awards
Richard King Mellon Scholar, UPMC Children's Hospital of Pittsburgh, 2018
UPMC Competitive Medical Research Fund Award, 2018
B*CURED Brain Cancer Research Investigator Award, 2018
Caroline Ross Endowed Fellowship Award, MD Anderson Cancer Center, 2017

News Media Appearances: 2022-23
"Cáncer de cerebro: cuáles son las siete señales para estar atentos y los 6 avances que dan esperanzas," lapatilla.com, May 24, 2023.
"New study uncovers key culprit behind pediatric brain cancer metastasis," EurekAlert/AAAS, March 6, 2023.
"New study uncovers key culprit behind pediatric brain cancer metastasis," bioengineer.org, March 6, 2023.
"New study uncovers key culprit behind pediatric brain cancer metastasis," scienmag.com, March 6, 2023.
"New research pinpoints key culprit behind brain cancer metastasis in children," news-medical.net, March 6, 2023.
"New study uncovers key culprit behind pediatric brain cancer metastasis," medicalxpress.com, March 6, 2023.
"New study uncovers key culprit behind pediatric brain cancer metastasis," healthmedicenet.com.com, March 6, 2023.
"Study pinpoints a key cause of metastasis from an aggressive form of pediatric brain cancer," azolifesciences.com March 6, 2023.
"New research pinpoints key culprit behind brain cancer metastasis in children,"news-medical.net, March 6, 2023.

Baoli Hu, PhD

Publications: 2022-23

• Refereed Articles:

Zou H, Poore B, Brown EE, Qian J, Xie B, Asimakidou E, Razskazovskiy V, Ayrapetian D, Sharma V, Xia S, Liu F, Chen A, Guan Y, Li Z, Wanggou S, Saulnier O, Ly M, Fellows-Mayle W, Xi G, Tomita T, Resnick AC, Mack MC, Raabe EH, Eberhart CG, Sun D, Stronach BE, Agnihotri S, Kohanbash G, Lu S, Herrup K, Rich JN, Gittes GK, Broniscer A, Hu Z, Li X, Pollack IF, Friedlander RM, Hainer SJ, Taylor MD, Hu B. A neurodevelopmental epigenetic program mediated by SMARCD3-DAB1-Reelin signaling is hijacked to promote metastatic dissemination of medulloblastoma. *Nat Cell Biol* 25(3):493-507 2023.

Frederico SC, Zhang X, Hu B, Kohanbash G. Pre-clinical models for evaluating glioma targeted immunotherapies. *Front Immunol* 13:1092399 2023.

Wu M, Wu L, Wu W, Zhu M, Li J, Wang Z, Li J, Ding R, Liang Y, Li L, hang T, Huang B, Cai Y, Li K, Lu Li, Zhang R, Hu B, Lin F, Wang X, Zheng S, Chen J, You Y, Jiang T, Zhang J, Chen H, Wang Q. Phagocytosis of glioma cells enhances the immunosuppressive phenotype of bone marrow-derived macrophages. *Cancer Res* 83(5):771-785 2023.

Srivastava R, Dodda M, Zou H, Li X, Hu B. Tumor niches: perspectives for targeted therapies in glioblastoma. *Antioxid Redox Signal* [Online ahead of print], 2023.

Chen A, Chao Y, Zou H, McCarl LH, Kohanbash G, Hu B. Protocol to assess the antitumor efficacy of an immunotherapeutic peptide in syngeneic orthotopic glioma mouse models. *STAR Protoc* [Online ahead of print], 2023.

Wu L, Wu W, Zhang J, Zhao Z, Li L, Zhu M, Wu M, Wu F, Zhou F, Du Y, Chai RC, Zhang W, Qiu X, Liu Q, Wang Z, Li J, Li K, Chen A, Jiang Y, Xiao X, Zou H, Srivastava R, Zhang T, Cai Y, Liang Y, Huang B, Zhang R, Lin F, Hu L, Wang X, Qian X, Lv S, Hu B, Zheng, S, Hu Z, Shen H, You Y, Verhaak RGW, Jiang T, Wang Q. Natural coevolution of tumor and immunoenvironment in glioblastoma. Cancer Discov 12(12):2820-2837, 2022.

Research Activities

Over the past year, the research efforts in Dr. Hu's Brain Tumor Evolution Therapy Lab have mainly focused on the completion of two projects, which include 1) developing a new class of drugs for targeting the immune-suppressive microenvironment in glioblastoma, and 2) understanding molecular mechanisms of medulloblastoma metastatic dissemination. The results of these projects have generated research grants and paper publications. The National Institute of Health (NIH)/National Cancer Institute (NCI) R01 and The National Institute of Neurological Disorders and Stroke (NINDS) R21 grants have continuously supporting these projects. Additionally, the research projects have been funded and supported by foundations including the Andrew McDonough B+ Foundation and the Walter L. Copeland Foundation. One manuscript was published in *Nature Cell Biology* and two invited papers were published in *Antioxidants and Redox Signaling* and *STAR Protocols* (Cell Press) as well as other co-authorship publications. Lab members have presented the results at local and international conferences, such as the 12th Annual Children's Hospital Research Symposium at the UPMC Children's Hospital of Pittsburgh and the Society of Neuro-Oncology (SNO) 27th Annual Meeting.

There were six undergraduate students and two medical students who have been mentored and trained in the lab. Among them, one undergraduate student was awarded the Dean's Award for poster presentation and two other undergraduate students were enrolled in Pitt School of Medicine, the Summer Undergraduate Research Program (SURP) and UPMC Children's Hospital of Pittsburgh's Summer Research Internship Program (SRIP).

Esther Jane, PhD

Research Assistant Professor

Esther Jane, PhD, graduated from Madurai Kamaraj University in India. She did her post doctoral training in Case Western Reserve University in Cleveland, Ohio, on the molecular mechanisms underlying regulation of homeotic gene expression during Drosophila development. Before joining the University of Pittsburgh Department of Neurological Surgery, she worked in the Pittsburgh Development Center in studying the cell biology of human embryonic stem cells before and after differentiation towards neuronal lineage.

Specialized Areas of Interest
Mode of action of multi-target tyrosine kinase inhibitors in glioma cells.

Professional Organization Membership
American Association for Cancer Research

Education & Training
BSc, Zoology, Sarah Tucker College, 1983
MSc, Zoology, The American College, 1986
PhD, Biology, The Madurai Kamaraj University, 1992

David L. Kaufmann, MD

Clinical Assistant Professor
Chief, Neurosurgery, UPMC Mercy

David L. Kaufmann, MD, is clinical assistant professor of neurological surgery at the University of Pittsburgh School of Medicine and is chief of neurosurgery at UPMC Mercy. He maintains a general neurosurgery practice with an emphasis on treating degenerative disorders of the spine and traumatic injuries of the brain and spine. He also has an interest in complex spinal reconstructive surgery for conditions involving spinal deformity and brain tumors. Dr. Kaufmann received his medical degree from the Albert Einstein College of Medicine in New York City and completed a general surgery internship at the Johns Hopkins Hospital in Baltimore. He performed his neurosurgical residency at Montefiore Medical Center and the Hyman-Newman Institute for Neurology and Neurosurgery at Beth Israel Medical Center in New York City. He is board certified in neurological surgery. Dr. Kaufmann is a member of the American Association of Neurological Surgeons, the Congress of Neurological Surgeons and the Pennsylvania Neurosurgical Society.

Specialized Areas of Interest
Spinal decompression and fusion surgery; complex spine surgery; brain and spine trauma; brain tumors; neurosurgical treatment of pain.

Board Certifications
American Board of Neurological Surgeons

Hospital Privileges
UPMC Mercy

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons
Pennsylvania Neurosurgical Society

David L. Kaufmann, MD

Education & Training
BA, Philosophy, Emory University, 1989
MA Candidate, Columbia University, 1990
MD, Albert Einstein College of Medicine, 1994
Residency, Montefiore Medical Center, 2000
Residency, Beth Israel Medical Center, 2000

Robert Kellogg, MD

Assistant Professor

Robert Kellogg, MD, joined the Department of Neurological Surgery, as an assistant professor in September of 2020 specializing in pediatric neurosurgery. His clinical and research interests include the comprehensive management of spasticity and movement disorders, craniofacial surgery, hydrocephalus, tethered spinal cord, pediatric brain tumors, and Chiari malformations. Dr. Kellogg grew up in Connecticut but has deep ties to Pennsylvania. He is married and has two sons. Dr. Kellogg received his medical education from Indiana University School of Medicine and did his internship and residency training in neurological surgery at Rush University Medical Center in Chicago. Dr. Kellogg completed a pediatric neurosurgery fellowship at UPMC Children's Hospital of Pittsburgh.

Specialized Areas of Interest
Spasticity and movement disorders; back/spine pain; craniofacial/ craniosynostosis; plagiocephaly.

Board Certifications
American Board of Neurological Surgery
American Board of Pediatric Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Harrisburg
UPMC Magee-Womens Hospital

Professional Organization Membership
American Association of Neurological Surgeons
AANS/CNS Joint Section on Pediatric Neurosurgery

Education & Training
BA, Indiana University, 2005
MD, Indiana University School of Medicine, 2009
Residency, Rush University Medical Center, 2015
Fellowship, University of Pittsburgh, 2016

Publications: 2022-23
• Refereed Articles:
Abou Khalil E, Gaines BA, Kellogg RG, Simon DW, Morgan KM, Richardson WM, Leeper CM. Association of Thromboelastography with Progression of Hemorrhagic Injury in Children with Traumatic Brain Injury. *Neurocrit Care* 38(2):326-334, 2023.

Gary Kohanbash, PhD

Assistant Professor
Director, PNIO Laboratory

Gary Kohanbash, PhD, joined the faculty of the Department of Neurological Surgery at UPMC Children's Hospital of Pittsburgh in January of 2017. Dr. Kohanbash graduated from the University of Pittsburgh in 2007 with a bachelor of science honors degree in neuroscience, specializing in neurodegenerative diseases. He then earned his masters of science degree in infectious diseases and microbiology in 2009, and a doctorate in philosophy in 2012, both from the University of Pittsburgh Graduate School of Public Health. While there, he identified novel pathways of immunosuppression in gliomas and participated in multiple phase I/II immunotherapy clinical trials. Dr. Kohanbash subsequently completed a post-doctoral fellowship in the University of Pittsburgh Department of Neurological Surgery in 2014. He continued his training as a post-doctoral fellow at the University of California, San Francisco (UCSF) Department of Neurological Surgery. While at UCSF, Dr. Kohanbash was privileged to complete a prestigious T32 training program in translational brain tumor research.

Specialized Areas of Interest
Immunotherapy for pediatric and adult central nervous system tumors.

Professional Organization Membership
Society for Immunotherapy of Cancer
Society for Neuro-Oncology
World Molecular Imaging Society

Professional Activities
Faculty Assembly Member, University of Pittsburgh
Senate Library Committee, University of Pittsburgh
Senate Member, University of Pittsburgh
Scientific Committee Member, Childhood Brain Tumor Tissue Consortium
Study Section, St. Baldrick's Foundation Fellowship
Study Section, American Brain Tumor Association

Education & Training
BS, (hons), Neuroscience, University of Pittsburgh, 2007
MS, Infectious Diseases and Microbiology, University of Pittsburgh, 2009
PhD, Brain Tumor Immunology, University of Pittsburgh, 2012
Postdoctoral Fellow, Neurological Surgery, University of Pittsburgh, 2014
Postdoctoral Fellow, Neurological Surgery, University of California, San Francisco, 2016

Honors & Awards
Research Travel Award, Society for Immunotherapy of Cancer, 2014-15
Honoree, The Annual Convocation of the University of Pittsburgh, 2010, 2014
Best Dissertation Award, Department of Infectious Diseases and Microbiology, University of Pittsburgh, 2013
Top Oral Presentation, Translational Research Cancer Center Consortium (TRCCC), 2013
International Research Travel Award, Japanese Society for Brain Tumor Pathology, 2012
Best Graduate Thesis Award, Department of Infectious Diseases and Microbiology, University of Pittsburgh, 2010
Top Poster Award, Translational Research Cancer Center Consortium (TRCCC), 2009

Gary Kohanbash, PhD

Publications: 2022-23

• Refereed Articles:

Nisnboym M, Vincze SR, Xiong Z, Sneiderman CT, Raphael RA, Li B, Sever RE, Jaswal A, Day KE, Latoche JD, Foley LM, Karimi H, Hitchens TK, Agnihotri S, Hu B, Rajasundaram D, Anderson CJ , Blumenthal DT, Pearce TM, Uttam S, Nedrow JR, Panigrahy A, Pollack IF, Lieberman FS, Drappatz J, Raphael I, Edwards WB. Kohanbash G. Immuno-PET Imaging of CD69 Visualizes T-Cell Activation and Predicts Survival following Immunotherapy in Murine GBM. *Cancer Research Communication* 3(7):1173–1188, 2023.

Bou-Samra P, Muhammad N, Chang A, Karsalia R, Azari F, Kennedy G, Stummer W, Tanyi J, Martin L, Vahrmeijer A, Smith B, Rosenthal E, Wagner P, Rice D, Lee A, Abdelhafeez A, Malek MM, Kohanbash G, Barry Edwards W, Henderson E, Skjøth-Rasmussen J, Orosco R, Gibbs S, Farnam RW, Shankar L, Sumer B, Kumar ATN, Marcu L, Li L, Greuv V, Delikatny EJ, Lee JYK, Singhal S. Intraoperative molecular imaging: 3rd biennial clinical trials update. *J Biomed Opt* 28(5):050901, 2023.

Frederico SC, Darling C, Bielanin JP, Dubinsky AC, Zhang X, Hadjipanayis CG, Kohanbash G. Neoadjuvant immune checkpoint inhibition in the management of glioblastoma: Exploring a new frontier. *Front Immunol* 14:1057567, 2023.

Chen A, Chao Y, Zou H, McCarl LH, Kohanbash G, Hu B. Protocol to assess the antitumor efficacy of an immunotherapeutic peptide in syngeneic orthotopic glioma mouse models. *STAR Protoc* 4(1):102049, 2023.

Zou H, Poore B, Brown EE, Qian J, Xie B, Asimakidou E, Razskazovskiy V, Ayrapetian D, Sharma V, Xia S, Liu F, Chen A, Guan Y, Li Z, Wanggou S, Saulnier O, Ly M, Fellows-Mayle W, Xi G, Tomita T, Resnick AC, Mack SC, Raabe EH, Eberhart CG, Sun D, Stronach BE, Agnihotri S, Kohanbash G, Lu S, Herrup K, Rich JN, Gittes GK, Broniscer A, Hu Z, Li X, Pollack IF, Friedlander RM, Hainer SJ, Taylor MD, Hu B. A neurodevelopmental epigenetic programme mediated by SMARCD3-DAB1-Reelin signalling is hijacked to promote medulloblastoma metastasis. *Nat Cell Biol* 25(3):493-507, 2023.

Sever R, Rosenblum LT, Schmitt L, Hartwick S, Schwab K, Wu Y, Raphael I, Reyes M, Edwards WB, Malek MM, Kohanbash G. Novel orthotopic model of neuroblastoma in RNU homozygous rats. *bioRxiv* [Preprint], 2023.

Panigrahy A, Jakacki RI, Pollack IF, Ceschin R, Okada H, Nelson MD, Kohanbash G, Dhall G, Bluml S. Magnetic Resonance Spectroscopy Metabolites as Biomarkers of Disease Status in Pediatric Diffuse Intrinsic Pontine Gliomas (DIPG) Treated with Glioma-Associated Antigen Peptide Vaccines. *Cancers* (Basel) 14(23):5995, 2022.

Research Activities

The Kohanbash Lab continues to work on improving immunotherapy for patients with brain tumors. One of the promising areas in the lab has been work in developing new techniques to monitor immunotherapy. Dr. Kohanbash has started and continues to use bioinformatic data and machine learning to accomplish this, however, he understands the need to do this using non-invasive techniques. Imaging capabilities continue to expand and Dr. Kohanbash is developing markers to track the status of immunotherapies throughout the tumor and without the need for samples from patients. This work will hopefully be available for patients in the future. As Dr. Kohanbash gains expertise in doing this type of work, he has been expanding this area of research to include intraoperative surgical guidance, and radiopharmaceutical therapies, using similar strategies showing promise for imaging. Dr. Kohanbash is also focusing on testing multiple new immunotherapies for translation and also developing new cell therapy approaches.

Michael J. Lang, MD

Assistant Professor

Michael J. Lang, MD, joined the University of Pittsburgh in 2019 as a vascular and endovascular neurosurgeon who specializes in treatment of vessel diseases of the brain, including aneurysms, stroke, carotid artery stenosis, arteriovenous malformations and fistulas, cavernomas, and intracerebral hemorrhage. He performs both minimally invasive endovascular and traditional open & skull base surgery, allowing a comprehensive approach in the treatment of cerebrovascular disease. He also has subspecialty training in functional/epilepsy neurosurgery. Dr. Lang completed his undergraduate work at the University of Wisconsin. He received his medical degree from Ohio State University, graduating with honors. Dr. Lang completed his neurosurgical residency and fellowships in both endovascular neurosurgery and functional & epilepsy surgery at Thomas Jefferson University. He then completed the prestigious fellowship in open cerebrovascular and skull base surgery at the Barrow Neurological Institute with extensive training in cerebral bypass surgery and removal of vascular lesions of the brainstem. Dr. Lang has published numerous papers and book chapters, participated in clinical trials, and delivered lectures to audiences all over the world. His research interests include clinical outcomes in the treatment of cerebrovascular disease and epilepsy surgery, as well as MRI-compatible robotics.

Specialized Areas of Interest
Intracranial aneurysms; arteriovenous malformations; arteriovenous fistulas; cavernous malformations; brain tumors carotid stenosis; intracranial stenosis,; venous sinus stenosis; ischemic stroke; trigeminal neuralgia; epilepsy.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Mercy
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
Alpha Omega Alpha
American Association of Neurological Surgeons
AANS/CNS Joint Section of Cerebrovascular Neurosurgery
Congress of Neurological Surgeons
North American Neuromodulation Society

Education & Training
BS, Biology, University of Wisconsin-Madison, 2006
MD (Honors), The Ohio State University College of Medicine, 2011
Residency (Neurosurgery), Thomas Jefferson University, 2018
Fellowship (Functional/Epilepsy), Thomas Jefferson University, 2016
Fellowship (Endovascular), Thomas Jefferson University, 2018
Fellowship (Cerebrovascular/Skull Base), Barrow Neurological Institute, 2019

Honors & Awards
Physician Excellence Award, UPMC, 2021

L. Dade Lunsford, MD

Lars Leksell & Distinguished Professor
Director Emeritus, Center for Image-Guided Neurosurgery
Associate Program Director, Neurological Surgery Residency

L. Dade Lunsford, MD, is the Lars Leksell Professor and Distinguished Professor at the Department of Neurological Surgery at the University of Pittsburgh. He is also director emeritus of the Center for Image-Guided Neurosurgery at the University of Pittsburgh Medical Center and an internationally recognized authority on stereotactic surgery, radiosurgery, and minimally invasive surgery. In 1981 Dr. Lunsford was the first in the world to install a dedicated CT scanner in an operating room, merging surgery with imaging for the first time. More than 10,000 patients have undergone various image-guided surgical procedures since that time. In 1987, Dr. Lunsford was responsible for bringing the Gamma Knife to the University of Pittsburgh Medical Center, the first center in the United States to offer this state-of-the-art, minimally invasive form of brain surgery. Since that time, more than 18,000 patients have undergone brain stereotactic radiosurgery using continuously updated version of the Gamma Knife. He and his team have trained more than 2,500 surgeons, oncologists and physicists in the field of radiosurgery via training courses conducted six times per year. Dr. Lunsford graduated from the University of Virginia and then received his medical degree in 1974 from the Columbia University College of Physicians and Surgeons. He completed his internship in surgery at the University of Virginia Hospital and his residency in neurological surgery at the University of Pittsburgh training under Peter Jannetta. Following a one-year fellowship in stereotactic and functional neurosurgery at the Karolinska institute in Stockholm, Sweden—where he studied with professors Lars Leksell and Erik-Olof Backlund—he joined the Department of Neurological Surgery faculty in 1981. He is an active staff member of several UPMC hospitals and was president of the medical staff at UPMC Presbyterian from 1999-2001 and past president of the Council of Clinical Chairs for the University of Pittsburgh School of Medicine in 2001-2003. Dr. Lunsford chairs the UPMC Health System Technology and Innovative Practice (TIPAC) committee and co-chairs the UPMC Brain Mapping (MEG) Center. Dr. Lunsford has been board-certified by the American Board of Neurological Surgery since 1983. He is the author of more than 1,400 published articles, abstracts, and book chapters and has served as the editor or co-editor of 17 books. Dr. Lunsford served as department chairman of the University of Pittsburgh Department of Neurological Surgery for ten years, before stepping down in July of 2006 to devote more time to his clinical work, clinical investigation, and resident and fellow training. He also served as the department residency program director from 1987 until 2020. Since 2012, he has served as a team physician (neurosurgeon) for the National Hockey League's Pittsburgh Penguins. In 2016, Dr. Lunsford received the Cushing Award for Technical Excellence and Innovation in Neurosurgery from the American Association of Neurological Surgery. In December of 2017, he received the prestigious Herbert Olivecrona Award—considered by some as the "Nobel Prize of Neurosurgery"—from the Karolinska Institute & Karolinska University Hospital in Stockholm, Sweden. In April of 2018, he was honored to present the 2018 Van Wagenen Lecture during the American Association of Neurological Surgeons Annual Meeting in New Orleans. On June 19, 2020, he delivered the inaugural Dan Leksell Lecture at the fourth meeting of the International Radiosurgery Research Foundation. In 2021, Dr. Lunsford received the Andrew Parsa award for mentorship from the AANS-CNS Section on Tumors and delivered the annual Ronald Bittner Lecture. In May 2022 he delivered the inaugural Lunsford Radiosurgery Lecture at the Miami Baptist Cancer Institute. Since 2002 Dr. Lunsford has been a Castle Connolly Top Doctor and currently serves on their Board of Medical Advisors.

Specialized Areas of Interest
Brain tumor management; Gamma Knife stereotactic radiosurgery; movement disorders and trigeminal neuralgia; vascular malformations; concussion; sports medicine.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Presbyterian
UPMC Shadyside
UPMC St. Margaret (Consulting)

Professional Organization Membership
AANS/CNS Joint Section for Stereotactic and Functional Neurosurgery (chair, 1995-97)
Allegheny County Medical Society
American Academy of Neurological Surgery
American Association of Neurological Surgeons, Fellow
American College of Surgeons, Fellow
American Society for Stereotactic and Functional Neurosurgery (president, 1995-97)
Congress of Neurological Surgeons
Florida Medical Association
International Radiosurgery Research Foundation, (founding chair)
International Stereotactic Radiosurgery Society, (co-founder and president, 1991-1993)
North American Skull Base Society (prior honored guest)
Pennsylvania Medical Society
Pennsylvania Neurosurgical Society

Professional Activities
Course Co-Director, Principles and Practices of Gamma Knife Radiosurgery, UPMC
Past Chair and Founder, International Radiosurgery Research Foundation
Team Co-Neurosurgeon, Pittsburgh Penguins, National Hockey League
Chair Data Safety Monitoring Board, Insightec®
Consultant, Teladoc, Inc.

Education & Training
BA, University of Virginia, 1970
MD, Columbia University, 1974
Internship, General Surgery, University of Virginia, 1975
Residency, University of Pittsburgh, 1980
Fellowship, Stereotactic and Functional Neurosurgery, Karolinska Sjukhuset, 1981

Honors & Awards
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2012-23
Inaugural Lunsford Radiosurgery Lecture, Miami Baptist Cancer Institute, 2022
Andy T. Parsa Mentorship Award, AANS/CNS Section on Tumors, 2021
Ronald L. Bittner Lecturer, AANS/CNS Section on Tumors, 2021
Excellence in Patient Experience Award, UPMC, 2018
Van Wagenen Lecturer, American Association of Neurological Surgeons Annual Meeting, 2018
Herbert Olivecrona Award, Karolinska Institute & Karolinska University Hospital, 2017
AANS Cushing Award for Technical Excellence and Innovation in Neurosurgery, 2016
Best Doctors in America, *Pittsburgh Business Times*, 2016
American Most Honored Professionals, Top 1%, 2016
America's Top Doctors for Cancer, Castle Connolly Medical, Ltd., 2005-16
Best Doctors in America, 2005-16
Top Doctor, *The Global Directory of Who's Who*, Neurological Surgery, 2013-16

Best Doctors in America database, 2010-16
Who's Who In America, Marquis, 2003, 2006-14
Pioneers in Radiosurgery Award, Leksell Gamma Knife Society, 2010
Leading Health Professionals of the World, 2010
Faculty Teaching Award, Department of Neurosurgery 1997, 1999, 2000, 2010
Guide to America's Top Surgeons, 2006-09
Allegheny County Medical Society Ralph C. Wilde Award, 2008
Castle Connolly Medical Ltd. National Physician of the Year Award, 2008
Who's Who in the World, 2008
Distinguished Professor, University of Pittsburgh, 2007
Who's Who in Science and Engineering, 2007
Congress of Neurological Surgeons Honored Guest, 2007
AANS Young Neurosurgeon Award, 2005
Academic Keys Who's Who in Medical Sciences Education, 2005
Lars Leksell Provost Lecture, 2000
International Stereotactic Radiosurgery Jacob Fabrikant Award, 1997
William S. McEllroy Award, University of Pittsburgh School of Medicine, 1997
Good Housekeeping Best Doctors, 1996
William P. Van Wagenen Fellowship, AANS, 1980
Phi Beta Kappa, University of Virginia, 1970
BA with High Honors, University of Virginia, 1970

Publications: 2022-23

• Refereed Articles:

Dumot C, Pikis S, Mantziaris G, Xu Z, Dayawansa S, Anand RK, Nabeel AM, Sheehan D, Sheehan K, Reda WA, Tawadros SR, Karim KA, El-Shehaby AMN, Eldin RME, Peker S, Samanci Y, Kaisman-Elbaz T, Speckter H, Hernández W, Isidor J, Tripathi M, Madan R, Zacharia BE, Daggubati LC, Moreno NM, Álvarez RM, Langlois AM, Mathieu D, Deibert CP, Sudhakar VR, Cifarelli CP, Icaza DA, Cifarelli DT, Wei Z, Niranjan A, Barnett GH, Lunsford LD, Bowden GN, Sheehan JP. Stereotactic radiosurgery for Koos grade IV vestibular schwannoma in patients ≥ 65 years old: a multi-institutional retrospective study. *Acta Neurochir* (Wien) 165(1):211-220, 2023.

Abdallah HM, Mallela AN, Wei Z, Abou-Al-Shaar H, Niranjan A, Lunsford LD. Gamma Knife radiosurgery for meningiomas of the confluence of the falx and tentorium. *J Neurooncol* 161(2):225-233, 2023.

Bin-Alamer O, Alnefaie N, Qedair J, Chaudhary A, Hallak H, Abdulbaki A, Mallela AN, Palmisciano P, Gersey ZC, Legarreta AD, Labib MA, Zada G, Sheehan JP, Couldwell WT, Lunsford LD, Abou-Al-Shaar H. Single session versus multisession stereotactic radiosurgery for the management of intracranial meningiomas: a systematic review and meta-analysis. *J Neurooncol* 161(2):215-224, 2023.

Mantziaris G, Pikis S, Xu Z, Mullen R, Alzate J, Bernstein K, Kondziolka D, Wei Z, Niranjan A, Lunsford LD, Liscak R, May J, Lee CC, Yang HC, Coupé FL, Mathieu D, Sheehan K, Sheehan D, Palmer JD, Perlow HK, Peker S, Samanci Y, Peterson J, Trifiletti DM, Shepard MJ, Elhamdani S, Wegner RE, Speckter H, Hernandez W, Warnick RE, Sheehan J. Stereotactic Radiosurgery for Intraventricular Metastases: A Multicenter Study. *Neurosurgery* 92(3):565-573, 2023.

Kowalchuk RO, Niranjan A, Hess J, Antonios JP, Zhang MY, Braunstein S, Ross RB, Pikis S, Deibert CP, Lee CC, Yang HC, Langlois AM, Mathieu D, Peker S, Samanci Y, Rusthoven CG, Chiang V, Wei Z, Lunsford LD, Trifiletti DM, Sheehan JP. Stereotactic radiosurgery and local control of brain metastases from triple-negative breast cancer. *J Neurosurg* 138:608-1614, 2023.

Lehrer EJ, Kowalchuk RO, Gurewitz J, Bernstein K, Kondziolka D, Niranjan A, Wei Z, Lunsford LD, Fakhoury KR, Rusthoven CG, Mathieu D, Trudel C, Malouff TD, Ruiz-Garcia H, Bonney P, Hwang L, Yu C, Zada G, Patel S, Deibert CP, Picozzi P, Franzini A, Attuati L, Prasad RN, Raval RR, Palmer JD, Lee CC, Yang HC, Harmsen WS, Jones BM, Sharma S, Ahluwalia MS, Sheehan JP, Trifiletti DM. Concurrent administration of immune checkpoint inhibitors and single fraction stereotactic radiosurgery in patients with non-small cell lung cancer, melanoma, and renal cell carcinoma brain metastases is not associated with an increased risk of radiation necrosis over non-concurrent treatment: An international multicenter study of 657 patients. *Int J Radiat Oncol Biol Phys* S0360-3016(23)00057-3, 2023.

Parikh P, Abdallah HM, Patel A, Shariff RK, Nowicki KW, Mallela AN, Tonetti DA, Sekula RF Jr, Lunsford LD, Abou-Al-Shaar H. Bibliometric Analysis of the Top 100 Cited Articles on Stereotactic Radiosurgery for Trigeminal Neuralgia. *Asian J Neurosurg* 18(1):101-107, 2023.

Lehrer EJ, Ahluwalia MS, Gurewitz J, Bernstein K, Kondziolka D, Niranjan A, Wei Z, Lunsford LD, Fakhoury KR, Rusthoven CG, Mathieu D, Trudel C, Malouff TD, Ruiz-Garcia H, Bonney P, Hwang L, Yu C, Zada G, Patel S, Deibert CP, Picozzi P, Franzini A, Attuati L, Prasad RN, Raval RR, Palmer JD, Lee CC, Yang HC, Jones BM, Green S, Sheehan JP, Trifiletti DM. Imaging-defined necrosis after treatment with single-fraction stereotactic radiosurgery and immune checkpoint inhibitors and its potential association with improved outcomes in patients with brain metastases: an international multicenter study of 697 patients. *J Neurosurg* 138:1178-1187, 2023.

Bin-Alamer O, Faramand A, Alarifi NA, Wei Z, Mallela AN, Lu VM, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Peker S, Samanci Y, Lee CC, Yang HC, Delabar V, Mathieu D, Tripathi M, Kearns KN, Bunevicius A, Sheehan JP, Chytka T, Liscak R, Moreno NM, Álvarez RM, Grills IS, Parzen JS, Cifarelli CP, Rehman AA, Speckter H, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Stereotactic Radiosurgery for Vestibular Schwannoma in Neurofibromatosis Type 2: An International Multicenter Case Series of Response and Malignant Transformation Risk. *Neurosurgery* 92(5):934-944, 2023.

Wei Z, Luy DD, Tang LW, Deng H, Jose S, Scanlon S, Niranjan A, Lunsford LD. Gamma Knife radiosurgery for gynecologic metastases to the brain: Analysis of pathology, survival, and tumor control. *Gynecol Oncol* 172:21-28, 2023.

Mantziaris G, Pikis S, Chytka T, Liščák R, Sheehan K, Sheehan D, Peker S, Samanci Y, Bindal SK, Niranjan A, Lunsford LD, Kaur R, Madan R, Tripathi M, Pangal DJ, Strickland BA, Zada G, Langlois AM, Mathieu D, Warnick RE, Patel S, Minier Z, Speckter H, Xu Z, Kormath Anand R, Sheehan JP. Adjuvant versus on-progression Gamma Knife radiosurgery for residual nonfunctioning pituitary adenomas: a matched-cohort analysis. *J Neurosurg* 138:1662-1668, 2023.

Abou-Al-Shaar H, Patel A, Mallela AN, Bin-Alamer O, Niranjan A, Peker S, Samanci Y, Liscak R, May J, Kumar JS, Sheehan JP, Lunsford LD. Chronic Encapsulated Expanding Hematomas After Stereotactic Radiosurgery for Intracranial Arteriovenous Malformations: An International Multicenter Case Series. *Neurosurgery* 92(1):195-204, 2023.

Wei Z, Pease M, Tang LW, Deng H, Shanahan R, Faramand A, Niranjan A, Lunsford LD. Radiosurgery outcomes in infratentorial juvenile pilocytic astrocytomas. *J Neurooncol* 162(1):157-165, 2023.

Dabhi N, Pikis S, Mantziaris G, Tripathi M, Warnick R, Peker S, Samanci Y, Berger A, Bernstein K, Kondziolka D, Niranjan A, Lunsford LD, Sheehan JP. Stereotactic radiosurgery for the treatment of hypoglossal schwannoma: a multi-institutional retrospective study. *Acta Neurochir* (Wien) 164(9):2473-2481, 2022.

Ironside N, Chen CJ, Xu Z, Schlesinger D, Lee Vance M, Hong GK, Jane JA Jr, Patel S, Bindal SK, Niranjan A, Lunsford LD, Liscak R, Chytka T, Jezkova J, Saifi O, Trifiletti DM, Berger A, Alzate J, Bernstein K, Kondziolka D, Speckter H, Hernandez W, Lazo E, Peker S, Samanci Y, Zacharia BE, Mau C, Wegner RE, Shepard MJ, Mathieu D, Maillet M, Sheehan JP. Effects of Neuroanatomic Structural Distances on Pituitary Function After Stereotactic Radiosurgery: A Multicenter Study. *Neurosurgery* 92(5):1035-1042, 2023.

Plute T, Patel A, Mallela AN, Sefcik RK, Hamilton DK, Lunsford LD, Friedlander RM, Abou-Al-Shaar H. United States Neurosurgery Department Program Directors: A Cross-Sectional Evaluation of Current and Future Trends and Attributes. *World Neurosurg* 170:e550-e557, 2023.

Singh R, Bowden G, Mathieu D, Perlow HK, Palmer JD, Elhamdani S, Shepard M, Liang Y, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Elazzazi AH, Warnick RE, Gozal YM, Daly M, McShane B, Addis-Jackson M, Karthikeyan G, Smith S, Picozzi P, Franzini A, Kaisman-Elbaz T, Yang HC, Wei Z, Legarreta A, Hess J, Templeton K, Pikis S, Mantziaris G, Simonova G, Liscak R, Peker S, Samanci Y, Chiang V, Niranjan A, Kersh CR, Lee CC, Trifiletti DM, Lunsford LD, Sheehan JP. Local Control and Survival Outcomes After Stereotactic Radiosurgery for Brain Metastases From Gastrointestinal Primaries: An International Multicenter Analysis. *Neurosurgery* [Online ahead of print], 2023.

Bin-Alamer O, Pikis S, Mantziaris G, Abdulbaki A, Mallela AN, Lu VM, Peker S, Samanci Y, Nabeel AM, Reda WA, Tawadros SR, El-Shehaby AMN, Abdelkarim K, Emad Eldin RM, Sheehan D, Sheehan K, Liscak R, Chytka T, Tripathi M, Madan R, Speckter H, Hernández W, Barnett GH, Hori YS, Dabhi N, Aldakhil S, Mathieu D, Kondziolka D, Bernstein K, Wei Z, Niranjan A, Kersh CR, Lunsford LD, Sheehan JP, Abou-Al-Shaar H. Adjuvant Stereotactic Radiosurgery With or Without Postresection Fractionated Radiation Therapy for the Management of Clival Chordomas in Adults: An International Multicenter Case Series. *Neurosurgery* [Online ahead of print], 2023.

Samanci Y, Askeroglu MO, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Legarreta A, Fernandes Cabral D, Anand S, Niranjan A, Lunsford LD, Tripathi M, Kumar N, Liščák R, May J, Lee CC, Yang HC, Martínez Moreno N, Martínez Álvarez R, Douri K, Mathieu D, Pikis S, Mantziaris G, Sheehan JP, Bernstein K, Kondziolka D, Peker S. Stereotactic Radiosurgery for Meningiomas in Children and Adolescents: An International Multi-Institutional Study. *Neurosurgery* [Online ahead of print], 2023.

Head JR, Bin-Alamer O, Wei Z, Waite K, Agrawal N, Mallela AN, Faramand A, Gersey ZC, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Vestibular Schwannoma Stereotactic Radiosurgery in Octogenarians: Case Series. *Neurosurgery* [Online ahead of print], 2023.

Wei Z, Jose S, Abou-Al-Shaar H, Deng H, Luy D, Kondziolka D, Niranjan A, Lunsford LD. Intracerebral and pituitary metastatic eccrine carcinoma: prolonged survival using stereotactic radiosurgery. *Br J Neurosurg* [Online ahead of print], 2023.

Xiao Y, Wan J, Zhang Y, Wang X, Zhou H, Lai H, Chong W, Hai Y, Lunsford LD, You C, Yu S, Fang F. Association between acute kidney injury and long-term mortality in patients with aneurysmal subarachnoid hemorrhage: A retrospective study. *Front Neurol* 13:864193, 2022.

Bin-Alamer O, Mallela AN, Palmisciano P, Gersey ZC, Elarjani T, Labib MA, Zenonos GA, Dehdashti AR, Sheehan JP, Couldwell WT, Lunsford LD, Abou-Al-Shaar H. Adjuvant stereotactic radiosurgery with or without postoperative fractionated radiation therapy in adults with skull base chordomas: a systematic review. *Neurosurg Focus* 53(5):E5, 2022.

L. Dade Lunsford, MD

Wei Z, Waite K, Deng H, Najjar Y, Niranjan A, Lunsford LD. Aggressive Stereotactic Radiosurgery Coupled With Immune and Targeted Therapy for Recurrent Melanoma Brain Metastases: A Case Report and Literature Review. *Cureus* 14(7):e26553, 2022.

Albano L, Deng H, Wei Z, Vodovotz L, Niranjan A, Lunsford LD. The longitudinal volumetric response of vestibular schwannomas after Gamma Knife radiosurgery. *J Neurosurg* 138(5):1273-1280, 2022.

Dumot C, Pikis S, Mantziaris G, Xu Z, Anand RK, Nabeel AM, Sheehan D, Sheehan K, Reda WA, Tawadros SR, Abdel Karim K, El-Shehaby AMN, Emad Eldin RM, Peker S, Samanci Y, Kaisman-Elbaz T, Speckter H, Hernández W, Isidor J, Tripathi M, Madan R, Zacharia BE, Daggubati LC, Moreno NM, Álvarez RM, Langlois AM, Mathieu D, Deibert CP, Sudhakar VR, Cifarelli CP, Icaza DA, Cifarelli DT, Wei Z, Niranjan A, Barnett GH, Lunsford LD, Bowden GN, Sheehan JP. Stereotactic radiosurgery for Koos grade IV vestibular schwannoma in young patients: a multi-institutional study. *J Neurooncol* 160(1):201-208, 2022.

Daza-Ovalle A, Bin-Alamer O, Flickinger J, Niranjan A, Lunsford LD. Outcomes after gamma knife radiosurgery for intraventricular meningiomas. *J Neurooncol* 160(1):23-31, 2022.

Wei Z, Vodovotz L, Luy DD, Deng H, Niranjan A, Lunsford LD. Stereotactic radiosurgery as the initial management option for small-volume hypothalamic hamartomas with intractable epilepsy: a 35-year institutional experience and systematic review. *J Neurosurg Pediatr* 31(1):52-60, 2022.

Lehrer EJ, Gurewitz J, Bernstein K, Kondziolka D, Fakhoury KR, Rusthoven CG, Niranjan A, Wei Z, Lunsford LD, Malouff TD, Ruiz-Garcia H, Peterson JL, Bonney P, Hwang L, Yu C, Zada G, Deibert CP, Prasad RN, Raval RR, Palmer JD, Patel S, Picozzi P, Franzini A, Attuati L, Mathieu D, Trudel C, Lee CC, Yang HC, Jones BM, Green S, Ahluwalia MS, Sheehan JP, Trifiletti DM. Concurrent Administration of Immune Checkpoint Inhibitors and Stereotactic Radiosurgery Is Well-Tolerated in Patients With Melanoma Brain Metastases: An International Multicenter Study of 203 Patients. *Neurosurgery* 91(6):872-882, 2022.

Wei Z, Yavan S, Deng H, Mallela AN, Gersey ZC, Shariff RK, Fazeli PK, Niranjan A, Lunsford LD, Abou-Al-Shaar H. The role of stereotactic radiosurgery in the multidisciplinary management of pituitary metastases. *Pituitary* 25(6):948-958, 2022.

Joseph C. Maroon, MD

Clinical Professor
Heindl Scholar in Neuroscience

Joseph C. Maroon, MD, is a board-certified clinical professor of neurological surgery at the University of Pittsburgh Medical Center, and the Heindl Scholar in Neuroscience. His clinical and research interests have been in the areas of the development of minimally invasive surgical procedures to the brain and spine, the prevention and treatment of traumatic injuries to the central nervous system, innovative approaches to pituitary and other brain tumors and more recently complimentary approaches to inflammatory diseases associated with aging. Working with neuropsychologist, Mark Lovell, PhD, he co-developed ImPACT© (Immediate Post-Concussion Assessment and Cognitive Testing). This is the first computerized system to determine concussion severity and the timing for return to contact sports. It is now the standard of care for concussion management in the National Football League, National Hockey League, Major League Baseball, NASCAR and is used in over 12,000 colleges and high schools in the United States. For over 20 years he has served as the neurosurgical consultant to professional and college athletes in football, baseball, golf, hockey and soccer and was team neurosurgeon to

the Pittsburgh Steelers for over 40 years. He has been honored by the neurosurgical societies of Japan, Korea, Thailand, Egypt, Brazil, Lebanon and China for his neurosurgical contributions, and was honored by his peers when he was elected president of the Congress of Neurological Surgeons, the largest society of neurosurgeons in North America. Other outside activities include a former member of the board of directors and chairman of the scientific and technology committee of Mylan Laboratories, the largest generic drug manufacturer in the world; former chairman of the scientific advisory board to General Nutrition Corporation (GNC); and chairman of the medical and scientific advisory board to Stemedica. He also serves on the NFL Head, Neck and Spine Committee and, in 2008, he became medical director of the World Wrestling Entertainment Corporation (WWE). Also in 2008, he was named senior vice president of the American Academy of Anti-Aging Medicine (A4M). Honored as one of America's best neurosurgeons for 12 consecutive years he has written over 290 papers, 40 book chapters and five books. His most recent book, published in February of 2017 and re-released in December of 2018, is entitled *Square One: A Simple Guide to a Balanced Life* that takes a look at the importance of understanding where you are in life and the need to keep all elements of your life in proper "balance." He has also authored *Fish Oil: The Natural Anti-Inflammatory*, published in 2006, and *The Longevity Factor: How Resveratrol and Red Wine Activate Genes for Longer and Healthier Life*, published in 2008. In his early years, his athletic abilities earned him a football scholarship to the University of Indiana in Bloomington where he was selected as Scholastic All-American in football. Despite his busy professional schedule, Dr. Maroon remains an avid athlete and has competed in over 78 triathlon events. These include eight Ironman distant triathlons (2.4 mile swim, 112 mile bike and 26.2 run) in Hawaii (1993, 2003, 2008, 2010 and 2013), Canada (1995), New Zealand (1997) and Europe (2000). He placed sixth in the Senior U.S. Olympics Triathlon in 2005. In 1999, he—along with Joe Montana and Kareem Abdul Jabaar—was inducted into the Lou Holtz Upper Ohio Valley Hall of Fame for his athletic accomplishments and contributions to sports medicine. On May 2, 2009, he was inducted into the Western Pennsylvania Sports Hall of Fame, and on March 14, 2010, he was inducted into the National Fitness Hall of Fame in Chicago. In June of 2017, Dr. Maroon was selected as Man of the Year by the Saints and Sinners Club of America, and in September of 2018, he was named Humanitarian of the Year by the Jerome Bettis Bus Stops Here Foundation. As medical director of the Live Free African Freedom Tour, on February 26, 2014, Dr. Maroon and his daughter, Isabella—along with a group of amputees—climbed Mt. Kilimanjaro in Africa, the highest free-standing mountain in the world. In May of 2015, Dr. Maroon completed The Crucible Extreme Hike, a 3-day, 70-mile hike in the Laurel Mountains of Pennsylvania to raise awareness for wounded veterans. In February of 2020, Dr. Maroon was named recipient of the UPMC Clinician of Courage Award. To further honor Dr. Maroon, upon presenting the award, UPMC announced that the award would be renamed the Joseph Maroon Clinician of Courage Award for future award winners.

Board Certifications
American Board of Neurological Surgery

Professional Organization Membership
Allegheny County Medical Society
American Academy of Anti-Aging Medicine
American Association of Neurological Surgeons
American College of Sports Medicine
American College of Surgeons
American Medical Association
Congress of Neurological Surgeons
Mid-Atlantic Neurosurgical Society
National Association for Disabled Athletes
National Football League Physicians Society

Joseph C. Maroon, MD

Neurosurgical Society of America
Pennsylvania Medical Society
Pennsylvania Neurosurgical Society

Professional Activities
National Science Advisory Panel, The Chuck Noll Foundation for Brain Injury Research
Medical Consultant, Viatris Laboratories
Consulting Neurosurgeon, The Pittsburgh Steelers
Medical Director, WWE
Senior Vice President, American Academy of Anti-Aging Medicine
Senior Advisor, NFL Head, Neck and Spine Committee
World Advisory Board, International Sports Hall of Fame
Chairman, Medical and Scientific Advisory Board, Stemedica
Consulting Neurosurgeon, Operation Backbone

Education & Training
AB, Anatomy & Physiology, Indiana University, 1961
MD, Indiana University, 1965
Residency, General Surgery, Georgetown University, 1967
Residency, Neurological Surgery, Indiana University, 1968
Residency, Neurological Surgery, Oxford University, 1969
Fellowship, Vermont College of Medicine, 1972

Honors & Awards
Distinguished Medical Alumni Award, Indiana University School of Medicine, 2022
UPMC Physician Excellence Award: Clinician of Courage, 2020
Inaugural Chuck Noll Foundation Lecture on Sports Related Trauma, American Association of Neurological Surgeons Annual Scientific Meeting, San Diego, 2019
Humanitarian of the Year, Jerome Bettis Bus Stops Here Foundation, 2018
Man of the Year, Circus Saints & Sinners Club, Bob Prince Tent, 2017
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2017-19
Lifetime Leadership Award for Concussion Research, UPMC Sports Medicine Concussion Program, 2016
Listed in The Best Doctors in America, 2000-14
Honorary President, World Association of Lebanese Neurosurgeons, 1999-2012
Ohio Valley Athletic Conference Hall of Fame Class of 2012
Pioneer Award, 25th Anniversary UPMC Center for Cranial Base Surgery, Pittsburgh, Pa., 2012
Distinguished Alumni Service Award, Indiana University, Bloomington, Ind., 2011
National Fitness Hall of Fame, 2010
Western Pennsylvania Chapter of the Sports Hall of Fame, 2009
Healthcare Hero Finalist, The Pittsburgh Business Times, 1999 and 2002
Lou Holtz/Upper Ohio Valley Hall of Fame inductee, for excellence in athletics and medicine, June 1999

News Media Appearances: 2022-23
"Tips for Migraine Relief," WTVR TV-6 News (Richmond, Va.), June 30, 2023.
"Effective, Drug-Free Relief From Migraines," newsmax health, June 9, 2023.
"University Of Pittsburgh Launches National Sports Brain Bank," *Forbers Magazine*, May 19, 2023.
"Jerome Bettis happy to be star player for new National Sports Brain Bank at Pitt," Pittsburgh Post-Gazette, May 18, 2023.
"4 Your Health: Former Steelers to join brain research effort," WTAE-TV, May 18, 2023.

"Jerome Bettis, Merril Hoge donating brains to University of Pittsburgh's new National Sports Brain Bank, KDKA-TV, May 18, 2023.

"An NFL Doctor Wants to Know Why Some Players Get CTE and Others Don't," *New York Times*, May 18, 2023.

"6 daily practices this 82-year-old triathlete and neurosurgeon uses to lengthen his healthspan," CNBC.com, January 26, 2023.

"Key neurological doctor believes Tua Tagovailoa isn't at risk of more concussions with proper rest," *Dolphin Nation*, January 24, 2023.

"Key doctor backs Dolphins' Chris Grier: Tua Tagovailoa isn't automatically concussion risk," *Palm Beach Post*, January 24, 2023.

"UPMC and Steelers neurosurgeon Joseph Maroon starts anti-aging research consortium," *Pittsburgh Post-Gazette*, January 4, 2023.

"From Concussion to Competition," The GoodMen Project, January 2, 2023

"Gerry Dulac: Why Kenny Pickett returned to Steelers practice so quickly," *Pittsburgh Post-Gazette*, October 21, 2022.

"Brain injury foundation honors Noll's legacy, makes advances for the future," *Pittsburgh Business Times*, October 6, 2022.

"Concussed Student-Athlete Program leading battle against brain injuries," *Palm Beach Post*, September 8, 2022.

"Chuck Noll Foundation funding research for an easy way to identify concussions," nextpittsburgh.com, August 3, 2022.

Publications: 2022-23

• Refereed Articles:

Mandal PK, Dwivedi D, Joon S, Goel A, Ahasan Z, Maroon JC, Singh P, Saxena R, Roy RG. Quantitation of Brain and Blood Glutathione and Iron in Healthy Age Groups Using Biophysical and In Vivo MR Spectroscopy: Potential Clinical Application. *ACS Chem Neurosci* 14(12):2375-2384, 2023.

Mandal PK, Jindal K, Maroon JC, Chhikara R, Samkaria A, Joshi M, Roy S, Arora Y. Brain Imaging Databases. *ACS Chem Neurosci* [Epub ahead of print], 2023.

Mandal PK, Goel A, Bush AI, Punjabi K, Joon S, Mishra R, Tripathi M, Garg A, Kumar NK, Sharma P, Shukla D, Ayton SJ, Fazlollahi A, Maroon JC, Dwivedi D, Samkaria A, Sandal K, Megha K, Shandilya S. Hippocampal glutathione depletion with enhanced iron level in patients with mild cognitive impairment and Alzheimer's disease compared to healthy elderly participants. *Brain Commun* 4(5):fcac215, 2022.

Maroon JC. The effect of hyperbaric oxygen therapy on cognition, performance, proteomics, and telomere length—The difference between zero and one: A case report. *Front Neurol* 13:949536, 2022.

Seyfried TN, Arismendi-Morillo G, Zuccoli G, Lee DC, Duraj T, Elsakka A, Maroon J, Mukherjee P, Ta L, Shelton L, D'Agostino DP, Kiebish MA, Chinopoulos C. Metabolic management of microenvironment acidity in glioblastoma. *Front Oncol* 12:968351, 2022.

Michael McDowell, MD

Assistant Professor

Michael McDowell, MD, joined the University of Pittsburgh Department of Neurological Surgery in July of 2022 after serving a fellowship at UPMC Children's Hospital of Pittsburgh. Dr. McDowell is a graduate of the University of Pittsburgh neurosurgery residency program and the Columbia University's College of Physicians and Surgeons medical school. In addition to his pediatric fellowship, he also completed a skull base fellowship at UPMC while a resident. He received undergraduate degrees in biochemistry and Latin dance from Arizona State University in 2005, graduating as valedictorian. Dr. McDowell has been heavily involved in teaching since medical school and was voted clinician of the year for his educational contributions to the Columbia Student Medical Outreach clinic in Washington Heights. He is also the founder and director of the University of Pittsburgh School of Medicine's mini-elective for second year medical students titled "Brain and Blade: The World of Neurosurgery." As well as general pediatric neurosurgery, Dr. McDowell has specific interests in skull base and cranio-cervical junction disorders in children. His research interests also include non-invasive monitoring and he is actively collaborating with investigators at Carnegie Mellon University in a clinical investigation using near infrared light to non-invasively measure intracranial pressure in adults and children. He is also the co-founder of Astria Biosciences, a company dedicated towards the early detection of brain aneurysms derived from research performed at UPMC.

Specialized Areas of Interest

Skull base and pituitary neurosurgery; Chiari malformation; pediatric neurosurgery; non-invasive intracranial pressure measurement; medical education.

Hospital Privileges

UPMC Children's Hospital of Pittsburgh
UPMC Magee-Womens Hospital
UPMC Presbyterian
UPMC Harrisburg

Professional Organization Membership

Allegheny County Medical Society
American Association of Neurological Surgery
AANS Section on the History of Neurological Surgery
AANS Early to Mid-Career Neurosurgery Committee
AANS/CNS Joint Section on Pediatric Neurosurgery
Congress of Neurological Surgeons
Pennsylvania Medical Society House of Delegates
Scoliosis Research Society

Professional Activities

Chair, Industry Relations Committee, AANS/CNS Pediatric Section
Consultant, National Cancer Institute Pediatric and Young Adult Chordoma Clinic

Education & Training

BS, Biochemistry, Arizona State University, 2009
MD, Columbia University College of Physicians and Surgeons, 2014
Fellowship, UPMC Skull Base Division, 2020
Residency, University of Pittsburgh, 2021
Fellowship, UPMC Children's Hospital of Pittsburgh, 2022

Honors & Awards

Hydrocephalus Association Award, AANS/CNS Section on Pediatric Neurosurgery, 2021
University of Pittsburgh School of Medicine Faculty Teaching Award, 2021
Pennsylvania Neurological Society Oral Presentation Award, 2019
Copeland Grant Winner, Pittsburgh Foundation, 2015,
Gold Medal, Top Gun Surgical Completion, Lumbar Pedicle Screw Placement, American Association of Neurological Surgeons, 2017
Charlie Kuntz Scholar, AANS/CNS Spine Summit, 2016
Christopher Getch Chair of Research, Brain Aneurysm Foundation, 2013

News Media Appearances: 2022-23

"Pitt and CMU Scientists Create Headband that Measures Brain Pressure in Seconds," inside.upmc.com, December 15, 2022.
"'An absolute miracle': 9-year-old girl recovering from near-fatal neck injury after skiing accident," WTAE-TV (Pittsburgh), September 2, 2022.
"Over 6 million kids have suffered traumatic brain injuries, many of them girls," NBC Today.com, August 17, 2022.

Publications: 2022-23

• Refereed Articles:

Patel A, Abou-Al-Shaar H, Algattas H, McDowell MM, Zenonos GA, Snyderman CH, Gardner PA. Endoscopic techniques in vascular neurosurgery. *Neurosurg Clin N Am* 33(4):491-503, 2022.

Fields DP, McDowell MM, Schulien A, Algattas H, Abou-Al-Shaar H, Agarwal N, Nima Alan, Costacou T, Wang E, Snyderman CH, Gardner PA, Zenonos GA. Low Preoperative Prealbumin Levels Are a Strong Independent Predictor of Postoperative Cerebrospinal Fluid Leak Following Endoscopic Endonasal Skull Base Surgery. *World Neurosurg* 167:110-116, 2022.

McDowell MM, Jacobs R, Valappil B, Abou-Al-Shaar H, Wang E, Snyderman CH, Gardner PA. Dural Sealants do not reduce post-operative cerebrospinal fluid leaks after endoscopic endonasal skull base surgery. *J Neurol Surg B Skull Base* 83(6):589-593, 2022 .

Palieri D, Champagne PO, Valappil B, McDowell MM, Gardner PA, Snyderman CH. Risk factors in a pediatric population for postoperative intracranial infection following endoscopic endonasal skull base surgery and the role of antibiotic prophylaxis. *Am J Rhinol Allergy* 37(1):13-18, 2023.

Gonzalez-Martinez J, Abou-Al-Shaar H, Mallela A, McDowell MM, Henry L, Fernandes-Cabral D, Fong J, Barot N, Castellano J, Rajesekaran V, Bagic A, Snyderman CH, Gardner PA. The endoscopic anterior transmaxillary temporal pole approach for mesial temporal lobe epilepsies: a feasibility study. *J Neurosurg* 138(4):992-1001, 2022.

Gardner PA, McDowell MM, Orhorhoro O, Snyderman CH, Gonzalez-Martinez J. A Novel Sublabial Anterior Trans-Maxillary Approach for Medically Refractory Mesial Temporal Lobe Epilepsy: A comparative anatomical study. *Oper Neurosurg* (Hagerstown) 24(2):92-103, 2023.

Research Activities

Dr. McDowell has specific interests in outcomes research related to skull base and craniocervical junction disorders in children. His research interests also include non-invasive monitoring and he is actively collaborating with investigators at Carnegie Mellon University in a clinical investigation using near infrared light to non-invasively measure intracranial pressure in adults and children. Preliminary data have suggested a high level of accuracy and precision with this method in comparison to invasive monitoring. Further work may allow for application in situ-

Michael McDowell, MD

ations relying upon invasive monitoring for clinical decision making such as hydrocephalus, craniosynostosis, and traumatic brain injury. Further, such a technology may allow for wider application of intracranial pressure monitoring such as in patients with Chiari malformations, shunt malfunction, concussions, and those who are undergoing prolonged sedation.

Antony MichealRaj, PhD

Assistant Professor

Antony MichealRaj, PhD, joined the faculty of the University of Pittsburgh Department of Neurological Surgery in September of 2021. Dr. MichealRaj graduated from the Madurai Kamaraj University with a bachelor of science degree in zoology. He then earned his master of science degree in biotechnology in 2007 from the University of Madras and PhD in genetics from the University of Delhi where he functionally characterized the rare and common variants of dopaminergic pathway genes associated with schizophrenia and other neurological disorders. He subsequently completed his postdoctoral training in neuro-oncology and tumor metabolism at the Arthur and Sonia Labatt Brain Tumor Research Centre at the Hospital for Sick Children (SickKids) in Toronto. While at SickKids, Dr. MichealRaj studied molecular disease mechanisms of pediatric brain tumors ependymoma and medulloblastoma using clinically relevant disease models of patients and mouse models. Dr. MichealRaj's independent research lab at University of Pittsburgh of School of Medicine is focused on unravelling molecular and metabolic dependency of pediatric brain tumors and their mechanistic role in tumor initiation, maintenance and recurrence/resistance.

Specialized Areas of Interest

Functional genomics and metabolism of pediatric and adolescent central nervous system tumors; ependymoma; medulloblastoma; DIPGs.

Professional Organization Membership

American Association for Cancer Research
Children's Brain Tumor Consortium
International Society of Pediatric Oncology
Society of Neuro-Oncology

Education & Training

BSc, Zoology, Madurai Kamaraj University
MSc, Biotechnology, Loyola College, University of Madras
PhD, Genetics, University of Delhi
Postdoctoral Fellowship, Hospital for Sick Children, Toronto

Publications: 2022-23

• Refereed Articles:

Yanchus C, Drucker KL, Kollmeyer TM, Tsai R, Winick-Ng W, Liang M, Malik A, Pawling J, De Lorenzo SB, Ali A, Decker PA, Kosel ML, Panda A, Al-Zahrani KN, Jiang L, Browning JWL, Lowden C, Geuenich M, Hernandez JJ, Gosio JT, Ahmed M, Loganathan SK, Berman J, Trcka D, Michealraj KA, Fortin J, Carson B, Hollingsworth EW, Jacinto S, Mazrooei P, Zhou L, Elia A, Lupien M, He HH, Murphy DJ, Wang L, Abyzov A, Dennis JW, Maass PG, Campbell K, Wilson MD, Lachance DH, Wrensch M, Wiencke J, Mak T, Pennacchio LA, Dickel DE, Visel A, Wrana J, Taylor MD, Zadeh G, Dirks P, Eckel-Passow JE, Attisano L, Pombo A, Ida CM, Kvon EZ, Jenkins RB, Schramek D. A non-coding single-nucleotide polymorphism a t 8q24 drives IDH1-mutant glioma formation. *Science* 378(6615):68-78, 2022.

Antony MichealRaj, PhD

Hamed AA, Kunz DJ, El-Hamamy I, Trinh QM, Subedar OD, Richards LM, Foltz W, Bullivant G, Ware M, Vladoiu MC, Zhang J, Raj AM, Pugh TJ, Taylor MD, Teichmann SA, Stein LD, Simons BD, Dirks PB. A brain precursor atlas reveals the acquisition of developmental-like states in adult cerebral tumours. *Nat Commun* 13(1):4178, 2022.

Jane EP, Reslink MC, Gatesman TA, Halbert ME, Miller TA, Golbourn BJ, Casillo SM, Mullett SJ, Wendell SG, Obodo U, Mohanakrishnan D, Dange R, Michealraj A, Brenner C, Agnihotri S, Premkumar DR, Pollack IF. Targeting mitochondrial energetics reverses panobinostat- and marizomib-induced resistance in pediatric and adult high-grade gliomas. *Mol Oncol* [Online ahead of print], 2023.

Research Activities

Dr. MichealRaj's Brain Tumor Metabolism and Functional Cancer Genomics Laboratory is exploring the underlying disease mechanism of pediatric brain tumors, with a specific interest in pediatric cancer stem cells, brain tumor metabolism and epigenetics and post transcriptional and translational regulation.

His team is investigating the following major themes in pediatric ependymomas and gliomas; 1) functional cancer genomics using in vivo and In vitro CRISPR screens; 2) metabolic dependencies and epigenetic regulation in primary and recurrent tumors; 3) unraveling the crosstalk between cell signaling and epigenetics; and 4) mRNA regulation and translational control.

Dr. MichealRaj's team is using patient-derived disease models (cell lines, xenografts) and transgenic mouse models and cutting edge next-generation genomic technologies (bulk and single cell sequencing, ChIP seq, long read sequencing), metabolomics (total and targeted), genetic engineering tools (genome-wide and focused CRISPR screen) to advance our existing knowledge on pediatric brain tumors and probe novel therapeutic options.

Vincent J. Miele, MD

Clinical Associate Professor

Vincent J. Miele, MD, joined the University of Pittsburgh Department of Neurosurgery as a clinical assistant professor on January 1, 2014 and was promoted to clinical associate professor in July of 2018. He is the former director of the neurosurgical spine service at West Virginia University. Dr. Miele received his undergraduate degree at Northeastern University in Boston where he graduated summa cum laude and was inducted into the Rho Chi Academic Pharmacy Honor Society as well as the Phi Kappa Phi Honor Society. He was also awarded the Northeastern University Alumni of the Year President's Award in 2001. Dr. Miele completed medical school and his neurosurgical residency at West Virginia University where he was elected to the medical honor society Alpha Omega Alpha and won the Gandee-Massey Award based on academic achievement. He is fellowship-trained in complex spine surgery from Cleveland Clinic Foundation, where he remains adjunct faculty in the Spine Research Laboratory. Dr. Miele's research has encompassed such areas as spinal biomechanics, concussion management and return to play, as well as accelerometer and MEMs technology translation into clinical applications. He has published more than 30 papers in refereed journals, authored 20 book chapters, and has presented scientific lectures both nationally and internationally. His research has led to invited written editorials in prominent media such as the New York Times. He has been actively involved in the Congress of Neurological Surgeons, American Association of Neurological Surgery, and North American Spine Society and is an ad hoc reviewer for various journals. Dr. Miele's major clinical interests embrace many aspects of neurosurgery focusing on spinal disorders including pathologies associated with degeneration and trauma, complex spinal instrumentation, revision spinal surgery, and spinal tumors. His areas of expertise include minimally invasive spine surgery and the newer

motion preservation technologies as well as the larger surgeries required for conditions such as adolescent/adult spinal deformity and the multidisciplinary treatment of spinal tumors. Dr. Miele also has a strong background in cranial neurosurgery and treats peripheral nerve conditions such as carpel tunnel syndrome. Dr. Miele frequently evaluates and manages sports-related head and spine injuries, and works at a national level with athletes on return to play issues. He is involved in the development of devices used to detect and prevent concussion and is frequently invited to speak on this subject nationally. He also is an independent neurosurgical consultant for the National Football League and the Pittsburgh Steelers. He is licensed to practice in Pennsylvania, Ohio, and West Virginia and has established clinics in Coraopolis, Monroeville, Mt. Morris, Bethel Park, UPMC Mercy and Bridgeville in Pennsylvania.

Specialized Areas of Interest
Spinal disorders and injuries, spine tumors, revision spinal surgery, adult deformity/scoliosis surgery, sports-related brain and spine injuries, peripheral nerve disorders, and spinal fusions.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Mercy
UPMC Presbyterian

Professional Organization Membership
Alpha Omega Alpha Medical Honor Society
American Association for the Improvement of Boxing
American Association of Neurological Surgeons
American Association of Professional Ringside Physicians
American College of Sports Medicine
Congress of Neurological Surgeons
International Federation of Sports Medicine
North American Spine Society
Ohio State Medical Society
Pennsylvania State Medical Society
United States Amateur Boxing Ringside Physicians
West Virginia State Medical Society

Education & Training
MD, West Virginia University, 2001
Residency, West Virginia University, 2007
Fellowship, Complex Spine, Cleveland Clinic, 2008

Honors & Awards
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2016-23
Best Faculty Teaching, Department of Neurological Surgery, 2022

News Media Appearances: 2022-23
"Gerry Dulac: Why Kenny Pickett returned to Steelers practice so quickly," *Pittsburgh Post-Gazette*, October 21, 2022.

John J. Moossy, MD

Professor
Director, Center for Pain Management
Chief, Neurosurgery, VA Pittsburgh Healthcare System

John J. Moossy, MD, joined the faculty of the Department of Neurological Surgery at the University of Pittsburgh in 1986. He is now chief of neurosurgery at the Veterans Affairs Pittsburgh Healthcare System. He attended medical school at Tulane University, earning an MD degree in 1980. He completed a surgical internship and the residency program in neurosurgery at Duke University. Prior to that, he was an undergraduate student at Wake Forest University in Winston Salem, North Carolina, and at the University of Pittsburgh. His clinical practice is one of general neurosurgery with a special interest in the surgical management of medically intractable pain. Dr. Moossy's publications include 32 articles in refereed journals and nine book chapters.

Specialized Areas of Interest
The surgical treatment of intractable pain problems through neuro-augmentative and neuro-ablative procedures.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
Latrobe Area Hospital
UPMC Presbyterian
UPMC Shadyside
Veterans Affairs Pittsburgh Healthcare System

Professional Organization Membership
Allegheny County Medical Association
American Association of Neurological Surgeons (AANS)
American Medical Association
Carroll F. Reynolds History of Medicine Society
Pennsylvania Medical Association
Pennsylvania Neurosurgical Society
Section on Pain of the AANS/CNS
Section on Disorders of the Spine & Peripheral Nerves of the AANS/CNS
Section on History of the AANS/CNS

Education & Training
BA, French, University of Pittsburgh, 1976
MD, Tulane University, 1980
Residency, Neurosurgery, Duke University, 1986

Honors & Awards
Best Doctors in America, *Pittsburgh Magazine*, 2014-17
Department of Neurological Surgery, Resident Teaching Award, 2001-03
Rudolph Matas Prize in History of Medicine, 1980

Vinayak Narayan, MD

Clinical Assistant Professor

Vinayak Narayan, MD, joined the faculty at the University of Pittsburgh Department of Neurological Surgery as a clinical assistant professor in August 2023. Dr. Narayan specializes in cerebrovascular and cranial base neurosurgery, interventional neuroradiology and stereotactic and functional neurosurgery. His neurosurgical expertise after completing the dual vascular fellowship training allows him to perform minimally invasive neurointerventional and endoscopic surgeries as well as open cerebrovascular and skull base surgeries, thereby providing patients a comprehensive and personalized approach in the treatment of neurovascular and skull base diseases. Dr. Narayan's knowledge and skill in functional neurosurgery and neuromodulation can also provide the best possible outcome in patients with movement disorders, intractable epilepsy and chronic pain. Dr. Narayan is affiliated with UPMC Neurological Institute, Harrisburg and UPMC Williamsport. Dr. Narayan graduated with honors from the renowned medical school, Government Medical College, Trichur in India. He then completed the neurosurgery residency program at the National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore which is an Institute of National Importance (INI), and the most prestigious neurosciences institute in India. After earning the double masters degree in neurosurgery, he moved to the United States and completed postdoctoral fellowship in cerebrovascular and skull base surgery as well as neuro interventional surgery at the Louisiana State University Health Sciences Center in Shreveport, La. and at Rutgers Robert Wood Johnson Medical School and University Hospital in New Jersey. Dr. Narayan also completed three prestigious clinical fellowship programs: stereotactic and functional neurosurgery (The Ohio State University Wexner Medical Center, Columbus, Ohio), interventional neuroradiology (NYU Langone Health and Bellevue Hospital Center, New York) and cerebrovascular neurosurgery (Northwell Health Lenox Hill Hospital, New York), which are accredited by the Committee on Advanced Subspecialty Training (CAST). Dr. Narayan enjoys scientific writing and has authored numerous neurosurgical publications, book chapters and abstracts. His clinical and translational research productivity can be viewed in the National Library of Medicine's publication database. He has been on the editorial board of various neurosurgical journals and medical book publishers. His research interests include neurological outcomes in the management of cerebrovascular as well as skull base diseases, neurosonography and impact of advanced neuromodulation in Parkinson's disease and essential tremor. Outside of neurological surgery, Dr. Narayan is passionate about music, riding motorcycles and biking.

Specialized Areas of Interest

Cerebrovascular and cranial base neurosurgery; interventional neuroradiology; stereotactic and functional neurosurgery.

Hospital Privileges

UPMC Carlisle
UPMC Community General
UPMC Hanover
UPMC Lititz
UPMC Memorial
UPMC Neurological Institute, Harrisburg
UPMC West Shore
UPMC Williamsport

Professional Organization Membership

American Association of Neurological Surgeons
American College of Surgeons

American Heart Association
American Medical Association
American Roentgen Ray Society
American Society of Neuroradiology
Congress of Neurological Surgeons
National Academy of Medical Sciences, India
Neurological Society of India
Neurotrauma Society of India
North American Skull Base Society
Sigma Xi, The Scientific Research Honor Society
Society of Neuro Interventional Surgery

Professional Activities

UPMC Stroke Committee, Central Pennsylvania
Editorial Board, Section Editor (Cerebrovascular & Endovascular Neurosurgery, Stereotactic and Functional Neurosurgery), *World Neurosurgery*
Editorial Board, Review Editor, *Frontiers in Surgery*, Section Neurosurgery
Research Peer Reviewer, American Heart Association
Invited Faculty, 6th Annual Winter Neurosurgical Forum
Fellow, American College of Surgeons

Education & Training

MD (Honors), Government Medical College, Trichur, India, 2011
Residency, Neurological Surgery, National Institute of Mental Health and Neurosciences (NIMHANS), India, 2017
Postdoctoral Fellowship, Cerebrovascular and Skull Base Surgery, Louisiana State University Health Sciences Center, 2018
Postdoctoral Fellowship, Neuro Interventional Surgery, Louisiana State University Health Sciences Center, 2018
Postdoctoral Fellowship, Cerebrovascular and Skull Base Surgery, Rutgers Robert Wood Johnson Medical School and University Hospital, 2019
Fellowship, Stereotactic and Functional Neurosurgery, The Ohio State University Wexner Medical Center, 2020
Fellowship, Interventional Neuroradiology, NYU Langone Health and Bellevue Hospital Center, 2022
Fellowship, Cerebrovascular Neurosurgery, Northwell Health Lenox Hill Hospital, 2023

Honors & Awards

Member-at-Large, Sigma Xi, The Scientific Research Honor Society, 2021
Meritorious certificate, LSUHSC, 2018
Top Poster Abstract, AANS/CNS Section on Pediatric Neurological Surgery, 2018
Outstanding contribution in reviewing articles, *World Neurosurgery*, 2018
Diplomate of National Board of Examinations, India, 2017
Herbert Krause Award, NSICON, India, 2016
Neurological Surgery Thesis Cum Laude, NIMHANS, 2016
State Board of Medical Research Award, India, 2008

Media Appearances

Rewiring the Mind, *The Press Magazine*, February 8, 2023.

Ajay Niranjan, MD

Professor
Associate Director, Center for Image-Guided Neurosurgery
Director, Radiosurgery Research
Director, UPMC Brain Mapping Center

Dr. Niranjan received his medical training at the King George's Medical College in Lucknow, India from 1980 to 1985, graduating with a bachelor of medicine and bachelor of surgery degree. Dr. Niranjan completed general surgery residency in 1989 and neurological surgery residency 1992. Dr. Niranjan joined the University of Pittsburgh as a fellow in image-guided neurosurgery in 1997 and completed his fellowship in 2000. He joined the faculty of neurological surgery in July of 2000. Dr. Niranjan has co-authored over 250 articles in refereed journals, over 170 book chapters and five books. His most recent book, Leksell Radiosurgery—presenting an update on state-of-the-art radiosurgery technology, including outcomes—was published in May of 2019. He has contributed guidelines for stereotactic radiosurgery for trigeminal neuralgia, pituitary adenomas, arteriovenous malformation, acoustic tumors, and brain metastases. Dr. Niranjan is the director of UPMC Brain Mapping Center which houses a magnetoencephalography unit. MEG is performed for pre-surgical mapping of critical brain functions in patients with brain tumors and for localization of seizure focus in patients with long standing epilepsy.

Specialized Areas of Interest
Radiosurgery for benign and malignant brain tumors; radiosurgery for brain vascular malformations; radio surgery for functional brain disorders; pre-surgical brain mapping using MEG.

Hospital Privileges
UPMC Presbyterian

Professional Organization Membership
American Clinical MEG Society
Congress of Neurological Surgeons
International Radiosurgery Research Foundation
International Stereotactic Radiosurgery Society

Professional Activities
Member, International Radiosurgery Research Foundation
Course Co-Director, Principles and Practices of Gamma Knife Radiosurgery, UPMC

Education & Training
MBBS, King George's Medical College, 1985
Residency, General Surgery, King George's Medical College, 1989
Residency, Neurological Surgery, King George's Medical College, 1992
Fellowship, University of Pittsburgh, 2000
MBA, University of Pittsburgh, 2009

Honors & Awards
Best Doctors in American, *Pittsburgh Magazine*, 2016-20
UPMC Excellence in Patient Experience, Physician and Medical Staff Honor Roll, 2017

Publications: 2022-23
• Refereed Articles:
Wei Z, Pease M, Tang LW, Deng H, Shanahan R, Faramand A, Niranjan A, Lunsford LD. Radiosurgery outcomes in infratentorial juvenile pilocytic astrocytomas. *J Neurooncol* 162(1):157-165, 2023.

Wei Z, Vodovotz L, Luy DD, Deng H, Niranjan A, Lunsford LD. Stereotactic radiosurgery as the initial management option for small-volume hypothalamic hamartomas with intractable epilepsy: a 35-year institutional experience and systematic review. *J Neurosurg Pediatr* 31(1):52-60, 2023.

Wei Z, Luy DD, Tang LW, Deng H, Jose S, Scanlon S, Niranjan A, Lunsford LD. Gamma Knife radiosurgery for gynecologic metastases to the brain: Analysis of pathology, survival, and tumor control. *Gynecol Oncol* 172:21-28, 2023.

Pikis S, Mantziaris G, Kormath Anand R, Nabeel AM, Sheehan D, Sheehan K, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad Eldin R, Peker S, Samanci Y, Kaisman-Elbaz T, Speckter H, Hernández W, Isidor J, Tripathi M, Madan R, Zacharia BE, Daggubati LC, Martínez Moreno N, Martínez Álvarez R, Langlois AM, Mathieu D, Deibert CP, Sudhakar VR, Cifarelli CP, Arteaga Icaza D, Cifarelli DT, Wei Z, Niranjan A, Barnett GH, Lunsford LD, Bowden GN, Sheehan JP. Stereotactic radiosurgery for Koos grade IV vestibular schwannoma: a multi-institutional study. *J Neurosurg* 138(2):405-412, 2023.

Ironside N, Chen CJ, Xu Z, Schlesinger D, Lee Vance M, Hong GK, Jane JA Jr, Patel S, Bindal SK, Niranjan A, Lunsford LD, Liscak R, Chytka T, Jezkova J, Saifi O, Trifiletti DM, Berger A, Alzate J, Bernstein K, Kondziolka D, Speckter H, Hernandez W, Lazo E, Peker S, Samanci Y, Zacharia BE, Mau C, Wegner RE, Shepard MJ, Mathieu D, Maillet M, Sheehan JP. Effects of Neuroanatomic Structural Distances on Pituitary Function After Stereotactic Radiosurgery: A Multicenter Study. *Neurosurgery* 92(5):1035-1042, 2023.

Dumot C, Pikis S, Mantziaris G, Xu Z, Dayawansa S, Anand RK, Nabeel AM, Sheehan D, Sheehan K, Reda WA, Tawadros SR, Karim KA, El-Shehaby AMN, Eldin RME, Peker S, Samanci Y, Kaisman-Elbaz T, Speckter H, Hernández W, Isidor J, Tripathi M, Madan R, Zacharia BE, Daggubati LC, Moreno NM, Álvarez RM, Langlois AM, Mathieu D, Deibert CP, Sudhakar VR, Cifarelli CP, Icaza DA, Cifarelli DT, Wei Z, Niranjan A, Barnett GH, Lunsford LD, Bowden GN, Sheehan JP. Stereotactic radiosurgery for Koos grade IV vestibular schwannoma in patients >= 65 years old: a multi-institutional retrospective study. *Acta Neurochir* (Wien) 165(1):211-220, 2023.

Bin-Alamer O, Fogg D, Wei Z, Duehr J, Mallela AN, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Intratumoral hemorrhage in vestibular schwannomas after stereotactic radiosurgery. *J Neurosurg* 138(2):413-419, 2023.

Bin-Alamer O, Faramand A, Alarifi NA, Wei Z, Mallela AN, Lu VM, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Peker S, Samanci Y, Lee CC, Yang HC, Delabar V, Mathieu D, Tripathi M, Kearns KN, Bunevicius A, Sheehan JP, Chytka T, Liscak R, Moreno NM, Álvarez RM, Grills IS, Parzen JS, Cifarelli CP, Rehman AA, Speckter H, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Stereotactic Radiosurgery for Vestibular Schwannoma in Neurofibromatosis Type 2: An International Multicenter Case Series of Response and Malignant Transformation Risk. *Neurosurgery* 92(5):934-944, 2023.

Abou-Al-Shaar H, Patel A, Mallela AN, Bin-Alamer O, Niranjan A, Peker S, Samanci Y, Liscak R, May J, Kumar JS, Sheehan JP, Lunsford LD. Chronic Encapsulated Expanding Hematomas After Stereotactic Radiosurgery for Intracranial Arteriovenous Malformations: An International Multicenter Case Series. *Neurosurgery* 92(1):195-204, 2023.

Abdallah HM, Mallela AN, Wei Z, Abou-Al-Shaar H, Niranjan A, Lunsford LD. Gamma Knife radiosurgery for meningiomas of the confluence of the falx and tentorium. *J Neurooncol* 161(2):225-233, 2023.

Mantziaris G, Pikis S, Xu Z, Mullen R, Alzate J, Bernstein K, Kondziolka D, Wei Z, Niranjan A, Lunsford LD, Liscak R, May J, Lee CC, Yang HC, Coupé FL, Mathieu D, Sheehan K, Sheehan D, Palmer JD, Perlow HK, Peker S, Samanci Y, Peterson J, Trifiletti DM, Shepard MJ, Elhamdani S, Wegner RE, Speckter H, Hernandez W, Warnick RE, Sheehan J. Stereotactic Radiosurgery for Intraventricular Metastases: A Multicenter Study. *Neurosurgery* 92(3):565-573, 2023. Wei Z, Luy DD, Jose S, Deng H, Yavan S, Worrell S, Belkhir JR, Tang LW, Niranjan A, Lunsford LD. Single-Session Gamma Knife Radiosurgery for Patients With 20 or More Brain Metastases. *Neurosurgery* [Online ahead of print], 2023.

Wei Z, Jose S, Abou-Al-Shaar H, Deng H, Luy D, Kondziolka D, Niranjan A, Lunsford LD. Intracerebral and pituitary metastatic eccrine carcinoma: prolonged survival using stereotactic radiosurgery. *Br J Neurosurg* [Online ahead of print], 2023.

Singh R, Bowden G, Mathieu D, Perlow HK, Palmer JD, Elhamdani S, Shepard M, Liang Y, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Elazzazi AH, Warnick RE, Gozal YM, Daly M, McShane B, Addis-Jackson M, Karthikeyan G, Smith S, Picozzi P, Franzini A, Kaisman-Elbaz T, Yang HC, Wei Z, Legarreta A, Hess J, Templeton K, Pikis S, Mantziaris G, Simonova G, Liscak R, Peker S, Samanci Y, Chiang V, Niranjan A, Kersh CR, Lee CC, Trifiletti DM, Lunsford LD, Sheehan JP. Local Control and Survival Outcomes After Stereotactic Radiosurgery for Brain Metastases From Gastrointestinal Primaries: An International Multicenter Analysis. *Neurosurgery* [Online ahead of print], 2023.

Samanci Y, Askeroglu MO, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Legarreta A, Fernandes Cabral D, Anand S, Niranjan A, Lunsford LD, Tripathi M, Kumar N, Liščák R, May J, Lee CC, Yang HC, Martínez Moreno N, Martínez Álvarez R, Douri K, Mathieu D, Pikis S, Mantziaris G, Sheehan JP, Bernstein K, Kondziolka D, Peker S. Stereotactic Radiosurgery for Meningiomas in Children and Adolescents: An International Multi-Institutional Study. *Neurosurgery* [Online ahead of print], 2023.

Rusthoven CG, Staley AW, Gao D, Yomo S, Bernhardt D, Wandrey N, El Shafie R, Kraemer A, Padilla O, Chiang V, Faramand AM, Palmer JD, Zacharia BE, Wegner RE, Hattangadi-Gluth JA, Levy A, Bernstein K, Mathieu D, Cagney DN, Chan MD, Grills IS, Braunstein S, Lee CC, Sheehan JP, Kluwe C, Patel S, Halasz LM, Andratschke N, Deibert CP, Verma V, Trifiletti DM, Cifarelli CP, Debus J, Combs SE, Sato Y, Higuchi Y, Aoyagi K, Brown PD, Alami V, Niranjan A, Lunsford LD, Kondziolka D, Camidge DR, Kavanagh BD, Robin TP, Serizawa T, Yamamoto M. Comparison of First-Line Radiosurgery for Small-Cell and Non-Small Cell Lung Cancer Brain Metastases (Cross-FIRE). *J Natl Cancer Inst* [Online ahead of print], 2023.

Mantziaris G, Pikis S, Dumot C, Dayawansa S, Liščák R, May J, Lee CC, Yang HC, Martinez Moreno N, Martinez Álvarez R, Lunsford LD, Niranjan A, Wei Z, Srinivasan P, Tang LW, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Hesham Elazzazi A, Peker S, Samanci Y, Padmanaban V, Jareczek FJ, McInerney J, Cockroft KM, Mathieu D, Aldakhil S, Alzate JD, Kondziolka D, Tripathi M, Palmer JD, Upadhyay R, Lin M, Zada G, Yu C, Cifarelli CP, Cifarelli DT, Xu Z, Sheehan JP. Outcome Evaluation of Repeat Stereotactic Radiosurgery for Cerebral Arteriovenous Malformations. *Stroke* [Online ahead of print], 2023.

Head JR, Bin-Alamer O, Wei Z, Waite K, Agrawal N, Mallela AN, Faramand A, Gersey ZC, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Vestibular Schwannoma Stereotactic Radiosurgery in Octogenarians: Case Series. *Neurosurgery* [Online ahead of print], 2023.

Daza-Ovalle A, Bin-Alamer O, Flickinger J, Niranjan A, Lunsford LD. Outcomes after gamma knife radiosurgery for intraventricular meningiomas. *J Neurooncol* 160(1):23-31 2022.

Mantziaris G, Pikis S, Chytka T, Liščák R, Sheehan K, Sheehan D, Peker S, Samanci Y, Bindal SK, Niranjan A, Lunsford LD, Kaur R, Madan R, Tripathi M, Pangal DJ, Strickland BA, Zada G, Langlois AM, Mathieu D, Warnick RE, Patel S, Minier Z, Speckter H, Xu Z, Kormath Anand R, Sheehan JP. Adjuvant versus on-progression Gamma Knife radiosurgery for residual nonfunctioning pituitary adenomas: a matched-cohort analysis. *J Neurosurg* [Online ahead of print], 2023.

Donohue JK, Wei Z, Deng H, Niranjan A, Lunsford LD. Management of sarcomatoid Malignant pleural mesothelioma brain metastases with stereotactic radiosurgery: an Illustrative case. *Br J Neurosurg* [Online ahead of print], 2023.

Bin-Alamer O, Pikis S, Mantziaris G, Abdulbaki A, Mallela AN, Lu VM, Peker S, Samanci Y, Nabeel AM, Reda WA, Tawadros SR, El-Shehaby AMN, Abdelkarim K, Emad Eldin RM, Sheehan D, Sheehan K, Liscak R, Chytka T, Tripathi M, Madan R, Speckter H, Hernández W, Barnett GH, Hori YS, Dabhi N, Aldakhil S, Mathieu D, Kondziolka D, Bernstein K, Wei Z, Niranjan A, Kersh CR, Lunsford LD, Sheehan JP, Abou-Al-Shaar H.. Adjuvant Stereotactic Radiosurgery With or Without Postresection Fractionated Radiation Therapy for the Management of Clival Chordomas in Adults: An International Multicenter Case Series. *Neurosurgery* [Online ahead of print], 2023.

Wei Z, Yavan S, Deng H, Mallela AN, Gersey ZC, Shariff RK, Fazeli PK, Niranjan A, Lunsford LD, Abou-Al-Shaar H. The role of stereotactic radiosurgery in the multidisciplinary management of pituitary metastases. *Pituitary* 25(6):948-958, 2022.

Wei Z, Waite K, Deng H, Najjar Y, Niranjan A, Lunsford LD. Aggressive Stereotactic Radiosurgery Coupled With Immune and Targeted Therapy for Recurrent Melanoma Brain Metastases: A Case Report and Literature Review. *Cureus* 14(7):e26553, 2022.

Lehrer EJ, Gurewitz J, Bernstein K, Kondziolka D, Fakhoury KR, Rusthoven CG, Niranjan A, Wei Z, Lunsford LD, Malouff TD, Ruiz-Garcia H, Peterson JL, Bonney P, Hwang L, Yu C, Zada G, Deibert CP, Prasad RN, Raval RR, Palmer JD, Patel S, Picozzi P, Franzini A, Attuati L, Mathieu D, Trudel C, Lee CC, Yang HC, Jones BM, Green S, Ahluwalia MS, Sheehan JP, Trifiletti DM. Concurrent Administration of Immune Checkpoint Inhibitors and Stereotactic Radiosurgery Is Well-Tolerated in Patients With Melanoma Brain Metastases: An International Multicenter Study of 203 Patients. *Neurosurgery* 91(6):872-882, 2022.

Kowalchuk RO, Niranjan A, Hess J, Antonios JP, Zhang MY, Braunstein S, Ross RB, Pikis S, Deibert CP, Lee CC, Yang HC, Langlois AM, Mathieu D, Peker S, Samanci Y, Rusthoven CG, Chiang V, Wei Z, Lunsford LD, Trifiletti DM, Sheehan JP. Stereotactic radiosurgery and local control of brain metastases from triple-negative breast cancer. *J Neurosurg* [Online ahead of print], 2022.

Dabhi N, Pikis S, Mantziaris G, Tripathi M, Warnick R, Peker S, Samanci Y, Berger A, Bernstein K, Kondziolka D, Niranjan A, Lunsford LD, Sheehan JP. Stereotactic radiosurgery for the treatment of hypoglossal schwannoma: a multi-institutional retrospective study. *Acta Neurochir* (Wien) 164(9):2473-2481, 2022.

Dumot C, Pikis S, Mantziaris G, Xu Z, Anand RK, Nabeel AM, Sheehan D, Sheehan K, Reda WA, Tawadros SR, Abdel Karim K, El-Shehaby AMN, Emad Eldin RM, Peker S, Samanci Y, Kaisman-Elbaz T, Speckter H, Hernández W, Isidor J, Tripathi M, Madan R, Zacharia BE, Daggubati LC, Moreno NM, Álvarez RM, Langlois AM, Mathieu D, Deibert CP, Sudhakar VR, Cifarelli CP, Icaza DA, Cifarelli DT, Wei Z, Niranjan A, Barnett GH, Lunsford LD, Bowden GN, Sheehan JP. Stereotactic radiosurgery for Koos grade IV vestibular schwannoma in young patients: a multi-institutional study. *J Neurooncol* 160(1):201-208, 2022.

Albano L, Deng H, Wei Z, Vodovotz L, Niranjan A, Lunsford LD. The longitudinal volumetric response of vestibular schwannomas after Gamma Knife radiosurgery. *J Neurosurg* 138(5):1273-1280, 2022.

Lehrer EJ, Ahluwalia MS, Gurewitz J, Bernstein K, Kondziolka D, Niranjan A, Wei Z, Lunsford LD, Fakhoury KR, Rusthoven CG, Mathieu D, Trudel C, Malouff TD, Ruiz-Garcia H, Bonney P, Hwang L, Yu C, Zada G, Patel S, Deibert CP, Picozzi P, Franzini A, Attuati L, Prasad RN, Raval RR, Palmer JD, Lee CC, Yang HC, Jones BM, Green S, Sheehan JP, Trifiletti DM. Imaging-defined necrosis after treatment with single-fraction stereotactic radiosurgery and immune checkpoint inhibitors and its potential association with improved outcomes in patients with brain metastases: an international multicenter study of 697 patients. *J Neurosurg* 138(5):1178-1187 2022.

Research Activities

Dr. Niranjan's clinical and research interests are in the management of tumors, vascular malformations and functional disorders of brain using radiosurgery. Outcome base clinical research involving brain tumor radiosurgery has been his primary focus for over 20 years. His basic science research interests include radiobiology of brain tumors, and the use of advanced imaging in improving the outcome of radiosurgery. His other major clinical research interest is in the development of presurgical brain mapping using magnetoencephalography. He is currently the principal investigator on "Thalamic Segmentation using advanced imaging."

David O. Okonkwo, MD, PhD

Professor
Director, Neurotrauma Clinical Trials Center
Director, Scoliosis and Spinal Deformity Program
Special Advisor, UPMC Enterprises

David Okonkwo, MD, PhD, is professor of neurological surgery and director of the Neurotrauma Clinical Trials Center at the University of Pittsburgh. He is also director of neurotrauma and the scoliosis and spinal deformity program at UPMC Presbyterian. Dr. Okonkwo is past chair of the AANS/CNS Section on Neurotrauma and Critical Care. In addition, Dr. Okonkwo is team neurosurgeon for the Pittsburgh Steelers. Dr. Okonkwo completed his undergraduate work at the University of Virginia, where he was a Howard Hughes Undergraduate Biomedical Research Scholar. He completed his medical and doctoral education through the MD/PhD program of the Medical College of Virginia of Virginia Commonwealth University. He joined the University of Pittsburgh Department of Neurological Surgery in 2006 following completion of neurosurgical residency at the University of Virginia and a fellowship at Auckland Public Hospital in Auckland, New Zealand. He has additional specialized training in scoliosis surgery. Dr. Okonkwo's clinical interests are traumatic injuries to the brain and spine as well as scoliosis and spinal deformity. His research endeavors involve developing biomarkers, advanced neuroimaging modalities and novel therapeutic interventions for brain and spinal cord injury. Dr. Okonkwo is a principal investigator of a national clinical research network (TRACK-TBI) to advance our understanding and treatment of traumatic brain injury. He is also principal investigator of several ongoing clinical studies in neurotrauma in Pittsburgh. Dr. Okonkwo has published more than 350 papers in refereed journals, authored numerous book chapters, and garnered several awards for his scientific research. He is a member of the American Association of Neurological Surgeons, the Congress of Neurological Surgeons and the National and International Neurotrauma Societies.

Specialized Areas of Interest

Brain and spine trauma; scoliosis; spinal deformity; minimally invasive spine surgery; sports medicine; experimental therapies for brain and spinal cord injuries.

David O. Okonkwo, MD, PhD

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Mercy
UPMC Presbyterian

Professional Organization Membership
Alpha Omega Alpha Medical Honor Society
American Academy of Neurosurgery
American Association of Neurological Surgery
Congress of Neurological Surgeons
International Spine Study Group
National Neurotrauma Society
Society of Lateral Access Surgery

Professional Activities
Team Neurosurgeon, Pittsburgh Steelers

Education & Training
BA, Biology, University of Virginia, 1994
MD, Virginia Commonwealth University, 2000
PhD, Anatomy, Virginia Commonwealth University, 2000
Fellowship, Neurosurgery, Auckland Public Hospital, 2005
Residency, Neurosurgery, University of Virginia, 2006

Honors & Awards
Best Doctors in Pittsburgh, *Pittsburgh Magazine*, 2018-22

News Media Appearances: 2022-23
"Ryan Shazier Remembers His Spinal Injury, Says It Took Him A Week To Understand Severity," *Steelers Depot*, December 23, 2022.
"Brain injury foundation honors Noll's legacy, makes advances for the future," *Pittsburgh Business Times,* October 6, 2022.

Ian F. Pollack, MD

A. Leland Albright Distinguished Professor
Vice Chair, Academic Affairs
Chief, Pediatric Neurosurgery, UPMC Children's Hospital of Pittsburgh
Co-Director, Neurosurgical Oncology
Professor of Clinical and Translational Science

Ian Pollack, MD, is chief of pediatric neurosurgery at UPMC Children's Hospital of Pittsburgh and A. Leland Albright Professor of Neurosurgery at the University of Pittsburgh School of Medicine. Prior to joining the faculty of the Department of Neurological Surgery at the University of Pittsburgh in 1992, he was awarded the 1991 Van Wagenen Traveling Fellowship, which afforded him a year of subspecialty training in the Department of Neurosurgery at the Hospital for Sick Children in Toronto, the Neuro-Oncology Laboratory of the University of Lausanne in Switzerland, and the Laboratory of Tumor Biology of the University of Uppsala in Sweden. Dr. Pollack graduated magna cum laude from Emory University in 1980, where he earned a BS degree in chemistry. He received his medical degree from the Johns Hopkins University School of Medicine

in 1984, then completed a surgical internship and neurosurgical residency at the University of Pittsburgh School of Medicine. He also was a research fellow in neuropathology and neurobiology during some of that time. Dr. Pollack has published more than 410 papers in refereed journals, numerous book chapters and invited papers, and has edited three books on childhood brain tumors. He is co-editor of the book *Principles and Practice of Pediatric Neurosurgery*—currently in its third edition—and an accompanying atlas *Operative Techniques In Pediatric Neurosurgery* as well as *Brain and Spinal Tumors of Childhood*, a multinational state-of-the-art text. He is currently a site principal investigator on NIH grants focusing on novel therapies for brain tumors, including immunotherapy in childhood brain tumors. Dr. Pollack was named vice chair of academic affairs for the department in July of 2008. He also chaired the Children's Oncology Group CNS Tumor Committee from 1999-2009, and co-chaired the National Cancer Institute Brain Malignancy Steering Committee between 2010 and 2017, and served on the American Board of Pediatric Neurosurgery from 2012-2022, and as chair the final year, and is currently chair of the ABPNS nominating committee. He is also a director on the Accreditation Council for Pediatric Neurosurgery Fellowships.

Specialized Areas of Interest
Pediatric neurosurgery; pediatric neuro-oncology; craniofacial surgery; congenital spinal abnormalities; brain tumor clinical trials.

Board Certifications
American Board of Neurological Surgery
American Board of Pediatric Neurosurgery

Hospital Privileges
UPMC Children's Hospital of Pittsburgh
UPMC Magee-Womens Hospital
UPMC Presbyterian

Professional Organization Membership
Academy of Neurological Surgeons
Alpha Omega Alpha
American Academy of Pediatrics
American Association for the Advancement of Science
American Association for Cancer Research
American Association of Neurological Surgeons (AANS)
American College of Surgeons
American Society for Pediatric Neurosurgery
American Society for Clinical Investigation
Association of American Physicians
Children's Oncology Group
Congress of Neurological Surgeons
John Hopkins Medical and Surgical Society
Joint Section on Tumors (AANS/CNS)
Phi Beta Kappa
Society of Neurological Surgeons
Society for Neuro-Oncology

Professional Activities
Institutional PI, Pediatric Brain Tumor Consortium
Steering Committee, Pediatric Brain Tumor Consortium
Executive Committee, Pediatric Brain Tumor Consortium

Ian F. Pollack, MD

Co-Chair, Neurosurgery and Local Delivery Committee, Pediatric Brain Tumor Consortium
Institutional PI, Hydrocephalus Clinical Research Network
Institutional PI, Synostosis Research Group
Past-Chair and Nominating Committee Chair, American Board of Pediatric Neurological Surgery
Director, Accreditation Council for Pediatric Neurosurgery Fellowships

Education & Training
BS, Chemistry, Emory University, Magna cum Laude, 1980
MD, Johns Hopkins University School of Medicine, 1984
Fellowship, University of Pittsburgh, 1990
Residency, University of Pittsburgh, 1991
Fellowship, Hospital for Sick Children, 1991
Fellowship, University of Lausanne, 1991
Fellowship, University of Uppsala, 1992

Honors & Awards
Pittsburgh's Best Doctors, *Pittsburgh Magazine*, 2012-23
Joan Venes Lectureship, University of Michigan, 2019
Albert Nelson Marquis Lifetime Achievement Award, Marquis *Who's Who*, 2018
Castle Connolly's America's Top Doctors, 2002-23
Who's Who in America, Marquis, 2005-21
Who's Who in the World, Marquis, 2008-21
Castle Connolly's America's Top Cancer Doctors, 2005-23
Certificate of Appreciation for BMSC Co-chairship, National Cancer Institute, 2017
E. Bruce Hendrick Visiting Professor in Pediatric Neurosurgery, University of Toronto, 2016
Columbia Softball Charity Award, American Association of Neurological Surgeons Annual Meeting, 2016
Children's Brain Tumor Foundation, Award for Scientific Excellence, 2016
Winn Prize, Society of Neurological Surgeons, 2015
Van Wagenen Lecturer, American Association of Neurological Surgeons Annual Meeting, 2014
Service Award, American Board of Pediatric Neurosurgery, 2023

Publications: 2022-23
• Refereed Articles:
Hallak H, Abou-Al-Shaar H, Malella AN, Mcdowell MM, Jabbour N, Padia R, Greene S, Pollack IF. The eyebrow approach for the management of pediatric frontal epidural abscesses secondary to diffuse sinusitis. *Pediatr Neurosurg* 57:213-221, 2022.

Rocque BG, Jensen H, Reeder RW, Kulkarni AV, Pollack IF, Wellons JC III, Naftel RP, Jackson EM, Whitehead EM, Pindrik JA. Limbrick DD Jr, McDonald PJ, Tamber MS, Hankinson TC, Hauptman JS, Krieger MD, Chu J, Simon TD, Riva-Cambrin J, Kestle JRW, Rozelle CJ. Endoscopic third ventriculostomy in previously shunted patients. *J Neurosurg: Pediatr* [Online ahead of print], 2022.

Chi D, Gibson E, Chiang SN, Lee K, Naidoo SD, Lee A, Birgfeld C, Pollack IF, Goldstein J, Golinko M, Bonfield C, Siddiqi FA, Kestle JR, Smyth MD, Patel KB. A Multi-Institutional survey on calvarial vault remodeling techniques for sagittal synostosis and outcomes analysis for patients treated at 12 months and older. *J Neurosurg: Pediatr* 30:490-498, 2022.

Panigrahy A, Jakacki RI Ceschin R, Okada H, Nelson MD, Kohanbash G, Dhall G, Pollack IF, Bluml S. Magnetic resonance spectroscopy metabolic biomarkers of disease status in pediatric diffuse intrinsic pontine gliomas treated with glioma-associated antigen peptide vaccination. *Cancers* 14:5995, 2022.

Hendrikse L, Haldipur P, Saulnier O, Millman J, Sjoboen A, Eriksen A, Ong W, Gordon V, Coudière-Morrison L, Mercier A, Shokouhian N, Scott D, Vladoiu M, Farooq H, Sirbu O, Suarez R, Nakashima T, Nambu S, Bahcheli A, Diaz-Mejia J, Bach K, Phuong-Bao T, Skowron P, Kumar S, Ly M, Balin P, Visvanathan A, Lee J, Mungall K, Luu B, Berube P, Wang YC, Pfister S, Kim S-K, Doz F, Delattre O, Bourdeaut F, Masliah-Planchon J, Grajkowska W, Loukides J, Dirks P, Fèvre-Montange M, Jouvet A, Rao AM, French P, Kros J, Zitterbart K, Bailey S, Eberhart C, Giannini C, Olson J, Garami M, Hauser P, Phillips J, Ra YS, de Torres C, Mora J, Li K, Ng HK, Poon WS, Pollack IF, López-Aguilar E, Gillespie GY, Van Meter TE, Shofuda T, Chen X, Vibhakar R, Thompson RC, Cooper M, Rubin J, Kumabe T, Jung S, Nakamura H, Lach B, Iolascon A, Zollo M, Robinson S, Stearns D, Van Meir E, Porrati P, Finocchiaro G, Massimino M, Carlotti CG, Faria CC, Roussel MF, Boop F, Chan JA, Aldinger KA, Ench-Razavi F, Silvestri E, McLendon RE, Thompson EM, Ansari M, Garre ML, Ponce de León FC, Aguilar PE, Conti MPPD, Morrissy S, Cavalli F, Wu X, Daniels C, Rich JN, Jones SJM, Moore RA, Marra MA, Huang X, Reimand J, Sorensen PHB, Wechsler-Reya RJ, Weiss WA, Pugh TJ, Garzia L, Kleiman CL, Stein LD, Jabado N, Malkin D, Ayrault O, Golden JA, Ellison DW, Doble B, Ramaswamy V, Werbowetski-Ogilvie TE, Suzuki H, Millen KJ, Chen X, Taylor M. Failure of human rhombic lip differentiation constitutes medulloblastoma. *Nature* 609:1021-1028, 2022.

Lilly JV, Rokita JL, Mason JL, Patton T, Stefiankiwiz S, Higgins D, Trooskins G, Larouci C, Kamnaa A, Appert E, Heath AP, Zhu Y, Brown MA, Zhang B, Farrow BK, Robins S, Ngyuen T, Frenkel E, Lehmann K, Drake E, Sullivan C, Plisiewicz A, Coleman N, Patterson LK, Koptyra M, Helili Z, Van Kuren N, Young N, Kin MC, Friedman C, Lubneuski A, Blackden C, Williams M, Baubet C, Williams, Tauhid L, Galangaugh J, Boucher K, Ijaz H, Cole KA, Choudhari N, Santi M, Diskin SJ, Mateos M, Parsons DW, Pollack IF, Goldman S. Leary S, Bulloliero AM, Scagnet M, Haussler D, Hanson D, Firestoein R, Cain J, Phillips J, Gupta N, Mueller S, Grant G, Monje-Deisseroth M, Partap S, Greenfield J, Hashizume R, Smith A, Zhu, Johnston J, Fangjusaro JR, Miller M, Wood , Gardner S, Carter C, Prolo L, Pisapia J, Pehavin K, Franson A, Niazi T, Rubin J, Abdelbaki M, Ziegler D, Lindsay H B, Stuckiline AG, Gerber N, Morozova O, Quinsey C, Rood BR, Nazarian J, Raabe E, Jackson E, Stapleton S, Lober R, Kram ED, Koschmann C, Storm PB, Lulla R, Prados M, Resnick AC, Waanders AJ. The Children's Brain Tuor Network (CBTN) – Accelerating research in pediatric central nervous system tumors through collaboration and open science. *Neoplasia* 35: 2022.

Zou H, Poore B, Brown EB, Qian J, Xie B, Razskazovskiy V, Ayrapetian D, Asimakidou E, Sharma V, Xia S, Liu F, Chen A, Guan Y, Li Z, Wanggou S, Wu X, Saulnier O, Ly M, Fellows-Mayle W, Xi G, Tomita T, Resnick AC, Mack SC, Raabe EH, Eberhart CG, Sun D, Stronach BE, Agnihotri S, Kohanbash G, Lu S, Herrup K, Rich JN, Gittes GK, Broniscer A, Hu Z, Li X, Pollack IF, Friedlander RM, Hainer SJ, Taylor MD, Hu B. A neurodevelopmental epigenetic programme mediated by SMARCD3-DAB1-Reelin signaling is hijacked to promote medulloblastoma metastasis. *Nature Cell Biol* 25:493-507, 2023.

Nturibi EM, Kim SL, Zhang X, Katz J, Pollack IF, Greene S. Retrospective single center series on the surgical management and postoperative outcomes of pediatric Chiari-1 malformation. Part 1. Operative management and complications. *J Neurosurg Pediatr* [In press], 2023.

Nturibi EM, Kim SL, Zhang X, Katz J, Pollack IF, Greene S. Retrospective single center series on the surgical management and postoperative outcomes of pediatric Chiari-1 malformation. Part 2. Symptomatic outcomes and revision surgery. *J Neurosurg Pediatr* [In press], 2023.

Jane EP, Reslink MC, Gatesman T, Halbert M, Miller TA, Golbourn BJ, Casillo SM, Mullett SJ, Obodo U, Wendell SG, Dange R, Michealraj A, Brenner C, Agnihotri S, Premkumar DR, Pollack IF. Targeting mitochondrial energetics reverses Panobinostat and marizomib-induced resistance in pediatric and adult high-grade gliomas. *Mol Oncol* [Online ahead of print], 2023.

Dewan MC, Isaacs AM. Cools M, Yengo-Kahn A, Naftel RP, Jensen H, Reeder R, Holubkov R, Haizel-Cobbin j, Riva-Cambrin J, Jafrani R, Pindrick J, Jackson EM, Judy B, Kurudzu E, Pollack IF, McDowell MM, Hankinson TC, Staulcup S, Hauptman J, Hall K, Tamber M, Cheong A, Warsi NM, Rocque BG, Saccomano B, Snyder R, Kulkarni AV, Kestle JRW, Wellons JC. Treatment of posterior fossa tumor resection: a multicenter collaboration from the Hydrocephalus Clinical Network. *J Neuro-Oncology* [Online ahead of print], 2023.

Ravindra VM, Jensen H, Riva-Cambrin J, Wellons JC III, Limbrick D, Pindrik J, Jackson E, Pollack IF, Hankinson T, Hauptman J, Tamber M, Kulkarni A, Rocque B, Rozzelle C, Whitehead W, Chu JA, Krieger M, Simon T, Reeder R, McDonald P, Kestle JRW. Comparison of outcomes in the management of abdominal pseudocyst in children with shunted hydrocephalus: A Hydrocephalus Clinical Research Network Study. *J Neurosurg: Pediatr* [In press], 2023.

• Published Abstracts:

Deck J, Aridgides P, Krailo M, Buxton A, Mahajan A, Merchant T, Strother D, Huang A, Biegel J, Judkins A, Ho B, Mazewski C, Lewis V, Pollack I, Fouladi M, Reddy A. Survival and patterns of failure following radiation (RT) in patients with atypical teratoid rhabdoid tumors (ATRT) on ACNS0333: A report from the Children's Oncology Group. Annual Congress of International Society of Pediatric Oncology, Abstract 491, 2022.

Federico SC, Sneiderman CT, Pollack IF, Kohanbash G. Developing an adoptive cell transfer immunotherapy for pediatric high-grade gliomas. *J Immunother Cancer* 10(Suppl 2):A236.

Rocque BG, Jensen H, Reeder RW, Kulkarni AV, Pollack IF, Wellons JC III, Naftel RP, Jackson EM, Whitehead EM, Pindrik JA. Limbrick DD Jr, McDonald PJ, Tamber MS, Hankinson TC, Hauptman JS, Krieger MD, Chu J, Simon TD, Riva-Cambrin J, Kestle JRW, Rozelle CJ. Endoscopic third ventriculostomy in previously shunted patients. *Child's Nerv System* 38:2401-2, 2022.

Research Activities

Dr. Pollack's group has extended their studies that define the mechanisms underlying resistance in childhood and adult malignant gliomas. They have expanded the repertoire of "drug-resistance" tumor model systems, paired with treatment naïve counterparts. The group has leveraged this unique resource to identify the NAD metabolic pathway as a key intermediate through which multiple cell lines achieve treatment resistance. Using RNA sequencing studies and pathway analysis, Dr. Pollack and his group have identified several common molecular drivers of this process, such as QPRT and NMNAT2. Gene set enrichment analysis has demonstrated that these mediators hijack glycolytic signaling. Metabolomic analysis of downstream signaling pathway components have shown an involvement of both glycolytic intermediates and mitochondrial energy metabolites that are amenable to therapeutic intervention. These observations have provided a basis for pharmacological and RNA interference-based strategies for reversing resistance as well as metabolic manipulations that may provide novel approaches for promoting tumor cell killing. Dr. Pollack's group has demonstrated dramatic enhancement in survival with treatment in one orthotopic xenograft model and are planning studies using other models and dietary modulation, which may open up several novel strategies for clinical therapies.

Dr. Pollack and his group have also continued their NIH-funded activities that focus on immunotherapy for pediatric brain tumors. They have applied RNA sequencing of peripheral blood mononuclear cells in their low-grade glioma cohort to characterize gene expression patterns associated with favorable response to vaccine therapy, and those associated with resistance to therapy. They are working to counteract the latter in preclinical therapeutic studies. Accrual continues on ongoing clinical trials for recurrent low-grade gliomas and ependymomas.

Daniel R. Premkumar, PhD

Research Assistant Professor

Prior to joining the faculty of the Department of Neurological Surgery at the University of Pittsburgh in 2008, Daniel R. Premkumar, PhD, was a senior scientist at a biotechnology company. He graduated from Madurai Kamaraj University in India where he earned his masters and doctorate degrees. Dr. Premkumar then completed his post-doctoral training at Case Western Reserve University in Cleveland. Dr. Premkumar has published more than 50 papers in refereed journals and has been awarded patents to characterize protein-protein interaction biosensors for cellular systems biology profiling. He is currently examining the efficacy of promising various receptor inhibitors, for inhibiting glioma proliferation in vitro, using genotypically diverse panel of malignant glioma cell lines to identify potential genotype-response associations.

Specialized Areas of Interest

Major research emphasis is directed towards understanding the molecular mechanisms of receptor tyrosine kinase inhibition and signaling in malignant human glioma cell lines.

Professional Organization Membership

American Association for Cancer Research
American Society of Pharmacology and Experimental Therapeutics

Education & Training

BS, Biology, Madura College, India, 1982
MS, Animal Sciences, Madurai Kamaraj University, India, 1984
PhD, Entomology, Madurai Kamaraj University, India, 1990

Publications: 2022-23

• Refereed Articles:

Jane EP, Reslink MC, Gatesman TA, Halbert ME, Miller TA, Golbourn BJ, Casillo SM, Mullett SJ, Wendell SG, Obodo U, Mohanakrishnan D, Dange R, Michealraj A, Brenner C, Agnihotri S, Premkumar DR, Pollack IF. Targeting mitochondrial energetics reverses panobinostat- and marizomib-induced resistance in pediatric and adult high-grade gliomas. *Mol Oncol* [Online ahead of print], 2023.

Research Activities

Malignant gliomas are the most common and fatal central nervous system tumors affecting both adults and children. Dr. Premkumar has demonstrated that the combination of inhibitors targeting important "survival nodes" displayed synergistic therapeutic activity against pediatric and adult high-grade gliomas. Despite the remarkable initial response to this combination, resistance emerged. During this process, the resistant cells undergo a major transformation to how they consume and utilize the energy they need to sustain their survival, growth, and progression. Dr. Premkumar's findings provide new insights into mechanisms of treatment resistance in gliomas and the potential for exploitable vulnerabilities associated with acquired resistance.

Ava M. Puccio, RN, PhD

Associate Professor
Co-Director, Neurotrauma Clinical Trials Center

Ava M. Puccio, RN, PhD, is an associate professor with tenure in the Department of Neurological Surgery and also co-director of the Neurotrauma Clinical Trials Center in collaboration with David O. Okonkwo, MD, PhD. Dr. Puccio received her bachelor of science degree in neuroscience in 1988 and bachelor degree in nursing in 1994, both from the University of Pittsburgh. In 1995, she joined the Department of Neurological Surgery as a nurse coordinator on the National Acute

Ava M. Puccio, RN, PhD

Brain Injury Study: Hypothermia (NABIS:H) study and also the coordinator for the Brain Trauma Research Center. Throughout her years of employment as a nurse coordinator, she pursued part-time advanced schooling to graduate with a master's degree in nursing from the University of Pittsburgh in 2000 and as a university scholar (top 2% of class) from the University of Pittsburgh School of Nursing with a doctoral degree, emphasis in neuroscience in 2008. Her dissertation, "Effect of short periods of normobaric hyperoxia on local brain tissue oxygenation and cerebrospinal fluid oxidative stress markers in severe traumatic brain injury" was published in the *Journal of Neurotrauma* in 2009. Dr. Puccio was appointed assistant professor in the Department of Neurological Surgery in 2010 and received her adjunct faculty position with The School of Nursing, Department of Acute/Tertiary Care in 2010 with collaborations with Yvette Conley, PhD, and Richard Henker, RN, PhD. She was promoted associate professor with tenure in 2022.

Specialized Areas of Interest
Traumatic brain injury research; biomarkers.

Board Certifications
RN License: Pennsylvania

Hospital Privileges
UPMC Mercy
UPMC Presbyterian

Professional Organization Membership
Eastern Nursing Research Society
International Initiative for Traumatic Brain Injury Research
National Neurotrauma Society
Neurocritical Care Society
Sigma Theta Tau International Nursing Honor Society
Society of Critical Care Medicine
Women in Neurotrauma Research

Professional Activities
Guest Lecturer, Pathophysiology Across the Lifespan, University of Pittsburgh
Copeland Foundation Grant Committee, University of Pittsburgh
Biomarker Working Group, TRACK-TBI, University of California, San Francisco
Working Group, Genetic Associations in Neurotrauma (GAIN) Consortium
Biomarker Working Group, International TBI Research (InTIBIR)
Executive and Steering Committee, TRACK-TBI, University of California, San Francisco
Working Group, NIH/NINDS TBI Classification and Nomenclature Workshop: Blood-based biomarkers, Washington, D.C.

Education & Training
BS, Neuroscience, University of Pittsburgh, 1988
BSN, Nursing, University of Pittsburgh, 1994
MSN, Nursing, University of Pittsburgh, 2000
PhD, Nursing/Neuroscience, University of Pittsburgh, 2008

Honors & Awards
Cold Spring Harbor Scholarship, 2012
Ruth Perkins Kuehn Nursing Research Award, 2011
Cameos of Caring Nursing Scholarship, 2007
Society of Critical Care Nursing Section Award, 2006

Publications: 2022-23

• Refereed Articles:

Eagle SR, Puccio AM, Agoston DV, Soose R, Mancinelli M, Nwafo R, McIntyre P, Agnone A, Tollefson S, Collins M, Kontos AP, Schneider W, Okonkwo DO. Evaluating Targeted Therapeutic Response With Predictive Blood-Based Biomarkers in Patients With Chronic Mild Traumatic Brain Injury. *Neurotrauma Rep* 4(1):404-409, 2023.

Eagle SR, Puccio AM, Agoston DV, Mancinelli M, Nwafo R, McIntyre P, Agnone A, Tollefson S, Collins M, Kontos AP, Schneider W, Okonkwo DO, Soose RJ. Association of Plasma Biomarkers with Sleep Outcomes and Treatment Response After Mild Traumatic Brain Injury. *Neurotrauma Rep* 4(1):251-254, 2023.

Yue JK, Kobeissy FH, Jain S, Sun X, Phelps RRL, Korley FK, Gardner RC, Ferguson AR, Huie JR, Schneider ALC, Yang Z, Xu H, Lynch CE, Deng H, Rabinowitz M, Vassar MJ, Taylor SR, Mukherjee P, Yuh EL, Markowitz AJ, Puccio AM, Okonkwo DO, Diaz-Arrastia R, Manley GT, Wang KKW. Neuroinflammatory Biomarkers for Traumatic Brain Injury Diagnosis and Prognosis: A TRACK-TBI Pilot Study. *Neurotrauma Rep* 4(1):171-183, 2023.

Yue JK, Krishnan N, Kanter JH, Deng H, Okonkwo DO, Puccio AM, Madhok DY, Belton PJ, Lindquist BE, Satris GG, Lee YM, Umbach G, Duhaime AC, Mukherjee P, Yuh EL, Valadka AB, DiGiorgio AM, Tarapore PE, Huang MC, Manley GT; TRACK-TBI Investigators. Neuroworsening in the Emergency Department Is a Predictor of Traumatic Brain Injury Intervention and Outcome: A TRACK-TBI Pilot Study. *J Clin Med* 12(5):2024, 2023.

Barton DJ, Coppler PJ, Talia NN, Charalambides A, Stancil B, Puccio AM, Okonkwo DO, Callaway CW, Guyette FX, Elmer J. Prehospital Electroencephalography to Detect Traumatic Brain Injury during Helicopter Transport: A Pilot Observational Cohort Study. *Prehosp Emerg Care* [Online ahead of print], 2023.

Agarwal N, Wilkins TE, Nwachuku EL, Deng H, Algattas H, Lavadi RS, Chang YF, Puccio A, Okonkwo DO. Long-term Benefits for Younger Patients with Aggressive Immediate Intervention following Severe Traumatic Brain Injury: A Longitudinal Cohort Analysis of 175 Patients from a Prospective Registry. *Clin Neurol Neurosurg* 224:107545, 2023.

Amodeo D, Lucarelli V, De Palma I, Puccio A, Nante N, Cevenini G, Messina G. Efficacy of violet-blue light to inactive microbial growth. *Sci Rep* 12(1):20179, 2022.

Deng H, Nwachuku EL, Wilkins TE, Yue JK, Fetzick A, Chang YF, Beers SR, Okonkwo DO, Puccio AM. Time to Follow Commands in Severe Traumatic Brain Injury Survivors With Favorable Recovery at 2 Years. *Neurosurgery* 91(4):633-640, 2022.

Kulbe JR, Jain S, Nelson LD, Korley FK, Mukherjee P, Sun X, Okonkwo DO, Giacino JT, Vassar MJ, Robertson CS, McCrea MA, Wang KKW, Temkin N, Mac Donald CL, Taylor SR, Ferguson AR, Markowitz AJ, Diaz-Arrastia R, Manley GT, Stein MB; TRACK-TBI Investigators. Correction to: Association of day-of-injury plasma glial fibrillary acidic protein concentration and six-month post-traumatic stress disorder in patients with mild traumatic brain injury. *Neuropsychopharmacology* 47(13):2332, 2022.

Privitera CM, Neerukonda SV, Aiyagari V, Yokobori S, Puccio AM, Schneider NJ, Stutzman SE, Olson DM; END PANIC Investigators. A differential of the left eye and right eye neurological pupil index is associated with discharge modified Rankin scores in neurologically injured patients. *BMC Neurol* 22(1):273, 2022.

Cai LT, Brett BL, Palacios EM, Yuh EL, Bourla I, Wren-Jarvis J, Wang Y, Mac Donald C, Diaz-Arrastia R, Giacino JT, Okonkwo DO, Levin HS, Robertson CS, Temkin N, Markowitz AJ, Manley GT, Stein MB, McCrea MA, Zafonte RD, Nelson LD, Mukherjee P; TRACK-TBI Investigators. Emotional Resilience Predicts Preserved White Matter Microstructure Following Mild Traumatic Brain Injury. *Biol Psychiatry Cogn Neurosci Neuroimaging* [Online ahead of print], 2022.

Korley FK, Jain S, Sun X, Puccio AM, Yue JK, Gardner RC, Wang KKW, Okonkwo DO, Yuh EL, Mukherjee P, Nelson LD, Taylor SR, Markowitz AJ, Diaz-Arrastia R, Manley GT; TRACK-TBI Study Investigators. Prognostic value of day-of-injury plasma GFAP and UCH-L1 concentrations for predicting functional recovery after traumatic brain injury in patients from the US TRACK-TBI cohort: an observational cohort study. *Lancet Neurol* 21(9):803-813, 20220.

Temkin N, Machamer J, Dikmen S, Nelson LD, Barber J, Hwang PH, Boase K, Stein MB, Sun X, Giacino J, McCrea MA, Taylor SR, Jain S, Manley G; TRACK-TBI Investigators. Risk Factors for High Symptom Burden Three Months after Traumatic Brain Injury and Implications for Clinical Trial Design: A Transforming Research and Clinical Knowledge in Traumatic Brain Injury Study. *J Nurotrauma* 39(21-22):1524-1532, 2022.

Kulbe JR, Jain S, Nelson LD, Korley FK, Mukherjee P, Sun X, Okonkwo DO, Giacino JT, Vassar MJ, Robertson CS, McCrea MA, Wang KKW, Temkin N, Mac Donald CL, Taylor SR, Ferguson AR, Markowitz AJ, Diaz-Arrastia R, Manley GT, Stein MB; TRACK-TBI Investigators. Association of day-of-injury plasma glial fibrillary acidic protein concentration and six-month posttraumatic stress disorder in patients with mild traumatic brain injury. *Neuropsychopharmacology* 47(13):2300-2308, 2022.

Pease M, Gonzalez-Martinez J, Puccio A, Nwachuku E, Castellano JF, Okonkwo DO, Elmer J. Risk Factors and Incidence of Epilepsy after Severe Traumatic Brain Injury. *Ann Neurol* 92(4):663-669, 2022.

Palacios EM, Yuh EL, Mac Donald CL, Bourla I, Wren-Jarvis J, Sun X, Vassar MJ, Diaz-Arrastia R, Giacino JT, Okonkwo DO, Robertson CS, Stein MB, Temkin N, McCrea MA, Levin HS, Markowitz AJ, Jain S, Manley GT, Mukherjee P; TRACK-TBI Investigators. Diffusion Tensor Imaging Reveals Elevated Diffusivity of White Matter Microstructure that Is Independently Associated with Long-Term Outcome after Mild Traumatic Brain Injury: A TRACK-TBI Study. *J Neurotrauma* 39(19-20):1318-1328, 2022.

Pease M, Arefan D, Barber J, Yuh E, Puccio A, Hochberger K, Nwachuku E, Roy S, Casillo S, Temkin N, Okonkwo DO, Wu S; TRACK-TBI Investigators. Outcome Prediction in Patients with Severe Traumatic Brain Injury Using Deep Learning from Head CT Scans. *Radiology* 304(2):385-394, 2022.

Research Activities

Dr. Puccio's research has focused on improving outcomes in traumatic brain injury patients, with clinical venues of controlled normothermia, mechanisms of brain oxygenations and exploring genetic variances and expression on outcome. She and was awarded a K99/R00 NINR grant in 2014, entitled "Transcriptomics in Traumatic Brain Injury: Relationship to Brain Oxygenation and Outcomes."

With over 25 years of clinical trial design, involvement and management, several traumatic brain and spine injury research studies have been completed and are ongoing. Many cutting-edge biomarker and high definition fiber tracking imaging and additional observational research studies are being conducted. Dr. Puccio is very involved in the Transforming Research and Clinical Knowledge in TBI (TRACK-TBI) consortium and was awarded a Department of Defense grant

Ava M. Puccio, RN, PhD

as PI of the Biospecimen Repository which collects, catalogues and stores cerebrospinal fluid, blood, serum DNA and RNA samples obtained from mild, moderate and severe TBI patients at 17 clinical sites.

Analyses from these samples has provided additional validation to the recent FDA-approval of the use of two biomarkers, glial fibrillary acidic protein (GFAP) and ubiquitin C-terminal hydrolase L1 (UCH-L1) obtained within 12 hours of a suspected TBI in determining the need for a brain CT scan, and is the central PI of the biorepository for a FDA-pivotal trial with Abbott Laboratories which results are pending. The success of this biorepository has also spring-boarded opportunities to acquire additional ongoing grant support through the DoD as the biorepository for the biomarkers in the "Brain Oxygenation Optimization Study Trial" (Bio-BOOST), as well as the TRACK-TBI Geriatric Initiative (NIH funded) to further define the elderly TBI cohort and TRACK Precision Medicine, an initiative for personalized care in TBI.

Michael J. Rutigliano, MD

Clinical Associate Professor
Director, Westmoreland County Community Neurosurgery

Michael J. Rutigliano, MD, MBA, was appointed to the University of Pittsburgh faculty in 1996. An active staff member of the University of Pittsburgh Medical Center, Dr. Rutigliano lives in Greensburg, Pa. and the primary focus of his clinical practice is in Westmoreland County at the hospitals of the Excela Health System through a cooperative venture between UPMC and Excela Health. His clinical interests include a wide range of neurosurgical diseases, focusing mostly in the areas of spinal and peripheral nerve disorders, and concussion and other sports-related injury. Surgical procedures performed include simple spinal surgery such as lumbar and cervical discectomy, laminectomies for spinal stenosis, and more complex spinal reconstructive surgery for spondylolisthesis and scoliosis. Common peripheral nerve surgery includes carpal tunnel release and ulnar neurolysis. He received his medical degree in 1989 from the University of Pittsburgh School of Medicine. Following an internship in general surgery, he completed residency training in neurological surgery at the University of Pittsburgh Medical Center. During this time, he also obtained an MBA from the Katz Graduate School of Business. Dr. Rutigliano's academic expertise is in medical economics and cost-effectiveness analysis. He was awarded the Pittsburgh Academy of Medicine Study Scholarship and was honored by the Stroke Council of the American Heart Association with a scholarship for research in cerebrovascular disease. Dr. Rutigliano has retired from the United States Army Reserve and has served in support of Operation Iraqi Freedom at Walter Reed Medical Center from April to July 2003, and in Balad, Iraq from October 2007 to February 2008.

Specialized Areas of Interest
Spinal disorders; peripheral nerve disorders.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
Latrobe Area Hospital
UPMC East
UPMC Presbyterian
Westmoreland Hospital

Professional Organization Membership
American Association of Neurological Surgeons

Michael J. Rutigliano, MD

AANS/CNS Joint Section on Spine and Peripheral Nerve
Congress of Neurological Surgeons

Education & Training
BS, Chemistry, University of Pittsburgh, 1985
MD, University of Pittsburgh, 1989
MBA, Joseph Katz School of Business, University of Pittsburgh, 1994
Residency, Neurosurgery, University of Pittsburgh, 1996

Varun Shandal, MD

Clinical Assistant Professor

Varun Shandal, MD, joined the University of Pittsburgh Center of Clinical Neurophysiology in April 2021. Dr. Shandal specializes in intraoperative neurophysiological monitoring of adult and pediatric neurosurgical, orthopedic, ENT, cardiothoracic, vascular, and interventional neuroradiology procedures, microelectrode recording and subcortical mapping for deep brain stimulation (DBS) electrode implantation, as well as motor and language mapping during awake craniotomy procedures. Dr. Shandal completed his neurology residency at Lewis Katz School of Medicine at Temple University Hospital in Philadelphia. He completed his clinical neurophysiology fellowship at North Shore University Hospital in Manhasset, N.Y. and intraoperative neurophysiologic monitoring fellowship at UPMC Presbyterian in Pittsburgh. Prior to residency, he completed his internship training in internal medicine at Medstar Good Samaritan Hospital in Baltimore, Maryland. Dr. Shandal completed his medical school at All India Institute of Medical Sciences in New Delhi, India.

Specialized Areas of Interest
Intraoperative neurophysiological monitoring; electromyography; transcranial motor evoked potentials; subcortical mapping with microelectrode recording.

Board Certifications
American Board of Psychiatry and Neurology; Neurology
American Board of Psychiatry and Neurology; Clinical Neurophysiology

Hospital Privileges
Excela Health Hospital System
Indiana Regional Medical Center
Trinity Health System
UPMC Altoona
UPMC Bedford
UPMC Children's Hospital of Pittsburgh
UPMC Children's Hospital of Pittsburgh North
UPMC Cole
UPMC East
UPMC Hamot
UPMC Horizon
UPMC Magee-Womens Hospital
UPMC McKeesport
UPMC Mercy
UPMC Muncy
UPMC Northwest
UPMC Passavant
UPMC Pinnacle

Varun Shandal, MD

UPMC Presbyterian
UPMC St. Margaret
UPMC Shadyside
UPMC Shenango
UPMC Somerset
UPMC Susquehanna
UPMC Western Maryland

Professional Organization Membership
American Academy of Neurology

Education & Training
MBBS, All India Institute of Medical Sciences, New Delhi, India, 2008
Internship, Internal Medicine, Medstar Good Samaritan Hospital, Baltimore, 2013
Residency, Neurology, Temple University Hospital, Philadelphia, 2016
Fellowship, Clinical Neurophysiology, North Shore University Hospital, Manhasset, N.Y., 2017
Fellowship, Intraoperative Neurophysiological Monitoring, UPMC, Pittsburgh, 2021

Publications: 2022-23
• Refereed Articles:
Moehl K, Shandal V, Anetakis K, Paras S, Mina A, Crammond D, Balzer J, Thirumala PD. Predicting transient ischemic attack after carotid endarterectomy: The role of intraoperative neurophysiological monitoring. *Clin Neurophysiol* 141:1-8, 2022.

Santos DPAD, Thirumala PD, Reddy G, Barros DF, Faria VNR, Shandal V, Kurtz P. Risk of perioperative stroke and cerebral autoregulation monitoring: a systematic review. *Arq Neuropsiquiatr* 80(12):1196-1203, 2022.

Fleseriu CM, Sultan I, Brown JA, Mina A, Frenchman J, Crammond DJ, Balzer J, Anetakis KM, Subramaniam K, Shandal V, Navid F, Thirumala PD. Role of Intraoperative Neurophysiological Monitoring in Preventing Stroke after Cardiac Surgery. *Ann Thorac Surg* S0003-4975(23)00017-6, 2023.

Adams GM, Crammond DJ, Shandal V, Gardner PA, Snyderman CH, Anetakis KM, Balzer JR, Thirumala PD. Minimally invasive extraocular cranial nerve electromyography. *J Neurosurg* 24: 1-9, 2023.

Natalie Sandel Sherry, PsyD

Assistant Professor

Natalie Sherry, PsyD, ABPP-CN, is a board-certified clinical neuropsychologist in the Departments of Neurological Surgery, Neurology, and Hematology/Oncology. She completed her undergraduate degree at the University of Pittsburgh in neuroscience graduating summa cum laude. She also has a joint degree from Widener University including a doctorate in clinical psychology and a master's in business administration. She completed internship rotations in the Department of Neurology at the Hospital of the University of Pennsylvania and the Department of Physical Medicine and Rehabilitation at Temple University Hospital. She completed a post-doctoral fellowship in clinical neuropsychology at the UPMC Sports Concussion Program. Dr. Sherry conducts neuropsychological testing for a variety of neurological, medical, and psychological conditions and is actively involved in clinical research.

Specialized Areas of Interest
Neuropsychology

Natalie Sandel Sherry, PsyD

Board Certifications
American Board of Clinical Neuropsychology

Professional Organization Membership
American Academy of Clinical Neuropsychology
American Psychological Association
International Neuropsychological Society
National Academy of Neuropsychology
Sport Neuropsychology Society
Pennsylvania Psychological Association

Education & Training
BS, Neuroscience, University of Pittsburgh, 2011
MA, Clinical Psychology, 2014
MBA, Widener University, 2016
PsyD, Widener University, 2016
Clinical Neuropsychology Fellowship, UPMC, 2018

Honors & Awards
Senior Researcher Award, American Academy of Child & Adolescent Psychiatry, 2019

Publications: 2022-23
• Refereed Articles:
Hoppe M, Habib A, Desai R, Edwards L, Kodavali C, Sherry NS, Zinn PO. Human brain organoid code of conduct. *Front Mol Med* 3:1143298, 2023.

Sherry N, Ernst N, French JE, Eagle S, Collins M, Kontos A. Performance validity testing in patients presenting to a specialty clinic with a mild traumatic brain injury. *J Head Trauma Rehabil* 37(3), E135-E143, 2022.

Jeremy G. Stone, MD

Clinical Assistant Professor
Medical Director, Stroke Research, UPMC Hamot

Jeremy G. Stone, MD, is a board eligible neurosurgeon with CAST-accredited subspecialty fellowship training in neuroendovascular surgery, completing both residency and fellowship at the University of Pittsburgh. He currently practices with Great Lakes Neurosurgery and Neurointervention at UPMC Hamot in Erie, Pa., serving as clinical assistant professor and medical director of stroke research. Dr. Stone enjoys general neurosurgery with clinical focus on open cerebrovascular, neuroendovascular, minimally invasive techniques, and spine deformity. He also leads scientific discovery with participation as site principal investigator in several clinical trials.

Specialized Areas of Interest
Cerebrovascular (open and endovascular neurosurgery); degenerative spine disease and spinal deformity with emphasis on minimally invasive 360-degree approaches for deformity correction; stroke.

Board Certifications
American Board of Neurological Surgery (board eligible)

Hospital Privileges
UPMC Hamot

Jeremy G. Stone, MD

UPMC Mercy
UPMC Presbyterian

Professional Organization Membership
Alpha Omega Alpha
American Association of Neurological Surgery
AANS/CNS Cerebrovascular Section
Congress of Neurological Surgeons
North American Spine Society
Society of Neurointerventional Surgeons

Education & Training
BS, Biology/Psychology, Case Western Reserve University, 2009
MD, University of Hawaii, 2014
CAST-Accredited Fellowship, Neuroendovascular Surgery, University of Pittsburgh, 2020
Residency, Neurological Surgery, University of Pittsburgh, 2021

Honors & Awards
Best Off-Service Teacher Award, Orthopedic Surgery Residency, UPMC Hamot, 2021
UPMC Medical Education LEAP Award for Patient Safety and Quality Improvement, 2017, 2020
Oral Presentation Award, Second Annual Graduate Medical Education Quality and Safety Symposium, University of Pittsburgh, 2019
Best Resident Research Presentation Runner Up, Stuart Rowe Society Lectureship, University of Pittsburgh, 2019
Top Score, American Board of Neurological Surgery Written Board Exam, 2018
Frank and Mary McDowell Award for Excellence in Surgery, 2014
Windsor and Mary Cutting Excellence in the Basic Sciences Award, 2014
Bernard Yim Award for Top Performance in Internal Medicine Clerkship, American College of Physicians, University of Hawaii John A. Burns School of Medicine, 2013
Po'okela and Noi'i Award for Outstanding Research, 2014
American College of Physicians Bernard Him Award for Top Performance in Internal Medicine, 2013

Publications: 2022-23
• Refereed Articles:
Siddiqui AH, Monteiro A, Hanel RA, Kan P, Mohanty A, Cortez GM, Rabinovich M, Matouk C, Sujijantarat N, Romero C, Stone J, Ebersole K, Fry L, Natarajan SK, Owusu-Adjei B, Ortega-Gutierrez S, Vivanco-Suarez J, Wakhloo AK, Levy EI. Triple therapy versus dual-antiplatelet therapy for dolichoectatic vertebrobasilar fusiform aneurysms treated with flow diverters. *J Neurointerv Surg* 5(7):655-663, 2023.

Research Activities
• Comparison of Anti-coagulation and anti-Platelet Therapies for Intracranial Vascular Atherostenosis (CAPTIVA)
Two-stage trial randomizing subjects with stroke attributed to 70-99% intracranial atherosclerotic stenosis to 1) ticagrelor + aspirin, 2) low dose rivaroxaban + aspirin, 3) clopidogrel + aspirin.

• Protection against Emboli during carotid artery stenting using a 3-in-1 delivery system comprised of a post-dilation balloon, integrated embolic filter, and a novel carotid stent II (PERFORMANCE II).
Prospective, single-arm, multicenter clinical trial to evaluate the safety and effectiveness of the Neuroguard IEP System for the treatment of carotid artery stenosis.

Mingui Sun, PhD

Professor

Mingui Sun, PhD, received a BS degree in instrumental and industrial automation in 1982 from the Shenyang Chemical Engineering Institute in Shenyang, China, and an MS degree in electrical engineering in 1986 from the University of Pittsburgh, where he also earned a PhD degree in electrical engineering in 1989. He was later appointed to the faculty in the Department of Neurological Surgery. Dr. Sun's research interests include neurophysiological signals and systems, biosensor designs, brain-computer interface, bioelectronics and bioinformatics. He has more than 460 publications.

Specialized Areas of Interest

Biomedical engineering; biomedical instrumentation; biomedical signal processing, computational neurophysiology, image and video processing; computer-assisted neurosurgery and diagnosis.

Professional Organization Membership

American Institute for Medical and Biological Engineering
Institute of Electrical and Electronics Engineers

Education & Training

BS, Instrumentation/Industrial Automation, Shenyang Chemical Institute, 1982
MS, Electrical Engineering, University of Pittsburgh, 1986
PhD, Electrical Engineering, University of Pittsburgh, 1989

Publications: 2022-23

• Refereed Articles:

Zheng X, Liu C, Gong Y, Yin Q, Jia W, Sun M. Food volume estimation by multi-layer superpixel. *Math Biosci Eng* 20(4):6294-6311, 2023.

Qiu J, Lo FP, Gu X, Jobarteh ML, Jia W, Baranowski T, Steiner-Asiedu M, Anderson AK, Mccrory MA, Sazonov E, Sun M, Frost G, Lo B. Egocentric Image Captioning for Privacy-Preserved Passive Dietary Intake Monitoring. *IEEE Trans Cybern* [Online ahead of print], 2023.

Sun M, Jia W, Chen G, Hou M, Chen J, Mao ZH. Improved Wearable Devices for Dietary Assessment Using a New Camera System. *Sensors* (Basel) 22(20):8006, 2022.

Chen Y, LiX, Jia W, Sun M. Development of an automatic measurement system for medical pills based on a PDMS capacitive sensor. *Measurement* 192:110899, 2022.

Research Activities

• Developing a Diet Sensor

It is well-known that an unhealthy diet is a top risk factor causing obesity and chronic diseases. Despite the importance of nutrition to health, scientists currently do not have user-friendly tools to conduct dietary assessment in real life. Months or years are often necessary to reverse a chronic condition by changing diet. Recently, Dr. Sun has been investigating a novel sensor system that conducts dietary assessment for macronutrients (carbohydrates, fats and proteins) automatically, leveraging on a coin-sized commercial sensor that measures interstitial glucose. This FDA-approved, low-cost and safety-proven sensor, called Continuous Glucose Monitor (CGM), has been used clinically for both diabetes management and research in heathy populations. Dr. Sun believes this convenient sensor can be converted to a powerful diet sensor using novel theoretical models and computational techniques. He has studied a unified food model

Mingui Sun, PhD

which accumulates daily amounts of macronutrients ingested from real-world foods and beverages. Using this model, a novel technological framework will be established based on the theory of feedback dynamic control. If successful, Dr. Sun's study may yield a powerful technology for a vast number of people who need to control diet-related diseases and conditions.

Fadi Sweiss, MD

Clinical Assistant Professor

Fadi Sweiss, MD, joined the University of Pittsburgh Department of Neurological Surgery in August of 2020, practicing at UPMC Williamsport in north central Pennsylvania. Dr. Sweiss specializes in the diagnosis and treatment of degenerative, traumatic, and oncologic spinal conditions using traditional, open surgical techniques and advanced, minimally invasive techniques. Dr. Sweiss received his medical degree from Northeast Ohio Medical University, Rootstown, Ohio, and completed his residency in neurosurgery at George Washington University Hospital, Washington, D.C. "As long as I can remember, I've wanted to be a doctor," said Sweiss. "My brother is a neurosurgeon and the field fascinated me. I enjoy being able to care for and build relationships with my patients. It never ceases to amaze me how the proper care can transform and change a patient's life and that's what it is all about for me."

Specialized Areas of Interest
Complex spine disorders; adult spine revision surgery and deformity correction; cervical, thoracic and lumbar surgery; neurotrauma.

Hospital Privileges
UPMC Williamsport

Education & Training
BS, Biology, Virginia Tech, 2006
MD, Northeast Ohio Medical University, 2013
Residency, George Washington University, 2020

Honors & Awards
Top 40 Physicians Under 40, Pennsylvania Medical Society, 2023

Bart Thaci, MD

Clinical Assistant Professor

Bart Thaci, MD, joined the University of Pittsburgh Department of Neurological Surgery as a clinical assistant professor in July 2022 specializing in neurovascular disease. His particular clinical interests include the treatment of brain and spinal cord vascular disorders such as aneurysms, arteriovenous malformations, arteriovenous fistulas, and cavernous malformations. He also performs embolization of brain and spinal cord tumors; cervical, intracranial, and venous stenting; and revascularization for acute ischemic stroke. Dr. Thaci received his medical degree from University of Tirana, Faculty of Medicine, Albania. After relocating in the United States, Dr. Thaci continued post-doctoral studies at the University of Chicago Brain Tumor Center and then a pre-residency neurosurgery fellowship at Boston Medical Center, Boston University. He completed his neurosurgery residency at the University of California-Davis. During his residency, Dr. Thaci completed two endovascular fellowships, the first at the University of Alabama, Birmingham in 2020 and the second at the CAST-approved University of California-Davis in 2022.

Bart Thaci, MD

Specialized Areas of Interest
Intracranial aneurysms; arteriovenous malformations; arteriovenous fistulas; cavernous malformations; brain tumors; carotid stenosis; intracranial stenosis; venous sinus stenosis; ischemic stroke.

Board Certifications
Eligible for American Board of Neurological Surgery

Hospital Privileges
UPMC Carlisle
UPMC Community General
UPMC Hanover
UPMC Harrisburg
UPMC Lititz
UPMC Memorial
UPMC West Shore

Professional Organization Membership
Congress of Neurological Surgeons

Education & Training
MD, University of Tirana, Faculty of Medicine, Albania, 2004
Fellowship, Pre-residency, Neurosurgery, Boston University Medical Center, 2015
Residency, University of California Davis Medical School, 2022
Fellowship, Endovascular Neurosurgery, University of Alabama, Birmingham, 2020
Fellowship, Endovascular Neurosurgery, University of California Davis Medical School, 2022

Parthasarathy D. Thirumala, MD

Professor
Director, Center of Clinical Neurophysiology
Director, Clinical Neurophysiology Laboratory

Parthasarathy D. Thirumala, MD, joined the Center of Clinical Neurophysiology in June 2008. He specializes in intraoperative neurophysiological monitoring to adult and pediatric neurosurgical, orthopedic, ENT, vascular and interventional neuroradiology procedures. Dr. Thirumala completed his neurology residency and clinical neurophysiology fellowship training at the University of Pittsburgh Medical Center. He completed his internship in internal medicine training at Brookdale University Hospital and Medical Center in Brooklyn, N.Y. Prior to clinical training he completed his masters degree in biomedical engineering at the University of Illinois at Chicago. Dr. Thirumala completed his medical training in India at Stanley Medical College in Chennai, India. His clinical and research interests include intraoperative neurophysiological monitoring during expanded endonasal approach, functional cortical mapping during awake craniotomies, ICU EEG. He has published over 90 peer reviewed articles, book chapters, and invited articles in the journals including *JAMA, Neurology, Neurology, Neurosurgery, Journal of Neurosurgery,* and *Journal of Clinical Neurophysiology*. He has given lectures both nationally and internationally on the value of intraoperative neurophysiological monitoring.

Specialized Areas of Interest
Intraoperative neurophysiological monitoring; functional cortical mapping during awake craniotomies; neurophysiological monitoring during minimally invasive endonasal approach to skull base surgeries; electroencephalography in the intensive care unit.

Parthasarathy D. Thirumala, MD

Board Certifications
American Board of Clinical Neurophysiology: Intraoperative Monitoring
American Board of Neuroimaging
American Board of Neurophysiologic Monitoring
American Board of Psychiatry and Neurology

Hospital Privileges
Jameson Hospital
Monongahela Valley Hospital
UPMC Children's Hospital of Pittsburgh
UPMC Hamot
UPMC Horizon
UPMC Magee-Womens Hospital
UPMC Mercy
UPMC Passavant
UPMC Presbyterian
UPMC St. Margaret
UPMC Shadyside

Professional Organization Membership
American Academy of Neurology
American Association of Neuromuscular and Electrodiagnostic Medicine
American Clinical Neurophysiology Society
American Epilepsy Society
American Medical Association
American Society of Neuroimaging
American Society of Neuromonitoring
America's Registry of Outstanding Professionals
North American Spine Society

Professional Activities
Course Co-Director, Principles and Practice of Intraoperative Monitoring, UPMC

Education & Training
MBBS, Stanley Medical College, 1997
MS, University of Illinois, Bioengineering, 2001
Residency, Neurology, University of Pittsburgh, 2006
Fellowship, Clinical Neurophysiology, University of Pittsburgh, 2007

Honors & Awards
Neurologist of the Year, Pennsylvania Neurology Society, 2021

Publications: 2022-23
• Refereed Articles:
Adams GM, Crammond DJ, Shandal V, Gardner PA, Snyderman CH, Anetakis KM, Balzer JR, Thirumala PD. Minimally invasive extraocular cranial nerve electromyography *J Neurosurg* 24:1-9, 2023.

Fleseriu CM, Sultan I, Brown JA, Mina A, Frenchman J, Crammond DJ, Balzer J, Anetakis KM, Subramaniam K, Shandal V, Navid F, Thirumala PD. Role of Intraoperative Neurophysiological Monitoring in Preventing Stroke After Cardiac Surgery. *Ann Thorac Surg* S0003-497, 2023.

Parthasarathy D. Thirumala, MD

Esper SA, Thirumala PD, Chu D. Perioperative Stroke Risk Model-One Size Fits All? *JAMA Surg* 157(8):e222237, 2022.

Moehl K, Shandal V, Anetakis K, Paras S, Mina A, Crammond D, Balzer J, Thirumala PD. Predicting transient ischemic attack after carotid endarterectomy: The role of intraoperative neurophysiological monitoring. *Clin Neurophysiol* 141:1-8, 2022.

Santos DPAD, Thirumala PD, Reddy G, Barros DF, Faria VNR, Shandal V, Kurtz P. Risk of perioperative stroke and cerebral autoregulation monitoring: a systematic review. *Arq Neuropsiquiatr* 80(12):1196-1203, 2022.

Daniel A. Wecht, MD, MSc

Clinical Professor
Chief, Neurosurgery, UPMC McKeesport
Chief, Neurosurgery, UPMC St. Margaret
Chief, Neurosurgery, UPMC Shadyside

Daniel A. Wecht, MD, joined the Department of Neurological Surgery as a clinical assistant professor in September of 1999. He was promoted to clinical associate professor in 2002 and full clinical professor in 2008. He was born and raised in Pittsburgh. After graduating from Harvard University, Dr. Wecht attended medical school at the University of Pennsylvania. He completed his neurosurgery residency at Baylor College and then completed a two-year neurovascular surgery fellowship at Yale University School of Medicine. He was board-certified with the American Board of Neurological Surgery in 2000 and was recertified in 2010. Dr. Wecht specializes in the treatment of brain tumors and general neurosurgery including an active spine practice. He has co-authored or authored several articles and publications. Dr. Wecht has been a neurosurgical faculty member at Yale University, University of New Mexico and Allegheny University of the Health Sciences (Pittsburgh, Pa.). He is an active participant in multiple professional and scientific societies. He is licensed to practice in Pennsylvania and New Mexico.

Specialized Areas of Interest
General neurosurgery; brain tumors; spinal and peripheral nerve microsurgery; chiari malformation.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC McKeesport
UPMC Presbyterian
UPMC St. Margaret
UPMC Shadyside

Professional Organization Membership
AANS/CNS Joint Section on Cerebrovascular Surgery
AANS/CNS Joint Section on Trauma
American Association of Neurological Surgeons

Professional Activities
Team Neurosurgeon, Pittsburgh Penguins

Fang-Cheng Yeh, MD, PhD

Associate Professor
High-Definition Fiber Tractography Lab

Fang-Cheng (Frank) Yeh, MD, PhD, joined the Department of Neurological Surgery in 2016 following the completion of his MD degree from National Taiwan University and PhD study in biomedical engineering at Carnegie Mellon University in 2014. Dr. Yeh and his team have made contributions to tractography-based connectomics, which have had impact on the field of brain connectivity research. His team developed correlational tractography, a technique that allows for the mapping of pathways that show correlation with specific study variables. This approach provides insights into the relationship between brain connectivity and clinical and cognitive factors, potentially influencing certain aspects of the diagnosis and treatment of neurological disorders. Another contribution is differential tractography, which identifies pathways undergoing neuronal changes over time. This approach contributes to the understanding of brain plasticity and pathology, potentially advancing knowledge in the area of neurological conditions. In addition to their research, Dr. Yeh and his team provide tools and methodologies to researchers worldwide, supporting the progress in understanding brain connectivity and its implications for neurological disorders. He developed DSI Studio, a software that is used in the neuroscience community. DSI Studio offers functionalities for diffusion MRI analysis, including preprocessing, tensor estimation, and fiber tractography. The software also provides additional tools such as automatic quality control, ROI editing, and clustering analysis, allowing researchers to customize their analyses to extent. DSI Studio supports various diffusion MRI data types, making it compatible with different research studies. DSI Studio has been cited in 2,000 publications, indicating recognition and contribution to neuroscience. The development team occasionally updates the software, incorporating certain features like GPU acceleration and cloud-based computing to improve performance and enable analysis of relatively larger datasets. DSI Studio's functionalities, tools, and compatibility with various diffusion MRI data types have positioned it as a tool that is used in diffusion MRI analysis. It has become a resource that is occasionally valued by researchers worldwide, supporting advancements in the field of brain connectivity.

Specialized Areas of Interest
Diffusion MRI; tractography; network analysis; medical image analysis; pathology informatics.

Education & Training
MD, National Taiwan University, 2006
PhD, Biomedical Engineering, Carnegie Mellon University, 2014

Honors & Awards
Chancellor's Commercialization Fund Award, Pitt Ventures First Gear Program, University of Pittsburgh, 2019

Publications: 2022-23
• Refereed Articles:
Yeh FC. Population-based tract-to-region connectome of the human brain and its hierarchical topology. *Nat Comm* 13(1):4933, 2022.

Research Activities
Dr. Yeh's research activities focus on addressing the limitations of connectome mapping by providing detailed information about the white matter pathways involved in region-to-region connectivity. To achieve this, he has developed a population-based tract-to-region connectome, which allows researchers to quantify the likelihood of a white matter tract connecting to a specific cortical region.

Fang-Cheng Yeh, MD, PhD

Through his research, he has discovered that approximately 85% of the entries in the tract-to-region connectome exhibit consistent patterns across individuals. However, the remaining 15% show significant variations that require individualized mapping. By employing hierarchical clustering techniques on cortical regions, he has identified distinct networks, including dorsal, ventral, and limbic networks, based on their unique tract-to-region connectivity patterns.

Additionally, his analysis of white matter bundles has revealed the categorization of fiber bundle systems within the association pathways. This categorization provides valuable insights into the connective architecture between cortical regions and white matter bundles. Moreover, the derived hierarchical relationship offers a systematic categorization of both gray and white matter structures.

Dr. Yeh's research on the tract-to-region connectome not only enhances our understanding of the connective topology within the brain but also sheds light on the organization of gray and white matter structures. These findings contribute to the broader field of neuroscience by providing a more comprehensive and detailed characterization of brain connectivity.

Georgios A. Zenonos, MD

Assistant Professor
Neurosurgical Co-Director, Center for Cranial Base Surgery
Neurosurgical Co-Director, Pituitary Center for Excellence
Director, Cranial Nerve Disorders Program
Director, Clinical Operations, UPMC Presbyterian
Co-Director, Neurosurgery Skull Base Fellowship

Georgios A. Zenonos, MD, joined the University of Pittsburgh Department of Neurological Surgery as associate director of Center for Cranial Base Surgery in July of 2019 after having received extensive formal sub-specialization in the field. He is one of a handful of neurosurgeons to have completed two fellowships in skull base surgery, one focusing on endoscopic and minimally invasive approaches at the University of Pittsburgh, and another focusing on complex cranial neurosurgery and cerebrovascular neurosurgery at the University of Miami with the renown Jacques J. Morcos, MD, and Roberto C. Heros, MD. Dr. Zenonos completed his internship, residency and chief residency in neurosurgery at the University of Pittsburgh from 2011-18. During this time, he received several distinctions and awards, including an award for achieving the highest score in the nation on the American Board of Neurological Surgery written exam. Other awards include the Robert J. Dempsey Award by the CNS/AANS Joint Cerebrovascular Section, the University of Pittsburgh Stuart N. Rowe Research Award, first place in the North American Skull Base Society knowledge competition, and four Walter L. Copeland Awards for cranial research. In addition, Dr. Zenonos has published extensively, has given numerous presentations nationally and internationally, and has been frequently invited as a scientific reviewer by prominent neurosurgical journals. Before residency, Dr. Zenonos, a native of Greece, graduated as valedictorian from the University of Athens School of Medicine in Greece, which he attended with a scholarship from the Ministry of Education. Winning the Alexander S. Onassis Award, he then pursued a basic science post-doctoral research fellowship at Harvard Medical School to study the mechanisms of programmed cell death. "I understand that having to see a neurosurgeon, or needing a neurosurgical procedure has to be one of the most frightening experiences in someone's life," Dr. Zenonos says. "My goal is to always to provide the best care possible for each and every one of my patients, one that utilizes the latest technologies and techniques, and one that is founded by evidence-based medicine, the same care I would want for my family, my friends, or myself. Putting myself in the patient's shoes and understanding the unique difficulties they are facing is always step one."

Georgios A. Zenonos, MD

Specialized Areas of Interest
Endoscopic endonasal neurosurgery; minimally invasive neurosurgery; skull base tumors; skull base pathology; neuro-oncology; cerebrovascular neurosurgery; cranial nerve disorders; radiosurgery.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Altoona
UPMC Children's Hospital of Pittsburgh
UPMC Hamot
UPMC Mercy
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
American Association of Neurological Surgeons
AANS/CNS Tumor Section
AANS/CNS Cerebrovascular Section
Congress of Neurological Surgeons
North American Skull Base Society
Alexander S. Onassis Scholars Society
SWOG Cancer Research Network

Professional Activities
Director, Neurosurgery Preceptorship Program, University of Pittsburgh
Director, Integrated Life Sciences Neurosurgery ENT Course, University of Pittsburgh
Grant Reviewer, University of Pittsburgh
Designated Physician, Pituitary Center of Excellence

Education & Training
MD, National & Kapodistrian University of Athens School of Medicine, 2002-08
Post-Doctoral Research Fellowship, Harvard Medical School, 2009-10
Residency, Neurological Surgery, UPMC, 2011-18
Fellowship, Minimally Invasive, and Open Skull Base Neurosurgery, University of Pittsburgh, 2015-17
Fellowship, Complex Skull Base and Cerebrovascular Neurosurgery, University of Miami, 2019

Honors & Awards
Best Basic Science Abstract, NASBS meeting, 2021 (senior author)
Best Neurosurgical Fellow Teacher Award, University of Miami, 2019
First Place, North American Skull Base Society Jeopardy Knowledge Competition, 2018
p clinical abstract presentation shortlist, North American Skull Base Society Annual Meeting, 2018
The Walter L. Copeland Award for Cranial Research, 2012-13, 2015, 2017
Runner-Up Presentation Award, Stuart N. Rowe Society Lectureship, 2017
Best Presentation Award, Stuart Rowe Society Lectureship, 2016
Highest score in the nation, ABNS Primary Examination, 2016
Chordoma Foundation Travel Scholarship, 2016
Robert J. Dempsey Joint AANS/CNS Cerebrovascular Section Award, 2015
3rd Best Abstract, Stereotactic and Functional Section, American Association of Neurological Surgery Annual Scientific Meeting, 2014

Georgios A. Zenonos, MD

Alexander S. Onassis Award, 2010
Valedictorian, National and Kapodistrian University of Athens, School of Medicine, 2008
National Scholarship Foundation Award, 2003-08
Baronos Award for Excellence in Pharmacology, 2005
Ministry of Education Scholarship, 2002-08
First ranking graduate, Military Officer Academy, 2001
National Physics Olympiad Prize, 2000

Publications: 2022-23

• Refereed Articles:

Gendreau J, Jimenez A, Lozinsky S, Zenonos G, Gardner P, Raza S, Dea N, Gokaslan Z, Choby G, Van Gompel J, Redmond K, Gallia G, Bettegowda C, Rowan N, Kuo CC, Mukherjee D. Radiotherapy after gross total resection of skull base chordoma: a SEER database analysis of overall survival outcomes. *World Neurosurg* 172:e68-e76 2023.

Agrawal N, Gersey ZC, Abou-Al-Shaar H, Gardner PA, Mantica M, Agnihotri S, Mahmud H, Fazeli PK, Zenonos GA. Major genetic motifs in pituitary adenomas: a practical literature update. *World Neurosurg* 169:43-50, 2023.

Champagne PO, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. The evolution of endoscopic endonasal approach for olfactory groove meningiomas. *Oper Neurosurg* 24(2):121-130, 2023.

Khiyami AM, Jokar TO, Abdallah HM, Gardner PA, Zenonos GA, Styker AK, Fazeli PK. Polycystic ovary syndrome preceding the diagnosis of acromegaly: a retrospective study in 97 reproductive-aged women. *Reprod Biol Endocrinol* 21(1):14, 2023.

Geltzeiler M, Choby GW, Ji KSY, Mace JC, Almeida JP, de Almeida J, Champagne PO, Chan E, Ciporen JN, Chaskes MB, Cornell S, Drozdowski V, Fernandez-Miranda J, Gardner PA, Hwang PH, Kalyvas A, Kong KA, McMillan RA, Nayek JV, Patel C, Patel ZM, Peris Celda M, Pinheiro-Neto C, Sanusi OR, Snyderman CH, Thorp BD, Van Gompel JJ, Zadeh G, Zenonos G, Zwagerman NT, Wang EW. Radiographic predictors of occult intracranial involvement in olfactory neuroblastoma patients. *Int Forum Allergy Rhinol* [Online ahead of print], 2023.

McDowell MM, Jacobs RC, Valappil B, Abou-Al-Shaar H, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Dural sealants do not reduce postoperative cerebrospinal fluid leak after endoscopic endonasal skull base surgery. *J Neurol Surg B Skull Base* 83(6):589-593, 2022.

Fields DP, McDowell MM, Schulien AJ, Algattas H, Abou-Al-Shaar H, Agarwal N, Alan N, Costacou T, Wang EW, Snyderman CH, Gardner PA, Zenonos GA. Low preoperative prealbumin levels are a strong independent predictor of postoperative cerebrospinal fluid leak following endoscopic endonasal skull base surgery. *World Neurosurg* 167:e110-e116, 2022.

Bin-Alamer O, Mallela AN, Palmisciano P, Gersey ZC, Elarjani T, Labib MA, Zenonos GA, Dehdashti AR, Sheehan JP, Couldwell WT, Lunsford LD, Abou-Al-Shaar. Adjuvant stereotactic radiosurgery with or without postoperative fractionated radiation therapy in adults with skull base chordomas. A systematic review. *Neurosurg Focus* 53(5):E5, 2022.

Champagne PO, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Endoscopic endonasal anterior clinoidectomy: volumetric assessment and feasibility. *World Neurosurg* 168:e269-e277, 2022.

Patel VA, Polster SP, Abou-Al-Shaar H, Kalmar CL, Zenonos GA, Wang EW, Gardner PA, Snyderman CH. Trigeminal schwannoma: a retrospective analysis of endoscopic endonasal management, treatment outcomes, and neuropathic sequelae. *J Neurol Surg B Skull Base* [Online ahead of print], 2022.

Patel A, Abou-Al-Shaar H, Malella AN, Algattas H, McDowell MM, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Endoscopic techniques in vascular neurosurgery. *Neurosurg Clin N Am* 33(4):491-503, 2022.

Frederico SC, Darling C, Zhang X, Huq S, Agnihotri S, Gardner PA, Snyderman CH, Wang EW, Zenonos GA. Circulating tumor DNA – a potential aid in the management of chordomas. *Front Oncol* 12:1016385, 2022.

• Published Abstracts:

Choby G, Geltzeiler M, Almeida JP, Champagne PO, Cetas J, Chan E, Ciporen J, Chaskes M, Fernandez-Miranda J, Gardner P, Gentili F, Hwang P, Ji KSY, Kalyvas A, Kong K, McMillan R, O'Byrne J, Patel C, Patel Z, Peris-Celda M, Pinheiro-Neto C, Sanusi O, Snyderman C, Thorp BD, Van Gompel JJ, Zenonos G, Zwagerman N, Wang EW. Olfactory neuroblastoma: a multicenter survival analysis and application of a staging modification incorporating Hyam's grade. *J Neurol Surg B Skull Base* 84:(S 01):S076, 2023.

Ali MS, Zenonos G, Snyderman C, Wang E, Gardner P. Endoscopic endonasal posterior clinoidectomy: surgical anatomy and operative technique. *J Neurol Surg B Skull Base* 84:(S 01):S085, 2023.

Ali MS, Gupta P, Zenonos G, Snyderman C, Wang E, Gardner P. Nasal chondrosarcoma: a separate entity? *J Neurol Surg B Skull Base* 84:(S 01):P085, 2023.

Alattar AA, Abou-Al-Shaar H, Fernandes-Cabral DT, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Patterns and management of intracranial recurrence of esthesioneuroblastoma. *J Neurol Surg B Skull Base* 84:(S 01):P161, 2023.

North LN, Daniels KE, Filimonov A, Ali MS, Zenonos G, Gardner PA, Snyderman CH, Wang EW. Visual outcomes for endoscopic endonasal orbital and optic nerve decompression for optic nerve sheath meningiomas prior to radiation therapy. *J Neurol Surg B Skull Base* 84:(S 01):S187, 2023.

Geltzeiler M, Choby G, Ji KSY, Mace J, Almeida JP, Champagne PO, Cetas J, Chan E, Ciporen J, Chaskes MB, Fernandez-Miranda J, Gardner P, Gentilit F, Hwang P, Kalyvas A, Kong KA, McMillan R, Patel C, Drozdowski V, Patel Z, Peris-Celda M, Pinheiro-Neto C, Sanusi O, Snyderman C, Thorp BD, Van Gompel JJ, Zadeh G, Zenonos G, Zwagerman NT, Cornell S, Wang EW. Radiographic predictors of occult intracranial involvement in olfactory neuroblastoma patients. *J Neurol Surg B Skull Base* 84:(S 01):S195, 2023.

Melder K, Choby G, Almeida J, Champagne PO, Cetas J, Chan E, Ciporen J, Chaskes MB, Fernandez-Miranda J, Gardner P, Gentili F, Hwang P, Ji KSY, Kalyvas A, Kong KA, McMillan R, O'Byrne J, Patel C, Patel Z, Peris-Celda M, Pinheiro-Neto C, Snyderman CH, Thorp BD, Van Gompel JJ, Zenonos G, Zwagerman NT, Sanusi O, Wang EW, Geltzeiler M. Recurrence morbidity of olfactory neuroblastoma. *J Neurol Surg B Skull Base* 84:(S 01):S164, 2023.

Filimonov A, North L, Daniels K, Ali MS, Zenonos G, Gardner P, Snyderman CH, Wang EW. Sinonasal neuroendocrine carcinoma: is induction chemotherapy and definitive chemoradiation associated with worse outcomes? A case series. *J Neurol Surg B Skull Base* 84:(S 01):P200, 2023.

Abdallah HM, Gersey ZC, Gray ZN, Fogg DN, Duehr JE, Abou-Al-Shaar H, Arani K, Stefko ST, Bonhomme GR, Fazeli P, Mahmud H, Wang EW, Snyderman CH, Gardner PA, Zenonos GA. Outcomes of redo endoscopic endonasal skull base surgery for recurrent or residual nonfunctioning pituitary adenomas: an analysis of 93 consecutive patients at the University of Pittsburgh Medical Center. *J Neurol Surg B Skull Base* 84:(S 01):P181, 2023.

Muthiah N, Gersey Z, Hoppe M, Abdallah H, Wang E, Snyderman C, Zenonos G, Gardner P. The utility of inflammatory biomarkers in predicting overall survival and recurrence among primary skull base chordoma patients. *J Neurol Surg B Skull Base* 84:(S 01):S206, 2023.

Fernandes DT, Alattar A, Zenonos GA, Wang E, Snyderman CH, Gardner P. Risk factors for tumor residual and recurrence in first-time resection of craniopharyngioma through endoscopic endonasal approach. *J Neurol Surg B Skull Base* 84:(S 01):S225, 2023.

Abou-Al-Shaar H, Wrigley R, Patel A, Mallela AN, Zenonos GA, Gardner PA. Skull base meningiomas as part of a novel meningioma syndrome associated with chronic depot medroxyprogesterone acetate use. *J Neurol Surg B Skull Base* 84:(S 01):S231, 2023.

Algattas HN, Alattar AA, Wang EW, Snyderman CH, Okonkwo DO, Hamilton DK, Zenonos GA, Gardner PA. A novel classification of compressive craniocervical junction disorders. *J Neurol Surg B Skull Base* 84:(S 01):S238, 2023.

Daniels KE, Mocharnuk J, Balogun Z, Zenonos GA, Gardner PA, Wang EW, Snyderman CH. Long-term complications of extracranial pericranial flaps in skull base reconstruction. *J Neurol Surg B Skull Base* 84:(S 01):S251, 2023.

Pascal O. Zinn, MD, PhD

Assistant Professor
Director, Adult Neurosurgical Oncology
Director, Molecular Tumor Biology and Personalized Precision Therapy Lab
Director, Neurosurgical Oncology Tissue Bank

Pascal O. Zinn, MD, PhD, joined the University of Pittsburgh Department of Neurological Surgery in 2019. He is an assistant professor and director of the adult neurosurgical oncology program. Dr. Zinn has undergone subspecialty training in tumor biology and neurosurgical oncology at the Dana-Farber Harvard Cancer Institute and the MD Anderson Cancer Center in state-of-the-art, patient-tailored treatment paradigms. At UPMC Hillman Cancer Center, Dr. Zinn is the principal investigator of a molecular biology laboratory, studying approaches in personalized tumor treatments and patient care. Dr. Zinn strongly believes in the individuality of every patient and is an expert in patient-tailored treatment approaches throughout the course of diagnosis (imaging/biopsy), possible surgical tumor removal/medical management, and follow-up. Dr. Zinn likes spending time with his patients and their families walking them through this seemingly complex treatment course through discussion, counseling, and review of evidence-based medicine approaches, thus reaching the very best—and most personalized—treatment plan.

Specialized Areas of Interest
Neurosurgical oncology; brain, skull base, and spinal cord tumors; personalized precision care for brain and spinal tumor patients; stereotactic radiosurgery for brain and spine tumors, laser ablation treatment for brain tumors.

Board Certifications
American Board of Neurological Surgeons

Pascal O. Zinn, MD, PhD

Hospital Privileges
UPMC Hamot
UPMC Hillman Cancer Center
UPMC Magee-Womens Hospital
UPMC Mercy
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons
CNS/AANS Joint Tumor Section
Glioma Society
Society for Neuro-Oncology
SWOG Cancer Research Network

Professional Activities
NRG Oncology IDH Wildtype Glioma Expert Group
Executive Committee, AANS and CNS Tumor Section
Young Neurosurgeons Co-Chair, AANS and CNS Tumor Section

Education & Training
MD, University of Zurich, Switzerland, 2007
Research Fellowship, Dana-Farber Cancer Institute, Harvard Medical School, 2012
PhD, University of Lausanne, Switzerland, 2012
Research Fellowship, MD Anderson Cancer Center, University of Texas, 2015
Neurosurgery Residency, Baylor College of Medicine and MD Anderson Cancer Center, 2019

Honors & Awards
Natus Award, Congress of Neurological Surgeons, 2022
Faculty Teaching Award, University of Pittsburgh Department of Neurosurgery, 2022
Kinjiro Iwata Award, Baylor College of Medicine, 2019
Caroline Ross Endowed Fellowship, MD Anderson Cancer Center, 2018
Rosenblum-Mahaley Clinical Research Award, Congress of Neurological Surgeons, 2018
Resident Award, Congress of Neurological Surgeons, 2018
Runner-Up Oral Platform Presentation Competition, Texas Association of Neurological Surgeons Annual Meeting, 2017
National Brain Tumor Society Mahaley Award, Congress of Neurological Surgeons, 2016
Kinjiro Iwata Academic Award, Baylor College of Medicine, 2016
Journal of Neuro-Oncology Award, Congress of Neurological Surgeons, 2012, 2015
William R. Cheek Award, Texas Children's Hospital, 2015
Best Oral Platform Presentation Award, American Society of Neuroradiology, 2015
Best Scientific Poster Award, American Society of Functional Neuroradiology, 2014
Kinjiro Iwata Academic Award, Baylor College of Medicine, 2013
Best Scientific Poster Award, American Society of Functional Neuroradiology, 2013
Travel Award, European Association of Neurological Surgeons, 2013
Best Oral Platform Presentation Award, American Society of Neuroradiology, 2012
The Thomas H. and Mayme P. Scott Fellowship in Cancer Research Award, 2012
Poster Award, MD Anderson Brain Tumor Center Retreat, 2011
First Prize, Clowes Visiting Professor Research Competition, Beth Israel Deaconess Medical Center, Harvard Medical School, 2010
Cold Spring Harbor Course on Brain Tumors Scholarship, American Brain Tumor Association, 2010

Pascal O. Zinn, MD, PhD

Swiss National Science Foundation two-year fellowship, Harvard Medical School, 2009
Socrates-Erasmus Scholarship, 2004
Acceptance to Swiss Army Special Forces: Honors in Marksmanship, Combat, Commando, and Fit Test, 2000

News Media Appearances: 2022-23
"Local woman recovering from major surgery for rare spinal tumor," WPXI-TV, June 12, 2023.

David S. Zorub, MS, MD

Clinical Professor

David S. Zorub, MD, joined the faculty of the University of Pittsburgh Department of Neurological Surgery in May of 2014. Dr. Zorub was born in Lebanon and immigrated to the United States at the age of nine. He grew up in Hot Springs, Ark., where he received his primary education. Dr. Zorub received his undergraduate degree from Tulane University College of Arts and Sciences, graduating summa cum laude with a major in history. His subsequent education was at Tulane University School of Medicine where he received his medical degree cum laude and a masters of science in neuroanatomy. Post-graduate education was at Duke University Medical Center where he completed his internship and residency in neurologic surgery. While at Duke he did a special postdoctoral fellowship for the Veteran's Administration and did research at the Institute of Physiology in Pisa, Italy. Upon completion of training at Duke University Medical Center, Dr. Zorub came to the University of Pittsburgh and Presbyterian University Hospital where he served as director of residency education and director of stereotactic surgery. He subsequently relocated to Shadyside Hospital and Foundation in 1979 and has served as director of neurosurgery, and subsequently as chief of neurosurgery from December 1979 to September 2014 and director of neuro-intensive care until June 30, 2019. Dr. Zorub served as chief of surgery at Shadyside Hospital from July 1993 to August 31, 2009. Dr. Zorub also functioned as vice president of clinical affairs for Shadyside Hospital for seven years and his responsibilities included the clinical oversight of the merger agreement with UPMC Presbyterian for the Shadyside Board of Trustees as well as serving as vice president overseeing medical staff services, infection control, informatics and process improvement and quality management. He has also been active in organized medicine, having served as president of the Allegheny County Medical Society, chair of its board of trustees, and chair of the ACMS Foundation Board of Trustees. Dr. Zorub continues to be active clinically at UPMC Shadyside. He has served in numerous positions at the hospital, participating in essentially all facets of the institution. His areas of expertise include brain tumors, pituitary microsurgery, cranial nerve disorders like trigeminal neuralgia, hemifacial spasm, treatment for benign and malignant disease and spine surgery. He also specializes in peripheral nerve disorders, having trained under Barnes Woodhall, MD.

Specialized Areas of Interest
Brain tumors; pituitary microsurgery; cranial nerve disorders; hemifacial spasm; spine surgery; peripheral nerve surgery; pain management.

Board Certifications
American Board of Neurological Surgery

Hospital Privileges
UPMC Cancer Center
UPMC Presbyterian
UPMC Shadyside

David S. Zorub, MS, MD

Professional Organization Membership
American Association of Neurological Surgeons
American Association for Stereotactic Surgery
American Medical Association
Congress of Neurological Surgeons
Pennsylvania Medical Society
Pennsylvania Neurosurgical Society

Education & Training
MS, Anatomy, Tulane University, 1970
MD, Tulane University, 1970
Residency, Duke University, 1970-76
Fellowship, University of Pisa, 1974
Fellowship, Duke University, 1974

Resident Biographies

Hussein Abdallah, MD

PGY-1 Resident

Hussein Abdallah, MD, MEng, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2023 after earning his medical degree from the University of Pittsburgh School of Medicine. Prior to medical school, Dr. Abdallah received bachelor of science and master of engineering degrees in electrical science and engineering with a concentration in control theory from the Massachusetts Institute of Technology. As a graduate student at MIT, Dr. Abdallah applied the engineering principles of control theory to the mathematical design of induced pluripotent stem cell reprogramming circuits. Following his studies at MIT, Dr. Abdallah was a senior research scientist in the Quantitative Sciences division at Takeda Pharmaceuticals, where he developed models for oncological immunotherapy metabolism. As a medical student at the University of Pittsburgh, Dr. Abdallah worked on multiple projects in the Center for Cranial Base Surgery under the mentorship of Paul Gardner, MD, and Georgios Zenonos, MD. His work on a next-generation prognostication panel for skull base chordoma was recognized by the North American Skull Base Society with an award for the best basic science abstract. Dr. Abdallah continues his research work on multiple clinical databases for skull base tumors, including pituitary adenomas and chordomas. He remains interested in all clinical aspects of neurosurgery, and other research interests include the application of data science for more efficient patient care and technology development in neurosurgery. Dr. Abdallah grew up in Dearborn, Mich. Outside of neurosurgery, he enjoys the great outdoors, and his hobbies include biking, running, weight-lifting and swimming.

Specialized Areas of Interest

Skull base surgery; minimally invasive neurosurgery; database outcomes research.

Professional Organization Membership

American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training

SB, Electrical Science and Engineering, Massachusetts Institute of Technology, 2016
MEng, Electrical Science and Engineering, Massachusetts Institute of Technology, 2018
MD, University of Pittsburgh School of Medicine, 2023

Honors & Awards

Theodore Kurze Senior Prize for Excellence in Neurological Surgery & Clinical Neuroscience, University of Pittsburgh, 2023.
Best Basic Science Abstract, North American Skull Base Society Annual Meeting, 2021.
T35 Training Grant for Student Research in Hematology/Oncology, NIH, 2020.
Best Poster and Presentation, 6th Annual Synthetic Biology Symposium, 2017.

Publications: 2022-23

• Refereed Articles:

Parikh P, Abdallah HM, Patel A, Shariff RK, Nowicki KW, Mallela AN, Tonetti DA, Sekula RF Jr, Lunsford LD, Abou-Al-Shaar H. Bibliometric Analysis of the Top 100 Cited Articles on Stereotactic Radiosurgery for Trigeminal Neuralgia. *Asian J Neurosurg* 18(1):101-107, 2023.

Khiyami AM, Jokar TO, Abdallah HM, Gardner PA, Zenonos GA, Styer AK, Fazeli PK. Polycystic ovary syndrome preceding the diagnosis of acromegaly: a retrospective study in 97 reproductive-aged women. *Reprod Biol Endocrinol* 21(1):14, 2023.

Hussein Abdallah, MD

Abdallah HM, Mallela AN, Wei Z, Abou-Al-Shaar H, Niranjan A, Lunsford LD. Gamma Knife radiosurgery for meningiomas of the confluence of the falx and tentorium. *J Neurooncol* 161(2):225-233, 2023. Jaman E, Abdallah HM, Zhang X, Greene S. Clinical Characteristics of Familial and Sporadic Pediatric Cerebral Cavernous Malformations and Outcomes. *J Neurosurgery: Ped* [in press], 2023.

Findlay MC, Drexler R, Khan M, Cole KL, Karbe A, Rotermund R, Ricklefs FL, Flitsch J, Smith TR, Kilgallon JL, Honegger J, Nasi-Kordhishti I, Gardner PA, Gersey ZC, Abdallah HM, Jane JA Jr, Marino AC, Knappe UJ, Uksul N, Rzaev JA, Galushko EV, Gormolysova EV, Bervitskiy AV, Schroeder HWS, Eördögh M, Losa M, Mortini P, Gerlach R, Antunes ACM, Couldwell WT, Budohoski KP, Rennert RC, Azab M, Karsy M. A Multicenter, Propensity Score-Matched Assessment of Endoscopic Versus Microscopic Approaches in the Management of Pituitary Adenomas. *Neurosurgery* [Online ahead of print], 2023.

Abdallah HM, Fernandes Cabral DT, Gersey ZC, Abou-Al-Shaar H, O'keefe S, Mysels S, John I, Gardner PA, Solari MG, Zenonos GA. Reduction of giant parietooccipital fibrous dysplasia using dynamic mirror image guidance: a case report and review of the literature. *Br J Neurosurg* [Epub ahead of print], 2023.

Hussam Abou-Al-Shaar, MD

Chief Resident

Hussam Abou-Al-Shaar, MD, received his medical degree from Alfaisal University College of Medicine in Riyadh, Saudi Arabia where he graduated summa cum laude, valedictorian and the top of his class. During medical school, Dr. Abou-Al-Shaar spent several years in the neurogenetics lab studying the genetics and novel therapeutic treatments for Parkinson's disease patients. After graduating from medical school, Dr. Abou-Al-Shaar completed 10 months of post-doctoral research fellowship in the Department of Neurosurgery at the University of Utah and a year of neurosurgery internship at Hofstra Northwell School of Medicine in New York. Dr. Abou-Al-Shaar is an avid researcher with deep interest in skull base and cerebrovascular neurosurgery and stereotactic radiosurgery. To date, he has published over 180 peer-reviewed articles and 28 book chapters and has spoken at several national and international conferences, with over 120 oral and poster presentations. He is also the section editor on two published books, including the tumor section in *Neurosurgery Case Review: Questions and Answers*, published by Thieme Publishing in January of 2020. He edited *The Surgical Handbook*, published by Thieme Publishing in July of 2020. Dr. Abou-Al-Shaar is actively involved in teaching medical students interested in neuroscience and neurosurgery. He was selected by the Congress of Neurological Surgeons to serve as the *Neurosurgery* Publications resident fellow and was also selected as a member of the Council of State Neurosurgical Societies. His hobbies outside of neurosurgery include soccer, tennis, and traveling.

Specialized Areas of Interest

Skull base; cerebrovascular neurosurgery; stereotactic radiosurgery.

Professional Organization Membership

American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons
North American Skull Base Society
Skull Base Congress

Hussam Abou-Al-Shaar, MD

Education & Training
MD, Alfaisal University College of Medicine, 2017

Honors & Awards
Lunsford & Leksell Radiosurgery Award, AANS, 2023
Neurosurgery Publications Resident Fellow, Congress of Neurological Surgeons, 2022-23
North American Skull Base Society Research Grant, North American Skull Base Society Annual Meeting, 2022.
Top Operative Technique Poster Award, Functional Section, Congress of Neurological Surgeons 2021 Annual Meeting, 2021.
Finalist, The Virginia Kaufman Pain Research Challenge, 2021
Best Resident Teacher Award, Department of Neurosurgery, Hofstra, 2018-19.
Summa Cum Laude and Valedictorian, Alfaisal University 2017
Academic Dean's List Scholarship, Alfaisal, 2010-17
Best Poster Presentation, Alfaisal University Annual Research Day Poster Competition, 2015 & 2016
Teacher of the year, Alfaisal University, 2012

Publications: 2022-23
• Refereed Articles:
Al-Mufti F, Gandhi CD, Couldwell WT, Rybkin I, Abou-Al-Shaar H, Dodson V, Amin AG, Wainwright JV, Cohen E, Schmidt MH, Cole C, Bowers CA. Preoperative meningioma embolization reduces perioperative blood loss: a multi-center retrospective matched case-control study. *Br J Neurosurg* 37(1):67-70, 2023.

Bin-Alamer O, Alnefaie N, Qedair J, Chaudhary A, Hallak H, Abdulbaki A, Mallela AN, Palmisciano P, Gersey ZC, Legarreta AD, Labib MA, Zada G, Sheehan JP, Couldwell WT, Lunsford LD, Abou-Al-Shaar H. Single session versus multisession stereotactic radiosurgery for the management of intracranial meningiomas: a systematic review and meta-analysis. *J Neurooncol* 161(2):215-224, 2023.

Abou-Al-Shaar H, Patel KP, Mallela AN, Sekula RF Jr. Lateral supraorbital approach for resection of large and giant olfactory groove meningiomas: a single center experience. *Br J Neurosurg* 37(1):90-96, 2023.

Agrawal N, Gersey ZC, Abou-Al-Shaar H, Gardner PA, Mantica M, Agnihotri S, Mahmud H, Fazeli PK, Zenonos GA. Major Genetic Motifs in Pituitary Adenomas: A Practical Literature Update. *World Neurosurg* 169:43-50, 2023.

Abdallah HM, Mallela AN, Wei Z, Abou-Al-Shaar H, Niranjan A, Lunsford LD. Gamma Knife radiosurgery for meningiomas of the confluence of the falx and tentorium. *J Neurooncol* 161(2):225-233, 2023.

Watanabe G, Palmisciano P, Conching A, Ogasawara C, Ramanathan V, Alfawares Y, Bin-Alamer O, Haider AS, Abou-Al-Shaar H, Lall R, Aoun SG, Umana GE. Degenerative Spine Surgery in Patients with Parkinson Disease: A Systematic Review. *World Neurosurg* 169:94-109.e2,2023.

Lu VM, Koester SW, Di L, Elarjani T, Luther EM, Eichberg DG, Morell AA, Graffeo CS, Bin-Alamer O, Abou-Al-Shaar H, Komotar RJ, Ivan ME, Shah AH. Frameless Robotic-Assisted Biopsy of Pediatric Brainstem Lesions: A Systematic Review and Meta-Analysis of Efficacy and Safety. *World Neurosurg* 169:87-93.e1, 2023.

Hussam Abou-Al-Shaar, MD

Plute T, Patel A, Mallela AN, Sefcik RK, Hamilton DK, Lunsford LD, Friedlander RM, Abou-Al-Shaar H. United States Neurosurgery Department Program Directors: A Cross-Sectional Evaluation of Current and Future Trends and Attributes. *World Neurosurg* 170:e550-e557, 2023.

Abou-Al-Shaar H, Patel A, Mallela AN, Bin-Alamer O, Niranjan A, Peker S, Samanci Y, Liscak R, May J, Kumar JS, Sheehan JP, Lunsford LD. Chronic Encapsulated Expanding Hematomas After Stereotactic Radiosurgery for Intracranial Arteriovenous Malformations: An International Multicenter Case Series. *Neurosurgery* 92(1):195-204, 2023.

Abou-Al-Shaar H, Karsy M, Eli IM, Agarwal JP, Gociman B, Mahan MA. Masseter-to-facial nerve transfer for facial nerve reanimation. *Neurosurg Focus Video* 8(1):V6, 2023.

Findlay MC, Yost S, Bauer SZ, Cole KL, Henson JC, Lucke-Wold B, Mehkri Y, Abou-Al-Shaar H, Plute T, Friedman L, Richards T, Wiggins R, Karsy M. Application of Radiomics to the Differential Diagnosis of Temporal Bone Skull Base Lesions: A Pilot Study. *World Neurosurg* 172:e540-e554, 2023.

Sharma N, Mallela AN, Abou-Al-Shaar H, Aung T, Gonzalez-Martinez J. Trans-Interhemispheric Stereoelectroencephalography Depth Electrode Placement for Mesial Frontal Lobe Explorations in Medically Refractory Epilepsy: A Technical Note and Case Series. *Oper Neurosurg* (Hagerstown) 24(6):582-589, 2023.

Bin-Alamer O, Faramand A, Alarifi NA, Wei Z, Mallela AN, Lu VM, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Peker S, Samanci Y, Lee CC, Yang HC, Delabar V, Mathieu D, Tripathi M, Kearns KN, Bunevicius A, Sheehan JP, Chytka T, Liscak R, Moreno NM, Álvarez RM, Grills IS, Parzen JS, Cifarelli CP, Rehman AA, Speckter H, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Stereotactic Radiosurgery for Vestibular Schwannoma in Neurofibromatosis Type 2: An International Multicenter Case Series of Response and Malignant Transformation Risk. *Neurosurgery* 92(5):934-944, 2023.

Hernandez J, Davidson C, Reilly T, Hanbali S, Abou-Al-Shaar H, Ebrahim G, Nguyen A, Lucke-Wold B. Research on the Damage of the Central Nervous System Lymphoma to the Nervous System. *J Mod Med Oncol* 3:1, 2023.

Polster SP, Beale O, Patel VA, Abou-Al-Shaar H, Stefko ST, Gardner PA. The Transcaruncular Corridor of the Medial Transorbital Approach to the Frontal Lobe: Technical Nuances and Applications. *Oper Neurosurg* (Hagerstown) 24(6):e458-e462, 2023.

Parikh P, Abdallah HM, Patel A, Shariff RK, Nowicki KW, Mallela AN, Tonetti DA, Sekula RF Jr, Lunsford LD, Abou-Al-Shaar H. Bibliometric Analysis of the Top 100 Cited Articles on Stereotactic Radiosurgery for Trigeminal Neuralgia. *Asian J Neurosurg* 18(1):101-107, 2023.

Lu VM, Abou-Al-Shaar H, Rangwala SD, Kappel AD, Lehman LL, Orbach DB, See AP. Neurosurgical outcomes of pediatric cerebral venous sinus thrombosis following acute mastoiditis: a systematic review and meta-analysis. *J Neurosurg Pediatr* 32(1):60-68, 2023.

Lu VM, Abou-Al-Shaar H, Bin-Alamer O, Luther EM, Benjamin CG. Postoperative course of cerebrospinal fluid diversion in the setting of leptomeningeal disease: a systematic review, meta-analysis, and meta-regression with an illustrative case. *J Neurooncol* 163(1):29-37, 2023.

Sharma N, Mallela AN, Shi DD, Tang LW, Abou-Al-Shaar H, Gersey ZC, Zhang X, McBrayer SK, Abdullah KG. Isocitrate dehydrogenase mutations in gliomas: A review of current understanding and trials. *Neurooncol Adv* 5(1):vdad053, 2023.

Hussam Abou-Al-Shaar, MD

Bin-Alamer O, Qedair J, Palmisciano P, Mallela AN, Nayar GM, Lu VM, Labib MA, Lang MJ, Gross BA, Langer DJ, Couldwell WT, Friedlander RM, Abou-Al-Shaar H. Dolichoectatic vertebrobasilar aneurysms: a systematic review and meta-analysis of management strategies and outcomes. *Neurosurg Focus* 54(5):E9, 2023.

Plute T, Agarwal P, Patel A, Mallela AN, Lunsford LD, Abou-Al-Shaar H. Idiopathic De Novo Arteriovenous Malformation: A Rare Acquired Intracranial Lesion. *Asian J Neurosurg* 18(2):400-403, 2023.

Wei Z, Jose S, Abou-Al-Shaar H, Deng H, Luy D, Kondziolka D, Niranjan A, Lunsford LD. Intracerebral and pituitary metastatic eccrine carcinoma: prolonged survival using stereotactic radiosurgery. *Br J Neurosurg* [Online ahead of print], 2023.

Jumah F, Abou-Al-Shaar H, Mallela AN, Wiley CA, Lunsford LD. Gamma Knife Radiosurgery in the Management of Hypothalamic Glioma: A Case Report with Long-Term Follow-Up. *Pediatr Neurosurg* 57(2):118-126, 2022.

Small C, Lucke-Wold B, Patel C, Abou-Al-Shaar H, Moor R, Mehkri Y, Still M, Goldman M, Miller P, Robicsek S. What are we measuring? A refined look at the process of disrupted autoregulation and the limitations of cerebral perfusion pressure in preventing secondary injury after traumatic brain injury. *Clin Neurol Neurosurg* 221:107389, 2022.

Fields D, McDowell M, Schulien A, Algattas H, Abou-Al-Shaar H, Agarwal N, Alan N, Costacou T, Wang E, Snyderman C, Gardner P, Zenonos G. Low Preoperative Prealbumin Levels Are a Strong Independent Predictor of Postoperative Cerebrospinal Fluid Leak Following Endoscopic Endonasal Skull Base Surgery. *World Neurosurg* 167:e110-e116, 2022.

Mallela AN, Beiriger J, Gersey ZC, Shariff RK, Gonzalez SM, Agarwal N, González-Martínez JA, Abou-Al-Shaar H. Targeting the Future: Developing a Training Curriculum for Robotic Assisted Neurosurgery. *World Neurosur* 167:e770-e777, 2022.

Gonzalez-Martinez JA, Abou-Al-Shaar H, Mallela AN, McDowell MM, Henry L, Fernandes Cabral DT, Sweat J, Urban A, Fong J, Barot N, Castellano JF, Rajasekaran V, Bagic A, Snyderman CH, Gardner PA. The endoscopic anterior transmaxillary temporal pole approach for mesial temporal lobe epilepsies: a feasibility study. *J Neurosurg* 138(4):992-1001, 2022.

Wei Z, Yavan S, Deng H, Mallela AN, Gersey ZC, Shariff RK, Fazeli PK, Niranjan A, Lunsford LD, Abou-Al-Shaar H. The role of stereotactic radiosurgery in the multidisciplinary management of pituitary metastases. *Pituitary* 25(6):948-958, 2022.

Patel A, Abou-Al-Shaar H, Mallela AN, Algattas H, McDowell MM, Zenonos GA, Wang EW, Snyderman CH, Gardner PA. Endoscopic Techniques in Vascular Neurosurgery. *Neurosurg Clin N Am* 33(4):491-503, 2022.

Mathkour M, Chu J, Scullen T, Ibrahim N, Werner C, Carr CJ, Huang B, Abou-Al-Shaar H, Dallapiazza RF, Maulucci CM, Singh M. Atlantoaxial instability secondary to Bartonella henselae osteomyelitis managed surgically by atlantoaxial instrumentation: A case report and systematic review. *J Craniovertebr Junction Spine* 13(3):224-232, 2022.

El Ahmadieh TY, Nuñez M, Vigo V, Abou-Al-Shaar H, Fernandez-Miranda JC, Cohen-Gadol AA. Frontotemporal-Orbitozygomatic Approach and Its Variants: Technical Nuances and Video Illustration. *Oper Neurosurg* (Hagerstown) 23(6):441-448, 2022.

Hussam Abou-Al-Shaar, MD

Bin-Alamer O, Mallela AN, Palmisciano P, Gersey ZC, Elarjani T, Labib MA, Zenonos GA, Dehdashti AR, Sheehan JP, Couldwell WT, Lunsford LD, Abou-Al-Shaar H. Adjuvant stereotactic radiosurgery with or without postoperative fractionated radiation therapy in adults with skull base chordomas: a systematic review. *Neurosurg Focus* 53(5):E5, 2022.

Mallela AN, Abou-Al-Shaar H, González-Martínez J. Letter to the Editor. SEEG and subdural grids: differences that go beyond morbidity. *J Neurosurg* 138(3):885-886, 2022.

Research Activities

Dr. Abou-Al-Shaar is looking at the outcomes of patients who underwent endoscopic endonasal surgery for pituitary adenomas, chordomas, meningiomas, among other pathologies. Additionally, he is investigating the role of combined transcranial and endoscopic endonasal approaches for various skull base lesions to determine their efficacy and limitation. Dr. Abou-Al-Shaar is investigating the role of a novel imaging tool in determining visual recovery and outcomes following endoscopic endonasal surgery for skull base lesions. He is also interested in studying the effects of hormonal medications of the growth of meningiomas as well as elucidating the role of Gamma Knife radiosurgery in the management of various skull base and cerebrovascular pathologies.

Prateek Agarwal, MD

PGY-4 Resident

Prateek Agarwal, MD, MBA, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2020 after earning a dual MD/MBA degree from the Perelman School of Medicine and Wharton School at the University of Pennsylvania. At the Perelman School of Medicine, he was elected into the Alpha Omega Alpha Honor Medical Society and received the Spencer Morris Prize, the School of Medicine's highest academic honor. Prior to medical and business school, he graduated summa cum laude and Phi Beta Kappa from Harvard University in 2015 with an AB in molecular and cellular biology and secondary field in economics Dr. Agarwal's neurosurgical research focuses on optimizing clinical outcomes, with an emphasis on employing system-level interventions to improve patient outcomes while reducing costs. His investigation on using behavioral economics principles to reduce neurosurgical postoperative infections and implant costs was awarded the 2018 Neurosurgery Paper of the Year in Socioeconomics, Health Policy, and Law. He has also performed translational research on injectable hydrogels for intervertebral disc regeneration, supported by the Neurosurgery Research and Education Foundation (NREF) Medical Student Summer Fellowship. His undergraduate basic neuroscience research in olfaction resulted in publications in *Nature Neuroscience* and *Nature Communications*. Dr. Agarwal is active in organized neurosurgery. He was selected as a Council of State Neurological Societies (CSNS) Socioeconomic Fellow for 2023-24 and appointed as an early career member on the AANS Education Committee in May 2022. Previously he was elected to serve on the Young Neurosurgeons Committee (YNC) in 2021 and served as the 2018 YNC MISSION fellow. He is also passionate about entrepreneurship and co-founded the medical device startup Sanguis, which won 1st place at the 2018 Penn Wharton Entrepreneurship Startup Challenge. Dr. Agarwal was born and raised in New Jersey. Outside of neurosurgery, he enjoys aviation, water polo, swimming, tennis and spending time with his family and friends.

Specialized Areas of Interest

Endovascular neurosurgery; open cerebrovascular neurosurgery; complex spine surgery; minimally invasive spine surgery; clinical outcomes research; socioeconomics in neurosurgery; organized neurosurgery; health policy and innovation.

Prateek Agarwal, MD

Professional Organization Membership
Alpha Omega Alpha
American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons

Education & Training
AB, Molecular and Cellular Biology, Harvard University, 2015
MD, Perelman School of Medicine at the University of Pennsylvania, 2020
MBA, Health Care Management, The Wharton School at the University of Pennsylvania, 2020

Honors & Awards
CSNS Socioeconomic Fellowship, 2023-24
Spencer Morris Prize, Perelman School of Medicine, 2020
Palmer Scholar, The Wharton School, 2020
Alpha Omega Alpha, Perelman School of Medicine, 2019
Neurosurgery Paper of the Year in Socioeconomics, Health Policy, and Law, 2018
MISSION Fellowship, Young Neurosurgeons Committee, 2018
Department of Neurosurgery Research Prize, Perelman School of Medicine, 2017
NREF Medical Student Summer Fellowship, 2016
Guggenheim Family Neurosurgery Scholarship, Perelman School of Medicine, 2016
Summa Cum Laude, Harvard University, 2015
Phi Beta Kappa, Harvard University, 2015

Publications: 2022-23
• Refereed Articles:
Plute TJ, Agarwal P, Patel A, Mallela A, Lunsford LD, Abou-Al-Shaar H. Idiopathic De Novo Arteriovenous Malformation: A Rare Acquired Intracranial Lesion. *Asian Spine J* [in press], 2023.

Hudson JS, Fernandes-Cabral D, Agarwal P, Legarreta A, Schulien A, Deng H, Agarwal V, Okonkwo DO. Anterior Thoracic Discectomy and Fusion for Symptomatic Ventral Bone Spur Associated Type I Cerebrospinal Fluid Leak: A Technical Report and Operative Video. *Global Spine J* [Online ahead of print], 2023.

Gupta A, Reddy V, Barpujari A, Lavadi R, Agarwal P, Chang YF, Mooney J, Elsayed GA, Agarwal N. Current trends in subspecialty fellowship training for 1,691 academic neurological surgeons. *World Neurosurg* 71:e47-56, 2023.

Agarwal P, Beale OM, Zhang X, Sandlesh P, Jaman E, Amankulor N. Machine Learning Identification of Immunotherapy Targets in Low-Grade Glioma using RNA Sequencing Expression Data. *World Neurosurg* 163:e349-362, 2022.

Agarwal P, Abou-Al-Shaar H. Comment to: Access to Mechanical Thrombectomy for Stroke: Center Qualifications, Prehospital Management, and Geographic Disparities. *Neurosurgery* 92(1):3-9, 2022.

Ali Alattar, MD

PGY-5 Resident

Ali Alattar, MD, MAS, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2019 after graduating from University of California, San Diego School of Medicine. While at UCSD, Dr. Alattar invested in additional training in clinical and biomedical research and earned a master of advanced studies in clinical research. Dr. Alattar studied biochemistry at Portland State University and graduated summa cum laude with a bachelor of science degree. Dr. Alattar cultivated an interest in neuro-oncology outcomes, especially regarding the impact of extent of surgical resection on survival and developed a novel biomarker platform for diagnosis of glioblastoma, during medical school. In residency, Dr. Alattar has continued to develop his interest in neuro-oncology and is also building his clinical expertise in spine surgery, skull base, and open and endovascular neurosurgery. Dr. Alattar's research interests include big data, cost-effectiveness, artificial intelligence, and machine learning as well as the application of augmented reality to image-guidance and development of unique biomarkers and molecular therapeutics in the diagnosis and treatment of intracranial aneurysms. He hopes to contribute to new cancer registries, develop clinical decision support systems, and discover genetic risk factors and molecular subtypes of disease. Beginning with his PGY-5 year, Dr. Alattar will be training in open and endoscopic skull base neurosurgery with Paul Gardner, MD, and Georgios Zenonos, MD. He continues his clinical research in tumor outcomes and biomarker discovery with a special emphasis on its application to skull base pathology. Dr. Alattar was born, raised and attended college in Portland, Ore. before moving to San Diego for medical school. In his free time, he enjoys reading novels, cooking, hiking, running and weight lifting.

Specialized Areas of Interest

Neuro-oncology; skull base neurosurgery; open and endovascular neurosurgery; spine surgery and correction of deformity.

Professional Organization Membership

American Association of Neurological Surgeons
Congress of Neurological Surgeons
Society for Neuro-Oncology

Professional Activities

Reviewer, *Journal of Neurosurgery*
Reviewer, *World Neurosurgery*

Education & Training

BS, Biochemistry, Portland State University, 2014
MAS, University of California San Diego, 2019
MD, University of California San Diego, 2019

Honors & Awards

Clinical Research Fellowship, UC San Diego School of Medicine, 2017-18
National Institutes of Health Summer Research Training Grant, 2015
Summa Cum Laude, Portland State University, 2014
Award for Outstanding Performance in General Chemistry, Organic Chemistry, and Biochemistry, 2011-13
Building Our Future Scholarship Award, 2010-11

Sharath Anand, MD

PGY-3 Resident

Sharath Kumar Anand, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2021 after earning an MD degree from Wayne State University School of Medicine. At Wayne State, he was elected into the Alpha Omega Alpha Honor Medical Society and was awarded the Karl G. Pinckard Scholarship. Prior to medical school, he graduated from the University of Michigan in 2017 with a bachelor of science degree in cellular and molecular biology as well as a minor in electrical engineering and computer science. During medical school, Dr. Anand conducted clinical neurosurgical research on topics including subarachnoid hemorrhage surgery outcomes, spine surgery and epilepsy care. He has a special interest in socioeconomic disparity research and institutional factors that affect neurosurgical outcomes Dr. Anand was born in Chennai, India and raised in Ann Arbor, Mich. Outside of neurosurgery he enjoys sports as well as spending time with his family and friends.

Specialized Areas of Interest
Cerebrovascular neurosurgery; spine surgery; skull base neurosurgery; general neurosurgery.

Professional Organization Membership
Alpha Omega Alpha Honor Society
American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training
BS, Cellular & Molecular Biology, University of Michigan, 2017
MD, Wayne State University School of Medicine, 2021

Honors & Awards
Karl G. Pinckard Scholarship, Wayne State University, 2021
Alpha Omega Alpha Honor Society, Wayne State University, 2020
Best Clinical Research Award: Tumor, Congress of Neurological Surgeons, 2020
Year III Comprehensive Honors, Wayne State University, 2020
Year II Comprehensive Honors, WSU, 2019

Stephanie Casillo, MD

PGY-1 Resident

Stephanie Casillo, MD joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2023 after earning her MD degree from the University of Pittsburgh School of Medicine. As a medical student, she was president of the AANS Medical Student Chapter, led the preclinical medical student neurosurgery elective course, and was awarded the Theodore Kurze, MD Senior Prize for Excellence in Neurological Surgery and Clinical Neurosciences. Prior to medical school, she graduated magna cum laude from Rochester Institute of Technology with a degree in biomedical engineering. Dr. Casillo's clinical and academic interests include neuro-oncology, pediatric neurosurgery, surgeon-scientist education, and women in neurosurgery. As a research fellow in the Physician-Scientist Training Program (PSTP), Dr. Casillo conducted longitudinal translational research on metabolic dependences in pediatric diffuse midline glioma (DMG). Specifically, she identified a novel mechanism by which the hallmark histone mutation H3K27M impacts tumor cell glycolysis through an ERK5-PFKFB3 axis involving both a critical kinase and a metabolic effector. Small molecule inhibitors targeting this axis prolong survival in mouse models. She was awarded the Neurosurgery Research and Education Foundation (NREF) Medical Student Summer Research Fellowship (MSSRF) for this work, which

Stephanie Casillo, MD

has resulted in publications in *Molecular Oncology* and *Nature Cancer*. Dr. Casillo is an advocate for the advancement of women in neurosurgery and was the lead investigator on a project narrating the life and accomplishments of Dorothy Klenke Nash, MD, the first female neurosurgeon in the United States. Her work has resulted in publications in *Neurosurgery* and *Journal of Neurosurgery* and the establishment of the Dorothy Klenke Nash Lectureship to be awarded annually by the University of Pittsburgh Department of Neurosurgery. Dr. Casillo has also sought clinical research opportunities in traumatic brain injury, vascular neurosurgery, spine surgery, and neurosurgical education. Dr. Casillo was born and raised in Buffalo, N.Y. Outside of work, she enjoys cooking, live music, and spending time with her family, friends, and partner Patrick.

Specialized Areas of Interest
Neuro-oncology; pediatric neurosurgery; surgeon-scientist education; women in neurosurgery.

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons
Society of Neuro-Oncology

Education & Training
MD, Physician-Scientist Training Program, University of Pittsburgh School of Medicine, 2023
BS, Biomedical Engineering, Rochester Institute of Technology, 2018

Honors & Awards
Theodore Kurze Senior Prize for Excellence in Neurological Surgery & Clinical Neuroscience, University of Pittsburgh, 2023.
Sell Family Physician Scientist Award, Physician-Scientist Training Program, University of Pittsburgh School of Medicine, 2023
Medical Student Summer Research Fellowship (MSSRF), Neurosurgery Research and Education Foundation, 2021
Physician-Scientist Training Program Scholarship, Physician-Scientist Training Program, University of Pittsburgh School of Medicine, 2018
Honors Program Research Grant, Rochester Institute of Technology, 2013
Presidential Scholarship, Rochester Institute of Technology, 2013

Publications: 2022-23
• Refereed Articles:
Jane EP, Reslink MC, Gatesman TA, Halbert ME, Miller TA, Golbourn BJ, Casillo SM, Mullett SJ, Wendell SG, Obodo U, Mohanakrishnan D, Dange R, Michealraj A, Brenner C, Agnihotri S, Premkumar DR, Pollack IF. Targeting mitochondrial energetics reverses panobinostat- and marizomib-induced resistance in pediatric and adult high-grade gliomas. *Mol Oncol* [Online ahead of print], 2023.

Golbourn BJ, Halbert ME, Halligan K, Varadharajan S, Krug B, Mbah NE, Kabir N, Stanton AJ, Locke AL, Casillo SM, Zhao Y, Sanders LM, Cheney A, Mullett SJ, Chen A, Wassell M, Andren A, Perez J, Jane EP, Premkumar DRD, Koncar RF, Mirhadi S, McCarl LH, Chang YF, Wu YL, Gatesman TA, Cruz AF, Zapotocky M, Hu B, Kohanbash G, Wang X, Vartanian A, Moran MF, Lieberman F, Amankulor NM, Wendell SG, Vaske OM, Panigrahy A, Felker J, Bertrand KC, Kleinman CL, Rich JN, Friedlander RM, Broniscer A, Lyssiotis C, Jabado N, Pollack IF, Mack SC, Agnihotri S. Loss of MAT2A compromises methionine metabolism and represents a vulnerability in H3K27M mutant glioma by modulating the epigenome. *Nat Cancer* 3(5):629-648, 2022.

Hansen Deng, MD

PGY-5 Resident

Hansen Deng, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2019. Dr. Deng graduated with distinction from the University of California San Francisco School of Medicine, where he was elected into the Alpha Omega Alpha Honor Medical Society. He completed his undergraduate degrees in oil-painting and biology at the University of California Berkeley, where he was elected into the Phi Beta Kappa Society. Traumatic brain injury (TBI) is a complex disorder with many diagnostic challenges. Dr. Deng's research in TRACK-TBI investigates the discriminatory ability of biomarkers to provide precise assessment of injury severity and assist with prognostication after injury. At the Brain Trauma Research Center, he investigates the role that genetic factors can play in the secondary pathophysiology of neurotrauma. Along with optimizing operative management of TBI and spinal cord injury (SCI) patients, his goal is to advance evidence-based clinical practices in the neurocritical intensive care unit. Dr. Deng serves as a mentor for undergraduate and graduate students with interests in medicine and neurosurgery. He enjoys painting, playing basketball, and cooking.

Specialized Areas of Interest

Cerebrovascular; spinal deformity; neurotrauma.

Professional Organization Membership

Alpha Omega Alpha
American Association of Neurological Surgeons
Congress of Neurological Surgeons
National Neurotrauma Society
North American Brain Injury Society
Pennsylvania Neurosurgery Society
Phi Beta Kappa

Education & Training

BA, Biology and Art (Oil-Painting), University of California Berkeley, 2014
MD (with Distinction in Clinical and Translational Research), University of California San Francisco, 2019

Honors & Awards

Neurotrauma and Critical Care Paper of the Year, Congress of Neurological Surgeons, 2023
Tumor Paper of the Year, Congress of Neurological Surgeons, 2021
Best Clinical Research Award, Neurotrauma and Critical Care, Congress of Neurological Surgeons, 2020
ThinkFirst Injury Prevention Award, American Association of Neurological Surgeons, 2020
Best Clinical Research Abstract, Pediatric Section, Congress of Neurological Surgeons, 2019
Ronald R. Tasker Young Investigator Award, Congress of Neurological Surgeons, 2019
Steinhart Scholarship Award, UCSF School of Medicine, 2019
Distinction in Clinical and Translational Research, University of California, San Francisco, 2019
Storytelling Prize, UCSF Synapse Student Voices, 2019
Journal of Neuro-Oncology Award, American Association of Neurological Surgeons, 2017
AANS/CNS Section on Trauma and Critical Care Abstract Finalist, 2017
Dean's Prize in Research and Scholarship Finalist, UCSF School of Medicine, 2016, 2019
University Grant in Medicine, UCSF School of Medicine, 2015-2019
Sussman Prize in Painting and Exhibition, University of California Berkeley, 2014
Phelan Art Scholarship, University of California Berkeley, 2013
Dean's Honors, University of California Berkeley, 2012-2014

Hansen Deng, MD

News Media Appearances: 2022-23

"Local woman recovering from major surgery for rare spinal tumor," WPXI-TV, June 12, 2023.

Publications: 2022-23

• Refereed Articles:

Puccio DJ, Deng H, Eagle SR, Okonkwo DO, Nwachuku EL. Pilot Biomarker Analysis and Decision Tree Algorithm Modeling of Patients with Chronic Subdural Hematomas. *Neurotrauma Rep* 4(1):184-196, 2023.

Yue JK, Kobeissy FH, Jain S, Sun X, Phelps RRL, Korley FFK, Gardner RC, Ferguson AR, Huie JR, Schneider ALC, Yang Z, Xu H, Lynch CE, Deng H, Rabinowitz M, Vassar MJ, Taylor SR, Mukherjee P, Yuh EL, Markowitz AJ, Puccio AM, Okonkwo DO, Diaz-Arrastia R, Manley GT; Wang KKW; TRACK-TBI Investigators. Neuroinflammatory Biomarkers for Traumatic Brain Injury Diagnosis and Prognosis: A TRACK-TBI Pilot Study. *Neurotrauma Rep* 4(1):171-183, 2023.

Deng H, Habib A, Andrews EG, Zhang X, McCarthy DJ, Wei Z, Dhupar R, Choudry MH, Zinn PO. Combined exploratory laparotomy, transpsoas, and thoracic approach to resection of a giant spinal ganglioneuroma: illustrative case. *J Neurosurg Case Lessons* 5(2):CASE22453, 2023.

Enam N, Deng H, Race NS, Majid DS, Okonkwo DO, Franzese KM. Continuum of care and longitudinal recovery in a 17-year-old athlete with second impact syndrome. *Brain Inj* 37(4):303-307, 2023.

Wei Z, Pease M, Tang LW, Deng H, Shanahan R, Faramand A, Niranjan A, Lunsford LD. Radiosurgery outcomes in infratentorial juvenile pilocytic astrocytomas. *J Neurooncol* 162(1): 157-165, 2023.

Tang LW, Mallela AN, Deng H, Richardson TE, Hervey-Jumper SL, McBrayer SK, Abdullah KG. Preclinical modeling of lower-grade gliomas. *Front Oncol* 13:1139383, 2023.

Yue JK, Deng H. Traumatic Brain Injury: Contemporary Challenges and the Path to Progress. *J Clin Med* 12(9):3283, 2023.

Yue JK, Krishnan N, Andrews JP, Semonche AM, Deng H, Aabedi AA, Wang AS, Caldwell DJ, Park C, Hirschhorn M, Ghoussaini KT, Oh T, Sun PP. Update on Pediatric Mild Traumatic Brain Injury in Rural and Underserved Regions: A Global Perspective. *J Clin Med* 12(9):3309, 2023.

Mallela AN, Deng H, Gholipour A, Warfield SK, Goldschmidt E. Heterogeneous growth of the insula shapes the human brain. *Natl Acad Sci U S A* 120(24):e2220200120, 2023.

Wei Z, Taori S, Song S, Deng H, Niranjan A, Lunsford LD. Does Adjuvant Gamma Knife Stereotactic Radiosurgery Have a Role in Treating Optic Nerve Sheath Meningiomas? *J Neuroophthalmol* [Online ahead of print], 2023.

Donohue JK, Wei Z, Deng H, Niranjan A, Lunsford LD. Management of sarcomatoid malignant pleural mesothelioma brain metastases with stereotactic radiosurgery: an illustrative case. *Br J Neurosurg* [Online ahead of print], 2023.

Alan N, Deng H, Muthiah N, Vodovotz L, Dembinski R, Guha D, Agarwal N, Ozpinar A, Hamilton DK, Kanter AS, Okonkwo DO. Graft subsidence and reoperation after lateral lumbar interbody fusion: a propensity score-matched and cost analysis of polyetheretherketone versus 3D-printed porous titanium interbodies. *J Neurosurg Spine* [Online ahead of print], 2023.

Hansen Deng, MD

Hudson JS, Fernandes-Cabral D, Agarwal P, Legarreta A, Schulien A, Deng H, Agarwal V, Okonkwo DO. Anterior Thoracic Discectomy and Fusion for Symptomatic Ventral Bone Spur Associated Type I Cerebrospinal Fluid Leak: A Technical Report and Operative Video. *Global Spine J* [Online ahead of print], 2023.

Wei Z, Jose S, Abou-Al-Shaar H, Deng H, Luy DD, Kondziolka D, Niranjan A, Lunsford LD. Intracerebral and pituitary metastatic eccrine carcinoma: prolonged survival using stereotactic radiosurgery. *Br J Neurosurg* [Online ahead of print], 2023.

Agarwal N, Wilkins TE, Nwachuku EL, Deng H, Algattas H, Lavadi RS, Chang YF, Puccio A, Okonkwo DO. Long-term Benefits for Younger Patients with Aggressive Immediate Intervention following Severe Traumatic Brain Injury: A Longitudinal Cohort Analysis of 175 Patients from a Prospective Registry. *Clin Neurol Neurosurg* 224:107545, 2022.

Andrew Faramand, MD

PGY-3 Resident

Andrew Faramand, MD, MSc, received his medical degree from Jordan University of Science and Technology in Irbid, Jordan. After graduating from medical school, Dr. Faramand pursued his master's degree with distinction in clinical neuroscience at University College London-Queen Square Institute of Neurology. His research at Great Ormond St. Hospital focused on the outcomes of epilepsy surgery in children. Dr. Faramand is a dedicated researcher in the field of Gamma Knife stereotactic radiosurgery. He completed three years of post-doctoral research fellowship at the UPMC Center of Image-Guided Neurosurgery at the University of Pittsburgh Department of Neurological Surgery under the mentorship of L. Dade Lunsford, MD. He specifically worked on clinical studies regarding stereotactic radiosurgery for brain tumors, arteriovenous malformations, and trigeminal neuralgia. He has published more than 50 peer-reviewed articles and book chapters and collaborated with world-renowned neurosurgeons and radiation oncologists through the International Radiosurgery Research Foundation. Dr. Faramand has presented his work at several national and international conferences. He enjoys playing soccer, swimming, and spending time with family and friends.

Specialized Areas of Interest
Neuro-oncology; stereotactic radiosurgery; cerebrovascular neurosurgery; skull-base neurosurgery.

Professional Organization Membership
American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons

Education & Training
MD, Jordan University of Science and Technology
MSc, Clinical Neuroscience, University College London-Queen Square Institute of Neurology
Fellowship, University of Pittsburgh

Honors & Awards
JANE Oral Presentation Award, AANS/CNS Spine Summit, 2019
High Distinction Graduate, University College London, 2015
Dean's Honors List, Jordan University of Science and Technology, 2004-2007

David T. Fernandes Cabral, MD

PGY-7 Resident

David T. Fernandes Cabral, MD, received his medical degree from the José María Vargas School of Medicine at the Universidad Central de Venezuela in Caracas, Venezuela where he graduated at the top of his class. While in medical school, Dr. Fernandes was a teacher assistant in the Department of Anatomy and Neuroanatomy, as well as a research assistant at the Department of Pharmacology. After graduating from medical school, David completed two years of mandatory service in a rural community in Venezuela where he served in a leadership role at the health center and was actively involved in teaching medical students during their rural rotations. In 2015, Dr. Fernandes joined the Fiber Tractography Lab at the University of Pittsburgh as a post-doctoral associate research fellow. Dr. Fernandes has been invited to lecture in white matter connectivity of the human brain at the University of Pittsburgh Department of Psychology, and is currently in charge of teaching the practical sessions in the surgical neuroanatomy course for fourth year medical students at the university. During his free time, David enjoys cooking, travelling, biking, watching movies and spending time with his family and friends.

Specialized Areas of Interest

Skull base surgery; cerebrovascular surgery; surgical neuro-oncology; diffusion-MRI fiber tractography; microsurgical anatomy; neurotrauma; teaching.

Professional Organization Membership

American Association of Neurological Surgeons
American Medical Association
AO Spine
Congress of Neurological Surgeons
North America Skull Base Society
Venezuelan Medical Association

Education & Training

MD, Universidad Central de Venezuela

Honors & Awards

Best Poster Presentation, Venezuelan Neurosurgery Society, 2012
Research Assistant of the Year, Universidad Central de Venezuela, 2011
Teacher Assistant of the Year, Department of Anatomy and Neuroanatomy, Universidad Central de Venezuela, 2010

Publications: 2022-23

• Refereed Articles:

Samanci Y, Askeroglu MO, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Legarreta A, Fernandes Cabral D, Anand S, Niranjan A, Lunsford LD, Tripathi M, Kumar N, Liscak R, May J, Lee CC, Yang HC, Martinez Moreno N, Martinez Alvarez R, Douri K, Mathieu D, Pikis S, Mantziaris G, Sheehan JP, Bernstein K, Kondkiolka D, Peker S. Stereotactic Radiosurgery for Meningiomas in Children and Adolescents: An International Multi-Institutional Study. *Neurosurgery* [Online ahead of print], 2023.

Borghei-Razavi H, Eguiluz-Melendez AG, Wenping X, Truong HQ, Fernandes-Cabral D, Najera E, Stefko ST, Fernandez-Miranda JC, Gardner PA. Surgical limitations of the microscopic transciliary supraorbital keyhole approach to the anterior and middle skull base. *World Neurosurg* 167:e1440-e1447 2022.

David T. Fernandes Cabral, MD

Gonzalez-Martinez J, Abou-Al-Shaar H, Mallela A, McDowell M, Henry L, Fernandes Cabral D, Sweat J, Urban A, Fong-Isariyawongse J, Barot N, Castellano J, Rajasekaran V, Bagic A, Snyderman CH, Gardner P. The endoscopic trans-maxillary temporal pole approach for mesial temporal lobe epilepsies: a feasibility study. *J Neurosurg* 138(4):992-1001, 2022.

Ricardo J. Fernández-de Thomas, MD

Chief Resident

Ricardo J. Fernández-de Thomas, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2021. Having graduated magna cum laude from the University of Puerto Rico Río Piedras Campus with a bachelor's degree in cellular and molecular biology, he completed his medical education at the University of Puerto Rico School of Medicine, where he also obtained his degree magna cum laude distinction. Dr. Fernández-de Thomas became interested in neurosurgery early in his education, meeting and identifying key mentors since his early college years. He was recognized as a student leader and researcher at the University of Puerto Rico, Río Piedras Campus, and the School of Medicine. He obtained various basic science and clinical research awards and became an active member of different student organizations. After completing medical school in Puerto Rico, Dr. Fernández-de Thomas completed four years of neurosurgery residency at the University of Puerto Rico School of Medicine. Dr. Fernández-de Thomas is also involved in community outreach and service projects, having spent time volunteering in different health clinics in Puerto Rico and Central America. His dedication to academics, community and education led to his election into the Alpha Omega Alpha Medical Honor Society and the Arnold P. Gold Humanism Honor Society. During the PGY-5 year, he completed the UPMC Senior Resident and Fellow Leadership Academy yearly course. Dr. Fernández-de Thomas was born and raised in San Juan, Puerto Rico. Outside of medicine, Ricardo enjoys spending time with family and friends, playing baseball, softball, practicing martial arts, tennis, volleyball, weight lifting, and outdoor activities.

Specialized Areas of Interest

Complex spine; minimally invasive spine surgery; deformity; spine oncology/spine tumors; neurotrauma; education in neurosurgery.

Professional Organization Membership

Alpha Omega Alpha
American Association of Neurological Surgeons
Arnold P. Gold Humanism Honor Society
Congress of Neurological Surgeons
Lumbar Spine Research Society North American Spine Society
Pennsylvania Medical Society
Pittsburgh Neurosurgical Society
Society for Minimally Invasive Spine Surgery

Education & Training

BS, Cellular and Molecular Biology University of Puerto Rico, Río Piedras Campus, 2013
MD, University of Puerto Rico, Medical Science Campus, School of Medicine, 2017
Residency, University of Puerto Rico, Medical Science Campus, School of Medicine, 2021

Honors & Awards

Pitt-UPMC Senior Resident and Fellow Leadership Academy, July 2022-June 2023
Society for Minimally Invasive Spine Surgery (SMISS) Young Surgeon Grant & Educational Track Award, September-October 2021
Alpha Omega Alpha Chapter Member, University of Puerto Rico, 2021

Ricardo J. Fernández-de Thomas, MD

Dr. Ramón Ruiz Arnau, Clinical Research Award, 2017
María T. Sáez Endowment Fund Medical Student Scholarship Award, 2017
University of Puerto Rico Alumni and Friends Abroad Scholarship Award, 2016
National Institutes of Health Research Initiative for Scientific Enhancement Program Fellow, 2011-13
Outstanding Image of the Month Confocal Microscopy Award, University of Puerto Rico, 2012
Dean's List Award, University of Puerto Rico, 2009-13

Publications: 2022-23

• Refereed Articles:

De Jesus O, Sandoval-Consuegra JI, De Jesús-Espinosa A, Fernández-de Thomas RJ, Carballo-Cuello CM. Neurosurgery Morbidity and Mortality: A Prospective Surgical and Medical Analysis. *P R Health Sci J* 42(1):29-34, 2023.

Carballo-Cuello CM, De Jesus O, Fernández-de Thomas RJ, De Jesús-Espinosa A, Vigo-Prieto JA. Spine Trauma Secondary to Diving Accidents: A Seven-year Retrospective Study in Puerto Rico. *P R Health Sci J* 41(4):222-225, 2022.

Ruiz-Rodríguez JF, Fernández-de Thomas RJ, De Jesus O. Secondary Acrocyanosis in a Paraplegic Patient With Spinal Cord Injury. *Cureus* 14(9):e29420, 2022.

De Jesus O, Carballo Cuello CM, Fernández-de Thomas RJ, Pastrana EA. Gamma Knife radiosurgery for a recurrent craniocervical junction solitary fibrous tumour. *BMJ Case Rep* 16;15(9), 2022.

Mittal AM, Nowicki KW, Fernández-de Thomas RJ, Mayor J, McEnaney RM, Gerszten PC. Intraoperative ultrasound evidence of accidental simultaneous cannulation of the common carotid artery and internal jugular vein: illustrative case. *J Neurosurg Case Lessons* 4(10), 2022.

Carballo-Cuello CM, De Jesus O, de Jesús Espinosa A, Fernández-de Thomas RJ, Murray G, Pastrana EA. Prognosis and Outcome of Cervical Primary Extraosseous Intradural Extramedullary Ewing Sarcoma: A Systematic Review. *Cureus* 14(7):e26665, 2022.

Daryl P. Fields II, MD, PhD

PGY-6 Resident

Daryl Pinion Fields II, MD, PhD, joined the University of Pittsburgh Department of Neurological Surgery in July of 2018. He completed his undergraduate degree at Saint John's University (Collegeville, Minn.), and his medical degree as well as research doctorate at the University of Wisconsin, Madison. Prior to medical school Dr. Fields held several leadership positions as a firefighter captain and medic. In addition, he spent several years as a neural rehab personal trainer managing clients with debilitating neuromuscular disorders; including stroke, brain trauma, multiple sclerosis and spinal cord injuries. These experiences have inspired both his research and clinical interest in spinal neurorestorative therapies. Dr. Fields has been recognized with several nationally competitive awards and fellowships from the National Institute of Health and National Science Foundation in addition to funding from private organizations such as the National Football League, Pittsburgh Steelers, Merck Pharmaceuticals and Live Like Lou Foundation. Dr. Fields is currently a senior neurological surgery resident with a dual appointment as a post-doctorate research fellow at the University of Pittsburgh. As the principal investigator of the Fields research group he leads several funded studies: 1) spinal cord stimulation for motor restoration in amyotrophic lateral sclerosis; 2) development of novel biomarkers for spinal cord injuries, and 3) development of clinical prognostic tools related to tumor, trauma and degenerative disorders.

Daryl P. Fields II, MD, PhD

Dr. Fields also maintains a collaborative relationship with other researchers within and beyond the University of Pittsburgh neurological surgery community. In his free time, Dr. Fields enjoys working out, running in the rain, and catching up with friends.

Specialized Areas of Interest
Spine; trauma; rehabilitation.

Professional Organization Membership
American Association of Neurological Surgeons
American Academy of Neurology
American Physiology Society
Congress of Neurological Surgeons
National Neurotrauma Society
Phi Delta Theta Fraternity
Society for Neuroscience

Education & Training
BA, Biochemistry, Saint John's University (Collegeville, Minn.), 2010
MD, University of Wisconsin, Madison, 2017
PhD, Molecular Neuroscience, University of Wisconsin, Madison, 2018

Honors & Awards
Travel Award, Wings for Life Foundation, 2023
Best Clinical Science Poster Award, Richard Simmons Research Day, University of Pittsburgh, 2023
Post-Doc Fellowship, Live Like Lou Foundation, 2022
UPMC Leadership Academy, Inaugural Class, 2022
Visiting Scholar, University of Florida, 2022
Copeland Research Awards, 2019, 2021, 2022
Charlie Kuntz Spine Scholar Award, 2021
Chuck Noll Foundation Research Award, 2021
Physician Champion for Nurses, UPMC Presbyterian, 2020
Physician Champion for Nurses, UPMC Children's Hospital of Pittsburgh, 2020
Walter Copeland Spine Research Award, 2019
Runner-up Presentation Award, Stuart Rowe Society Lectureship Day, 2018
NIH MD/PhD F30 Fellowship, 2015-18
Top Ambulatory Medicine Project, University of Wisconsin, 2017
UNCF/Merck Graduate Fellowship, 2015-17
Bennett Hiner Top Neuroscience Medical Student Award, 2016
Top Neuroscience Presentation Award, University of Wisconsin, 2016
Top Biomedical Science Presentation Award, University of Wisconsin, 2016
Caroline Tum Suden Abstract Award, 2016
Society for Neuroscience Abstract Award, 2015
Daryl and Sharon Buss Abstract Award, University of Wisconsin, 2015
Neuromuscular Graduate Fellowship, University of Florida, 2015
Science/Medicine Graduate Fellowship, University of Wisconsin, 2014

Publications: 2022-23
• ***Refereed Articles:***
Powell MP, Verma N, Sorensen E, Carranza E, Boos A, Fields D, Souvik R, Ensel S, Barra B, Balzer J, Goldsmith J, Friedlander RM, Wittenberg G, Fisher LE, Krakauer JW, Gerszten PC, Pirondini E, Weber DJ, Capogrosso M. Epidural stimulation of the cervical spinal cord improves voluntary motor control in post-stroke upper limb paresis. *Nat Med* 29(3):689-699 2023.

Daryl P. Fields II, MD, PhD

Fields DP, McDowell MM, Schulien AJ, Algattas H, Abou-Al-Shaar H, Agarwal N, Alan N, Costacou T, Wang EW, Snyderman CH, Gardner PA, Zenonos GA. Low preoperative prealbumin levels are a strong independent predictor of postoperative cerebrospinal fluid leak following endoscopic endonasal skull base surgery. *World Neurosurg* 167:e110-e116, 2022

Joseph Garcia, MD

PGY-2 Resident

Joseph H. Garcia, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2022 after graduating from the University of California, San Francisco School of Medicine, earning his MD with distinction in molecular medicine. He received his undergraduate degree from the University of California, Davis. Prior to residency, Dr. Garcia performed basic science research focused on understanding the role of cellular metabolism in neurodegeneration and in brain tumor biology. He also conducted clinical neurosurgical research on topics ranging from cerebrovascular disease to surgical treatments for epilepsy. Dr. Garcia was born and raised in San Francisco, Calif. Outside of neurosurgery, he enjoys sports, getting outside, and spending time with his family and friends.

Specialized Areas of Interest
Cerebrovascular neurosurgery; epilepsy surgery; neuro-oncology; skull base neurosurgery.

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training
BS, Plant Biology, University of California Davis, 2014
MD, University of California San Francisco, 2022

Honors & Awards
Best Basic Scientific Paper Abstract Award, AANS Cerebrovascular Section, 2023
MD with Distinction in Molecular Medicine, UCSF, 2022
Steinhart Award for students matching into surgical subspecialties, UCSF, 2022
Dean's Prize for Long-Term Research, UCSF, 2021
Research Diversity Supplement, NIH-National Cancer Institute (NCI), 2020
Dean's Prize for Short-Term Research, UCSF, 2018

Publications: 2022-23
• Refereed Articles:
Lu AY, Winkler EA, Garcia JH, Raygor KP, Fullerton HJ, Fox CK, Kim H, Auguste KI, Sun PP, Hetts SW, Lawton MT, Abla AA, Gupta N. A comparison of incidental and symptomatic unruptured brain arteriovenous malformations in children. *J Neurosurg Pediatr* 31(5):463-468, 2023.

Scherschinski L, Srinivasan VM, Karahalios K, Garcia JH, Koester SW, Jubran JH, Benner D, Winkler EA, Catapano JS, Labib MA, Graffeo CS, Lawton MT. You Take the Low Road: Differential Outcomes After Tangential and Transcortical Approaches to Medial Temporal Brain Arteriovenous Malformations. *World Neurosurg* 173:e81-e90, 2023.

Burke JF, Garcia JH, Safaee MM, Wong C, Gill SA, Chou D, Mummaneni PV, Deviren V, Ames CP, Clark AJ. Patient Frailty Influences Outcome After Open, But Not Minimally Invasive, Transforaminal Interbody Fusion: A Case Series of 115 Patients With Lumbar Degenerative Disease. *Oper Neurosurg* (Hagerstown) 24(6):565-571, 2023.

Joseph Garcia, MD

Hartke JN, Srinivasan VM, Rahmani R, Catapano JS, Labib MA, Rumalla K, Garcia JH, McDougall CM, Abla AA, Lawton MT. Sphenoparietal Sinus Dural Arteriovenous Fistulas: A Series of 10 Patients. *Oper Neurosurg* (Hagerstown) 23(2):139-147, 2022.

Choy W, Garcia J, Safaee MM, Rubio RR, Loftus PA, Clark AJ. Superior Laryngeal Nerve Palsy After Anterior Cervical Diskectomy and Fusion: A Case Report and Cadaveric Description. *Oper Neurosurg* (Hagerstown). 23(2):e152-e155, 2022.

Garcia J, WinklerE, Müller K, Kao E, Narsinh K, Ko N, Cornett P, Abla AA, Shieh JT, Cooke DL. Endovascular Biopsy for Detection of Somatic Mosaicism in Human Fusiform Cerebral Aneurysms. *Stroke Vasc Interv Neurol* 2(5): e000354, 2022.

Raygor KP, Garcia J, Rutledge C, Tonetti DA, Raper DMS, Abla AA. The Lateral Supraorbital Craniotomy Approach for Anterior Circulation Aneurysms: A Modern Surgical Case Series in the Endovascular Era. *World Neurosurg* 166:e799-e807 2022.

Reihl SJ, Garcia JH, Morshed RA, Sankaran S, DiGiorgio A, Chou D, Theodosopoulos PV, Aghi MK, Berger MS, Chang EF, Mummaneni PV. Impact of the COVID-19 Pandemic on Neurosurgical Transfers: A Single Tertiary Center Study. *World Neurosurg* 166:e915-e923, 2022.

Zachary C. Gersey, MD

PGY-7 Resident

Zachary C. Gersey, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2017. Having graduated cum laude from University of Florida with a degree in biology, he completed his medical education at the University of Miami Miller School of Medicine. Dr. Gersey's research is focused on the molecular targeting of glioblastoma stem cells—a subset of cells theorized to be the cause of tumor recurrence and treatment resistance. His research has led to several awards and distinctions. Dr. Gersey is also involved in community outreach and service, having spent time volunteering in health clinics across south Florida and also abroad in Central America. His dedication to academics, community, and education led to his election into the Alpha Omega Alpha Medical Honor Society. Dr. Gersey was born in Rochester, N.Y., but moved to Merritt Island, Fla., while in high school. Outside of medicine, Zach enjoys spending time with family and friends, playing soccer and baseball, playing the guitar and weight lifting.

Specialized Areas of Interest
Neurosurgical oncology; skull base neurosurgery.

Education & Training
BA, Biology, University of Florida, 2011
MA, University of Miami, 2016
MD, University of Miami, 2017

Honors & Awards
Neil Peart Neurosurgery Research Award, Glioblastoma Foundation, 2020
Clinical and Translational Investigation Scholarship, University of Miami, 2016
Alpha Omega Alpha, University of Miami, 2016
Best Poster Award, Florida Center for Brain Tumor Research, Brain Tumor Summit, 2016

Jeffery Head, MD

PGY-4 Resident

Jeffery Head, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2020. He graduated from Colgate University in 2012 with honors in cellular neuroscience and earned his medical degree from Sidney Kimmel Medical College at Thomas Jefferson University in 2020, where he graduated cum laude and was elected into the Alpha Omega Alpha Honor Society. Prior to medical school, Dr. Head spent two years as a post-baccalaureate research fellow at the National Institutes of Health studying developmental neurobiology in zebra fish. His work focused on understanding the molecular signaling pathways that regulate collective cell migration in the peripheral nervous system during embryogenesis and creating digital reconstructions of the relationships between these cells during their migration. During his medical school career, Dr. Head was involved in research on spinal cord stimulation waveforms in treating chronic low-back pain, surgical approaches to the spine in treating ossification of the posterior longitudinal ligament, mechanical thrombectomy in distal circulation strokes, and the risk-factors for infection in external ventricular drains. Dr. Head was born and raised in Fairfield, Conn. Outside of neurosurgery Dr. Head is an avid skier and enjoys cooking, hiking, running, softball, soccer, and spending time with his friends and family. Dr. Head enjoys finding new restaurants to enjoy around Pittsburgh and recently purchased a home in Lawrenceville with his fiancé, who is a resident at UPMC in the Department of Otolaryngology.

Specialized Areas of Interest
General neurosurgery; spine surgery; neuro-oncology.

Professional Organization Membership
Alpha Omega Alpha Honor Society
American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training
BA, Cellular Neuroscience, Colgate University, 2012
MD, Sidney Kimmel Medical College at Thomas Jefferson University, 2020

Honors & Awards
Cum Laude, Sidney Kimmel Medical College (SKMC), Thomas Jefferson University 2020
Alpha Omega Alpha Honor Society, SKMC 2019
Top Performer, AANS Top Gun Neurosurgical Skills Competition, AANS Meeting 2019
Dr. George McClellan Surgical Honor Society, SKMC 2018
Hobart Amory Hare Medical Honor Society, SKMC 2018
Best Poster Award, Sigma-Xi Student Research Day, SKMC 2018
Best Poster Award, Post-Baccalaureate Poster Day, NIH 2014
Honors, Neuroscience Concentration, Colgate University 2012

Publications: 2022-23
• Refereed Articles:
Jovanovich N, Habib A, Head J, Anthony A, Edwards L, Zinn PO. Opinion: Bridging gaps and doubts in glioblastoma cell-of-origin. *Front Oncol* 12:1002933, 2022.

Jovanovich N, Habib A, Head J, Hameed F, Agnihotri S, Zinn PO. Pediatric diffuse midline glioma: Understanding the mechanisms and assessing the next generation of personalized therapeutics. *Neurooncol Adv* 5(1):vdad040 2023.

Jeffery Head, MD

Head JR, Bin-Alamer O, Wei Z, Waite K, Agrawal N, Mallela AN, Faramand A, Gersey ZC, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Vestibular Schwannoma Stereotactic Radiosurgery in Octogenarians: Case Series. Neurosurgery [Online ahead of print], 2023.

Joseph Scott Hudson, MD

PGY-5 Resident

Joseph Scott Hudson, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2019 after graduating with research distinction from the University of Iowa Carver College of Medicine. He also received his undergraduate degree from the University of Iowa with honors in biology, a minor in chemistry, and high distinction. During his undergraduate education, he became heavily involved in the Department of Neurosurgery at the University of Iowa Hospitals and Clinics. His work under the mentorship of David Hasan, MD, in cerebrovascular neurosurgery included basic science investigations into the pathogenesis of intracranial aneurysms, device development, and neurovascular imaging development. During medical school, Dr. Hudson received research support from the Neurosurgery Research and Education Foundation (NREF) as a medical student fellow, subsequently receiving the 2016 NREF best medical student abstract award. His research has led to numerous peer reviewed publications, abstracts, and oral presentations at national neurosurgical conferences. Dr. Hudson is an elected member of the Alpha Omega Alpha medical honor society. Dr. Hudson is currently an enfolded complex and minimally invasive spine fellow. Dr. Hudson was born in Waterloo, Iowa. He was raised in Cedar Falls, Iowa and Plankstadt, Germany. His hobbies outside of neurosurgery include spending time with family and friends, golf, professional and collegiate sports, snow skiing, travel, and water sports.

Specialized Areas of Interest

Cerebrovascular neurosurgery; spine surgery; general neurosurgery.

Professional Organization Membership

Alpha Omega Alpha
American Association of Neurological Surgeons
American Heart Association/American Stroke Association
Congress of Neurological Surgeons

Education & Training

BA, Biology, Minor in Chemistry, University of Iowa, 2015
MD, University of Iowa Carver College of Medicine, 2019

Honors & Awards

Travel Grant, International Society for the Advancement of Spine Young Surgeons, 2023
Richard Kessel Scholarship in Medicine, University of Iowa Carver College of Medicine, 2018
Melvin Marcus Scholarship for Excellence, University of Iowa Carver College of Medicine, 2018
Trainee Scholar Travel Award, University of Iowa Carver College of Medicine, 2018
Award for Excellence in Clinical Neuroscience Research, University of Iowa Carver College of Medicine, 2017
Best Abstract Award, AANS/NREF Medical Student Summer Research Fellowship, 2016
Honors Graduate, Biology, University of Iowa, 2015
High Distinction Graduate, University of Iowa, 2015
Dean's List, University of Iowa, 2011-2015
President's List, University of Iowa, 2011-2015

Joseph Scott Hudson, MD

Publications: 2022-23

• Refereed Articles:

Hudson JS, Fernandes-Cabral D, Agarwal P, Legarreta A, Schulien A, Deng H, Agarwal V, Okonkwo DO. Anterior Thoracic Discectomy and Fusion for Symptomatic Ventral Bone Spur Associated Type I Cerebrospinal Fluid Leak: A Technical Report and Operative Video. *Global Spine J* [Online ahead of print], 2023.

Hudson JS, McCarthy DJ, Alattar A, Medhi Z, Lang MJ, Gardner PA, Zenonos GA, Friedlander RM, Gross BA. Increased Prevalence of Blister aneurysm formation during the Covid-19 pandemic. *Clin Neurol Neurosurg* 226:107613, 2023

Research Activities

Dr. Hudson's current research interests in spine surgery are wide ranging, and include applications of artificial intelligence in spine surgery, expanding the indications of minimally invasive spine procedures, radiomics in spine surgery, the clinical management of spinal trauma, and better understanding complex spinal deformity.

Sakibul Huq, MD

PGY-3 Resident

Sakibul Huq, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2021 after earning his MD from the Johns Hopkins University School of Medicine. He previously graduated from the University of North Carolina at Chapel Hill, where he studied biology and business administration on the fully funded Morehead-Cain Scholarship. During medical school, Dr. Huq developed academic interests in multiple areas of neurosurgery. His translational research introduced targeted therapies and drug repurposing strategies for brain and skull base tumors. His clinical research involved applications of predictive analytics and frailty assessments to neurosurgical oncology. Dr. Huq is also passionate about medical education. He has organized educational cadaver labs, served as a mentor to students at multiple stages of training, and written about education-related topics in neurosurgery. His work has resulted in numerous awards and 40 peer-reviewed publications in journals such as *Molecular Cancer Therapeutics, Journal of Clinical Investigation, Neurosurgery,* and *Journal of Neurosurgery*. Dr. Huq is also interested in organized neurosurgery. He previously served as the AANS Young Neurosurgeons Committee MISSION Fellow. Prior to medical school, he worked in management consulting with Huron Consulting Group, where he developed interests in healthcare quality, value and leadership. Dr. Huq is a native of Pittsburgh. His hobbies outside neurosurgery include fitness, soccer, basketball, travel and music. He enjoys spending time with his fiancée, an Ob-Gyn resident at UPMC Magee-Womens Hospital, and their Australian shepherd Kobe.

Specialized Areas of Interest

Skull base neurosurgery; neuro-oncology; cerebrovascular neurosurgery; radiosurgery; general neurosurgery; quality improvement; high value care; medical education and socioeconomics.

Professional Organization Membership

American Association of Neurological Surgeons
AANS/CNS Section on Tumors
American Medical Association
Congress of Neurological Surgeons

Education & Training

MD, Johns Hopkins University School of Medicine, 2021
BS, University of North Carolina at Chapel Hill, 2014

Sakibul Huq, MD

Honors & Awards
Walter Copeland Grant, Pittsburgh Foundation, 2023
Brian D. Silber Award, AANS, 2020
James Rutka Pediatric Brain Tumor Award, CNS, 2020
Harvey Cushing Medical Student Research Award, Johns Hopkins Medicine, 2020
Medical Student Summer Research Fellowship, AANS/NREF, 2020
MISSION Fellowship, AANS Young Neurosurgeons Committee, 2019
Medical Student Summer Fellowship, American Brain Tumor Association, 2019
Paul Ehrlich Research Award, Johns Hopkins Young Investigators Day, 2019
Carolyn L. Kuckein Student Research Fellowship, Alpha Omega Alpha, 2018
Henry Strong Denison Outstanding Student Research Award, Johns Hopkins Medicine, 2018
Tylenol Future Care Scholarship, 2016
Morehead-Cain Scholarship, University of North Carolina at Chapel Hill, 2014
Phi Beta Kappa, University of North Carolina at Chapel Hill, 2014
Highest Distinction, University of North Carolina at Chapel Hill, 2014

Rachel C. Jacobs, MD

PGY-4 Resident

Rachel C. Jacobs, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2020 after receiving her medical degree from the University of Pittsburgh School of Medicine. She obtained her undergraduate degree in neuroscience and behavioral biology from Emory University as a liberal arts scholarship recipient. During her undergraduate education, she spent four years at Yerkes National Primate Research Center studying selective MRI-guided neurotoxic lesions and neuroanatomical procedures in rhesus macaques to assess brain reorganization following neonatal brain lesions. During medical school, she became heavily involved in the UPMC Center for Image-Guided Neurosurgery under the mentorship of L. Dade Lunsford, MD. Specifically, she worked on clinical studies regarding stereotactic radiosurgery outcomes for benign and malignant brain tumors, arteriovenous malformations and cavernous malformations. Her peer-reviewed work has been presented at regional and national neurosurgical conferences in oral and abstract form. Dr. Jacobs enjoys boxing, spinning, and international travel in her free time. She is a native of Atlanta, Ga.

Specialized Areas of Interest
Cerebrovascular neurosurgery; endoscopic endonasal; skull base neurosurgery.

Professional Organization Membership
American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons

Education & Training
BS, Neuroscience/Behavioral Biology, Emory University, 2016
MD, University of Pittsburgh School of Medicine, 2020

Honors & Awards
Excellence in Neurosurgery Award, University of Pittsburgh Department of Neurosurgery, 2022
Morris H. and Gertrude M. Harris Foundation Scholar for Jewish Medical Students, 2016-20

Research Activities
Dr. Jacobs is investigating outcomes for endovascular therapy versus microsurgical clipping of ruptured wide neck aneurysms at UPMC. She is also evaluating hemorrhage risk in AVM-associated aneurysms in the pediatric population.

Albin John, MD

PGY-1 Resident

Albin A. John, MD MBA, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2023 after graduating from Texas Tech University Health Sciences Center. He received his undergraduate degree from Duke University. Prior to residency, Dr. John performed clinical and translational research in various fields including neurology, orthopedics, plastic surgery, burn and neurosurgery. He has conducted clinical neurosurgical research on topics ranging from optogenetics to spinal hardware, operative techniques and advanced imaging for Chiari patients. Additionally he is co-editor of the textbook *COVID-19 in Alzheimer's Disease and Dementia*. Dr. John was born and raised in Singapore. After immigrating to the United States, he spent his formative years in Houston, Texas. Outside of neurosurgery, he enjoys sports, cooking, salsa dancing, and spending time with family and friends.

Specialized Areas of Interest
Complex spine; spine oncology; hardware and medical devices; entrepreneurship.

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training
BA, Neuroscience, Duke University, 2018
MBA, Rawls College of Business, 2020
MD, Texas Tech University Health Sciences Center, 2023

Honors & Awards
Alpha Omega Alpha, Zeta Texas Chapter, 2022
Phi Kappa Phi, Rawls College of Business, 2019
Distinction in Neuroscience, Duke University, 2018

Publications: 2022-23
• Refereed Articles:
Collins RA, John A, Daniel H, Garza J, Nagy L, Jacob R. Association of Cerebellar Tonsil Dynamic Motion and Outcomes in Pediatric Chiari I Malformation. *World Neurosurg* 168:e518-e529, 2022.

Justiss A. Kallos, MD

PGY-7 Resident

Justiss Kallos, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in June of 2017 after graduating from the Vanderbilt University School of Medicine. Prior to matriculating for residency, she spent a year as project coordinator for a neuroplasticity lab working to improve stroke rehabilitation outcomes and expand access to rehabilitation services for rural veterans within the U.S. Department of Veterans Affairs in Atlanta, Ga. She also spent a postgraduate year studying at the University of St. Andrews as a Robert T. Jones, Jr. Memorial Scholar after graduating summa cum laude from Emory University with a degree in neuroscience and behavioral biology. She has a wide array of interests, having been involved in projects assessing perioperative factors that predict outcomes following vascular and skull base operations using traditional and machine learning models, Gamma Knife Radiosurgery, stroke rehabilitation and telemedicine, and social determinants affecting health outcomes. Outside of residency, she enjoys international travel, playing board games, hiking, and spending quality time with family.

Justiss A. Kallos, MD

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training
BS, Neuroscience/Behavioral Biology, Emory University, 2011
MD, Vanderbilt University School of Medicine, 2017

Honors & Awards
Cornelius Vanderbilt Scholar, Vanderbilt University School of Medicine, 2013-17
Gold Humanism Honor Society, Vanderbilt University School of Medicine, 2016
Robert T. Jones, Jr. Scholar, Emory University, 2011-12
Summa Cum Laude, Emory University, 2011

Andrew D. Legarreta, MD

PGY-5 Resident

Andrew D. Legarreta, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2019 after receiving his medical degree from Vanderbilt University School of Medicine. He received his undergraduate degree from Duke University, completing a BA in history. During medical school, Dr. Legarreta studied the effects of sport-related concussion in the high school athlete population. Specifically, he examined predictors of post-concussion syndrome and, separately, structural and functional neuroimaging findings in football players. His peer-reviewed work has been presented at regional and national neurosurgical conferences in oral and abstract form. Dr. Legarreta enjoys playing guitar, international travel, and golf in his free time. He is a native of Buffalo, N.Y.

Specialized Areas of Interest
Minimally invasive spine surgery; machine-learning; scoliosis and complex spinal deformity; sport-related concussion.

Professional Organization Membership
American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons

Education & Training
BA, History, Duke University, 2014
MD, Vanderbilt University School of Medicine, 2019

Honors & Awards
Cornelius Vanderbilt Scholarship, Vanderbilt University School of Medicine, 2015-19

Publications: 2022-23
• Refereed Articles:
Samanci Y, Askeroglu MO, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Legarreta A, Fernandes Cabral D, Anand S, Niranjan A, Lunsford LD, Tripathi M, Kumar N, Liščák R, May J, Lee CC, Yang HC, Martínez Moreno N, Martínez Álvarez R, Douri K, Mathieu D, Pikis S, Mantziaris G, Sheehan JP, Bernstein K, Kondziolka D, Peker S. Stereotactic Radiosurgery for Meningiomas in Children and Adolescents: An International Multi-Institutional Study. *Neurosurgery* [Online ahead of print], 2023.

Andrew D. Legarreta, MD

Singh R, Bowden G, Mathieu D, Perlow HK, Palmer JD, Elhamdani S, Shepard M, Liang Y, Nabeel AM, Reda WA, Tawadros SR, Abdelkarim K, El-Shehaby AMN, Emad RM, Elazzazi AH, Warnick RE, Gozal YM, Daly M, McShane B, Addis-Jackson M, Karthikeyan G, Smith S, Picozzi P, Franzini A, Kaisman-Elbaz T, Yang HC, Wei Z, Legarreta A, Hess J, Templeton K, Pikis S, Mantziaris G, Simonova G, Liscak R, Peker S, Samanci Y, Chiang V, Niranjan A, Kersh CR, Lee CC, Trifiletti DM, Lunsford LD, Sheehan JP. Local Control and Survival Outcomes After Stereotactic Radiosurgery for Brain Metastases From Gastrointestinal Primaries: An International Multicenter Analysis. *Neurosurgery* [Online ahead of print], 2023.

Hudson JS, Fernandes-Cabral D, Agarwal P, Legarreta A, Schulien A, Deng H, Agarwal V, Okonkwo DO. Anterior Thoracic Discectomy and Fusion for Symptomatic Ventral Bone Spur Associated Type I Cerebrospinal Fluid Leak: A Technical Report and Operative Video. *Global Spine J* [Online ahead of print] 2023.

Mittal AM, Pease M, McCarthy D, Legarreta A, Belkhir R, Crago EA, Lang MJ, Gross BA. Hunt-Hess Score at 48 Hours Improves Prognostication in Grade 5 Aneurysmal Subarachnoid Hemorrhage. *World Neurosurg* 171:e874-e878, 2023.

Single session versus multisession stereotactic radiosurgery for the management of intracranial meningiomas: a systematic review and meta-analysis. Bin-Alamer O, Alnefaie N, Qedair J, Chaudhary A, Hallak H, Abdulbaki A, Mallela AN, Palmisciano P, Gersey ZC, Legarreta AD, Labib MA, Zada G, Sheehan JP, Couldwell WT, Lunsford LD, Abou-Al-Shaar H. *J Neurooncol* 161(2):215-224, 2023.

Research Activities

Dr. Legarreta's research activity encompasses the application of machine learning methodologies in the domain of neurosurgery. Machine learning, a subset of artificial intelligence, utilizes statistical models to enable computers to learn and make inferences from data autonomously.

Dr. Legarreta applies machine learning algorithms to decipher complex neuroimaging data, thereby facilitating enhanced diagnostic precision and therapeutic interventions. This approach also assists in generating predictive models to estimate patient outcomes based on diverse patient-specific variables.

Dr. Legarreta's research interest extends to the field of minimally invasive spine surgery, a modern surgical approach aiming to minimize tissue damage and improve patient recovery times. He is particularly focused on investigating the utility and effectiveness of these procedures in managing various spinal pathologies. His research includes the study of patient outcomes, the development of novel surgical techniques, and the evaluation of long-term functional recovery. By leveraging advanced technologies such as robotics and intraoperative imaging, Dr. Legarreta's research aims to optimize surgical accuracy, reduce postoperative complications, and enhance patient quality of life. His ongoing studies continue to contribute valuable insights into the rapidly evolving field of minimally invasive spine surgery.

Arka N. Mallela, MD

Chief Resident

Arka N. Mallela, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2018 after graduating from the University of Pennsylvania School of Medicine, earning his MD and MS in translational research. He received his undergraduate degrees from the Vagelos Scholars Program at the University of Pennsylvania, completing a BA in biophysics, biochemistry, and philosophy and an MS in biological chemistry. He is currently in the enfolded fellowship program in epilepsy and functional neurosurgery under Jorge Gonzalez-

Arka N. Mallela, MD

Martinez, MD, PhD, and has a strong interest in neuro-oncology as well. Dr. Mallela's research lies at the intersection of neurophysiology, neuroimaging, network theory and deep learning. He is currently interested in utilizing these tools to study a variety of neurological diseases, including expressive language, fetal brain folding, epilepsy, and brain tumors. For his work, Dr. Mallela has received the 2023 CNS Stryker Tumor Award and was selected for the 2022 AES Fellows program. He was previously selected for the Burroughs Wellcome Foundation Physician Scientist Incubator Program. He is currently funded via the NIH NRSA F32 grant to study the role of the supplementary motor area and associated areas in the generation of complex speech and motor movements using intracranial electrophysiology. In his free time, Dr. Mallela enjoys hiking, movie making, and spending time with his family, wife, and friends.

Specialized Areas of Interest
Epilepsy surgery; neuro-oncology.

Professional Organization Membership
American Association of Neurological Surgeons
American Epilepsy Society
Association for Clinical and Translational Sciences
Congress of Neurological Surgeons
Society for the Neurobiology of Language

Education & Training
BS, Biophysics, Biochemistry, Philosophy, University of Pennsylvania, 2013
MS, Biological Chemistry, University of Pennsylvania, 2013
MS, Translational Research, University of Pennsylvania, 2018
MD, University of Pennsylvania Perelman School of Medicine, 2018

Honors & Awards
Stryker CNS Tumor Award, AANS, 2023
American Epilepsy Society Fellow, 2022
F32 Ruth L. Kirschstein Postdoctoral Individual National Research Service Award, 2022
Highest ABNS Score Award, UPMC Department of Neurosurgery, 2021, 2022
Physician Scientist Incubator Program, Burroughs Wellcome Foundation, 2021
Walter L. Copeland Grant, Copeland Foundation, 2020-2022
American Brain Tumor Association Young Investigator Award, 2017
ITMAT Prize for Clinical/Translational Research, University of Pennsylvania, 2015

Publications: 2022-23
• Refereed Articles:
Bin Alamer O, Qedair J, Palmisciano P, Mallela AN, Nayar GM, Lu VM, Labib MA, Lang MJ, Gross BA, Langer DJ, Couldwell WT, Friedlander RM, Abou-Al-Shaar H. Dolichoectatic vertebrobasilar artery aneurysms: a systematic review and meta-analysis of management strategies and outcomes. *Neurosurg Focus* 54(5):E9, 2023.

Muthiah N, Mallela AN, Vodovotz L, Sharma N, Akwayena E, Pan E, Welch W, Ibrahim GM, Abel TJ. Development of a clinical model to predict vagus nerve stimulation response in pediatric patients with drug-resistant epilepsy. *J Neurosurg Pediatr* 31(5):476-483, 2023.

Sharma N, Mallela AN, Abou-Al-Shaar H, Aung T, Gonzalez-Martinez J. Trans-interhemispheric SEEG depth electrode placement for mesial frontal lobe explorations in medically refractory epilepsy: an early feasibility study. *Oper Neurosurg* 24(6):582-589, 2023.

Arka N. Mallela, MD

Abou-Al-Shaar H, Patel A, Mallela AN, Niranjan A, Peker S, Samanci Y, Liscak R, Hanuska J, Kumar JS, Sheehan JP, Lunsford LD. Chronic Encapsulated Expanding Hematomas After Stereotactic Radiosurgery for Intracranial Arteriovenous Malformations: An International Multicenter Study. *Neurosurg* 92(1):195-204, 2023.

Tang W, Mallela AN, Deng H, Richardson TE, Hervey-Jumper SL, Abdullah KG, McBrayer SK. Preclinical modeling of low-grade glioma. *Front Onc* 13:1139383, 2023.

Mallela AN, Deng H, Gholipour A, Warfield SK, Goldschmidt E. Heterogeneous growth of the insula shapes the human brain. *Proc Natl Acad Sci USA* 120(24):e2220200120, 2023.

Plute T, Patel AK, Mallela AN, Hamilton D, Lunsford LD, Friedlander RM, Abou-Al-Shaar. United States Neurosurgery Department Program Directors: A Cross-Sectional Evaluation of Current and Future Trends and Attributes. *World Neurosurg* 170:e550-e557, 2023.

Bin-Alamer O, Pikis S, Mantziaris G, Abdulbaki A, Mallela AN, Lu VM, Peker S, Samanci Y, Nabeel AM, Reda WA, Tawadros SR, El-Shehaby AM, Abdelkarim K, Emad Eldin RM, Sheehan D, Sheehan K, Liscak R, Chytka T, Tripathi M, Madan R, Speckter H, Hernández W, Barnett GH, Hori YS, Dabhi N, Aldakhil S, Mathieu D, Kondziolka D, Bernstein K, Wei Z, Niranjan A, Kersh CR, Lunsford LD, Sheehan JP, Abou-Al-Shaar H. Adjuvant Stereotactic Radiosurgery with or without Postresection Fractionated Radiation Therapy for the Management of Clival Chordomas in Adults: An International Multicenter Analysis. *Neurosurgery* [Online ahead of print], 2023.

Pease M, Mallela AN, Elmer J, Okonkwo DO, Shutter L, Barot N, Gonzalez-Martinez J, Castellano JF. Association of post-traumatic epilepsy with outcomes in individuals with severe traumatic brain injury. *Neurology* 100(19):e1967-e1975, 2023.

Pease M, Elmer J, Shahabadi AZ, Mallela AN, Ruiz-Rodriguez JF, Sexton D, Barot N, Gonzalez-Martinez J, Shutter L, Okonkwo DO, Castellano JF. Predicting post-traumatic epilepsy using admission electroencephalography after severe traumatic brain injury. *Epilepsia* [Online ahead of print], 2023.

Sharma N, Mallela AN, Shi DD, Tang LW, Abou-Al-Shaar H, Gersey ZC, Zhang X, McBrayer SK, Abdullah KG. Isocitrate dehydrogenase mutations in gliomas: a review of current understanding and trials. *Neurooncol Adv* [In press], 2023.

Patel A, Varga G, Mallela AN, Abou-Al-Shaar H, Bukowinski A, Mamaug E, Zambrano EV, Greene S. Paraspinal Desmoid Tumor in a Pediatric Patient with No Surgical History: A Case Report. *Asian J Neurosurg* [In press], 2023.

Plute T, Abou-Al-Shaar H, McDowell MM, Snyderman CH, Gardner PA. Endoscopic Endonasal Resection of a Recurrent Pre-Pontine Neurenteric Cyst: A 2-Dimensional Operative Video. *Oper Neurosurg* [In press], 2023.

Bin-Alamer O, Wei Z, Head JR, Waite K, Agarwal N, Mallela AN, Faramand A, Gersey ZC, Niranjan A, Lunsford LD, Abou-Al-Shaar H. Vestibular Schwannoma Stereotactic Radiosurgery in Octogenarians: Case Series. *Neurosurg* [In press], 2023.

Plute T, Agarwal P, Patel A, Mallela AN, Lunsford LD, Abou-Al-Shaar. Idiopathic De Novo Arteriovenous Malformation: A Rare Acquired Intracranial Lesion. *Asian J Neurosurg* [In press], 2023.

Arka N. Mallela, MD

• Letter to the Editor:
Mallela AN, Abou-Al-Shaar H, Gonzalez-Martinez JA. Letter to the Editor. SEEG and subdural grids: differences that go beyond morbidity. *J Neurosurg* 138(3):885-886, 2022.

Research Activities

• Mechanisms of expressive language and naming in the human brain:
Under the mentorship of Jorge Gonzalez-Martinez, MD, PhD, in the UPMC Department of Neurological Surgery and Brad Mahon, PhD, of the Carnegie Mellon Department of Psychology, Dr. Mallela is studying the mechanisms of expressive language and naming using intracranial electrophysiology. His primary focus is the role of the supplementary motor area (SMA) in the generation of language, complex speech, and motor functions. Patients with injury to the SMA and associated areas develop a profound deficit in contralateral motor function and expressive language (if in the dominant hemisphere). Intriguingly, most patients improve to their baseline in 6-8 weeks. Dysfunction in the SMA has also been linked to speech and language disorders including stuttering and apraxia of speech. Using stereo EEG, Dr. Mallela is investigating 1) how the SMA contributes to the production of fluent expressive speech and 2) how the brain compensates for SMA injury. These results can not only increase understanding of fluent speech in the human brain but can also serve as a model of recovery from other brain injuries. Dr. Mallela is also helping lead other efforts in the Gonzalez-Martinez and Mahon labs studying the role of the hippocampus and temporal lobe structures in auditory and picture naming.

• Fetal brain folding:
Working closely with Ezequiel Goldschmidt, MD, PhD, Dr. Mallela has studied the fetal development of the insula and Sylvian fissure. His most recent work identifies a unique form of radial migration that creates the insula and shapes the global configuration of the cerebrum. His previous efforts have demonstrated that the Sylvian fissure is also formed via specific genetic patterning. These findings not only help elucidate the mechanisms of fetal brain development but also explain important adult anatomy, including why no middle cerebral artery branches cross the Sylvian fissure (facilitating the fissure split).

David J. McCarthy, MD

PGY-4 Resident

David McCarthy, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2020 after graduating from the University of Miami Miller School of Medicine. He earned a master's degree in clinical and translational research with a focus in statistics from the University of Miami and a bachelor of science degree in biochemistry from the University of Florida. During medical school, Dr. McCarthy cultivated an interest in ischemic and hemorrhagic stroke treatment modalities and outcomes. In the laboratory, he investigated endothelial dysfunction in aneurysms and pharmaceutical stroke recovery enhancement. For aneurysms, he researched molecular inhibition of pathologic endothelial cell expression and enhanced endothelization following endovascular treatment modalities. In ischemic stroke, he utilized a murine photochemical cortical stroke model to assess the efficacy of various neuroprotective pharmaceutical agents. In clinical research, Dr. McCarthy authored and co-authored manuscripts that focused on optimizing neuroendovascular access, and post stroke thrombectomy critical care. Dr. McCarthy's research interests include neurosurgical epidemiology and treatment trends, neuroendovascular devices, and the molecular physiology of cerebral aneurysms. He hopes to apply artificial intelligence and machine learning for computation flow dynamic assessment of cerebral aneurysms, comparing physiologic cell stress to genomic expression. Additionally, he hopes to contribute to neurosurgical literature with the improvement of current statistical methods. Dr. McCarthy was raised in Tampa, Fla. In his free time, he enjoys creating art (resin, graphite), winter mountaineering, skiing, hiking, running, and weight lifting.

David J. McCarthy, MD

Specialized Areas of Interest
Cerebrovascular neurosurgery; neuro-oncology; pediatric neurosurgery; functional neurosurgery; neurotrauma.

Professional Organization Membership
American Association of Neurological Surgeons
American Heart Association: Stroke Council
Congress of Neurological Surgeons

Education & Training
BS, Biochemistry, University of Florida, 2014
MS, University of Miami, 2018
MD, University of Miami Miller School of Medicine, 2020

Honors & Awards
Judson Scholarship Recipient, University of Miami Miller School of Medicine, 2014-2020
ISC Junior Investigator Travel Award, American Heart Association, 2019
Second Place Clinical Poster Award, Eastern Atlantic Student Research Forum, 2018
Cerebrovascular Disease and Stroke Fellowship Recipient, American Heart Association, 2017
Best Clinical Poster Presentation Winner, Eugene J. Sayfie Research Day, 2017
Medical Student Research Fellow, Neurosurgery Research and Education Foundation, 2017
Clinical and Translational Investigation Scholarship, University of Miami, 2017

Gautam M. Nayar, MD

Chief Resident

Gautam M. Nayar, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2018. After graduating from the University of Florida with a degree in computer science, Dr. Nayar completed his medical education at Duke University School of Medicine. As the Ruth K. Broad Foundation Neurosciences Fellow, he studied neuronal response and processing towards integration of sensory brain-computer interfaces in the laboratory of Miguel Nicolelis, MD, PhD. Dr. Nayar also cultivated an interest in spinal outcomes research focusing on minimally invasive approaches, radiation reduction protocol, and identification of pre-operative risk factors. Dr. Nayar's work on the clinical efficacy of ultra-low radiation imaging protocols was awarded the 2017 AANS Donald Quest Clinical Science Award. Although raised in Pittsburgh, Dr. Nayar moved to Gainesville, Fla. for high school and college. In his free time, he enjoys hiking, weight lifting, and spending time with his family.

Specialized Areas of Interest
Vascular neurosurgery; endovascular; spine surgery.

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training
BS, Computer Science, University of Florida, 2014
MD, Duke University, 2018

Honors & Awards
Donald Quest Clinical Science Award, AANS, 2017

Gautam M. Nayar, MD

Publications: 2022-23

• Refereed Articles:

Bin-Alamer O, Qedair J, Palmisciano P, Mallela AN, Nayar GM, Lu VM, Labib MA, Lang MJ, Gross BA, Langer DJ, Couldwell WT, Friedlander RM, Abou-Al-Shaar H. Dolichoectatic vertebrobasilar aneurysms: a systematic review and meta-analysis of management strategies and outcomes. *Neurosurg Focus* 54(5):E9, 2023.

Eric M. Nturibi, MD

PGY-2 Resident

Eric M. Nturibi, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July of 2022 after earning an MD degree from the University of Pittsburgh School of Medicine. He received his undergraduate education at Franklin and Marshall College in Lancaster, Pa., graduating cum laude in 2015. Prior to residency, Dr. Nturibi was involved in basic science research aimed at understanding the molecular mechanisms underpinning influenza infections in cellular and animal models. He was also involved in clinical and translational neurosurgical research in the fields of neurocritical care and pediatric neurosurgery. Dr. Nturibi was born and raised in Nairobi, Kenya. Outside of the hospital, he enjoys sports—particularly soccer and athletics—grilling, spending time with his friends and exploring Pittsburgh.

Specialized Areas of Interest

Neurotrauma; spine deformity surgery.

Hospital Privileges

Pittsburgh VA Hospital
UPMC Children's Hospital of Pittsburgh
UPMC Mercy
UPMC Presbyterian
UPMC Shadyside

Professional Organization Membership

American Medical Association
American Association of Neurological Surgery
Congress of Neurological Surgery
National Medical Association

Education & Training

BA, Biochemistry & Molecular Biology, Franklin and Marshall College, 2015
MD, University of Pittsburgh, 2022

Honors & Awards

Theodore Kurze Senior Prize for Excellence in Neurological Surgery, UPMC Neurosurgery, 2022
Academic Achievement Award for Academic Merit and Community Service, Pittsburgh National Medical Association, 2018
Cum Laude, Franklin and Marshall College, 2015

Anthony J. Schulien, MD

PGY-3 Resident

Anthony J. Schulien, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2021 after earning an MD degree from the University of Pittsburgh School of Medicine. Here, he completed the five-year Physician Scientist Training Program (PSTP), and was awarded The Theodore Kurze, MD, award for Excellence in Neurological Surgery and Clinical Neurosciences. Prior to medical school, he graduated magna cum laude from the University of Pittsburgh with a degree in neuroscience as well as a minor in chemistry. During his training, Dr. Schulien has conducted longitudinal research on ischemic neuroprotective strategies at the Pittsburgh Institute for Neurodegenerative Diseases (PIND). His translational research has resulted in the development of a novel, blood brain barrier-permeable neuroprotective peptide that mitigates Kv2.1 potassium channel-mediated apoptotic neuronal death and improves neurologic functional outcomes following cerebral ischemia in a murine model. His work has resulted in publications in *Science Advances, Brain,* and the *Journal of Neuroscience*, among others. Dr. Schulien has presented this work broadly in both national and international forums. He has also performed clinical research in outcomes following skull base surgery with the department. Before matriculation to medical school, Dr. Schulien found his passion for medicine as a volunteer EMT with the Loudoun County Volunteer Rescue Squad. Dr. Schulien was born and raised in Potomac Falls, Va. His hobbies include backcountry backpacking, snowboarding, and spending time with his family, friends, and dog.

Specialized Areas of Interest

Cerebrovascular neurosurgery; endovascular neurosurgery; neurotrauma; spine surgery; general neurosurgery.

Professional Organization Membership

American Association of Neurological Surgeons
American Medical Association
Congress of Neurological Surgeons
Society for Neuroscience

Education & Training

BS, Neuroscience, University of Pittsburgh, 2015
MD, Physician Scientist Training Program, University of Pittsburgh, 2021

Honors & Awards

The Theodore Kurze, MD, Senior Prize for Excellence in Neurological Surgery, UPMC Neurosurgery, 2021
Certificate of Merit for Excellence in the Longitudinal Research Project, University of Pittsburgh School of Medicine, 2021
Top Research Poster Award, Brain Day, University of Pittsburgh Brain Institute, 2018
Physician Scientist Training Program (PSTP) Trainee Scholarship, University of Pittsburgh School of Medicine, 2016
Neuroscience Research Excellence Award, University of Pittsburgh Department of Neuroscience, 2015
Summer Undergraduate Research Program (SURP) in Molecular Pharmacology Fellowship, Center for Neuroscience at the University of Pittsburgh (CNUP), 2014
The Chancellor's Undergraduate Research Fellowship, University of Pittsburgh Honors College, 2014
President's Volunteer Service Award, Loudoun County Volunteer Rescue Squad, 2013-14

Anthony J. Schulien, MD

Publications: 2022-23

• Refereed Articles:

Hudson JH, Fernandes-Cabral D, Agarwal P, Legarreta A, Schulien AJ, Deng H, Agarwal V, and Okonkwo DO. Anterior thoracic discectomy and fusion for symptomatic ventral bone spur associated type I cerebrospinal fluid leak: a technical report and operative video. *Global Spine J* [Online ahead of print], 2023.

Fields DP, McDowell MM, Schulien AJ, Algattas H, Abou-Al-Shaar H, Agarwal N, Alan N, Costacou T, Wang EW, Synderman CH, Gardner PA, Zenonos GA. Low pre-operative prealbumin levels are a strong independent predictor of postoperative cerebrospinal fluid leak following endoscopic endonasal skull base surgery. *World Neurosurg* 167:e110-e116 2022.

Roberta K. Sefcik, MD

PGY-7 Resident

Roberta K. Sefcik, MD, began her residency with the University of Pittsburgh Department of Neurosurgery in June of 2017. She graduated from Carnegie Mellon University in 2011 where she pursued an interdisciplinary degree in psychology and music performance, focusing on bagpipe performance. She was admitted to the Humanities and Medicine Program and the Patient-Oriented Research Training and Leadership Program at the Icahn School of Medicine at Mount Sinai in New York where she received her medical degree and a master of science in clinical research in 2017. Dr. Sefcik was born and raised in Dunedin, Fla.

Specialized Areas of Interest

Spine surgery; general neurosurgery.

Professional Organization Membership

American Association of Neurological Surgeons
Congress of Neurological Surgeons
Phi Beta Kappa Association

Education & Training

BA, Psychology/Music Performance, Carnegie Mellon University, 2011
MS, Clinical research, Icahn School of Medicine at Mount Sinai, 2017
MD, Icahn School of Medicine at Mount Sinai, 2017

Honors & Awards

Distinction in Research, Icahn School of Medicine at Mount Sinai, 2017
Phi Beta Kappa, 2011

Publications: 2022-23

• Refereed Articles:

Plute T, Patel A, Mallela A, Sefcik R, Hamilton DK, Lunsford LD, Friedlander RM, Abou-Al-Shaar H. United States neurosurgery department program directors: A cross-sectional evaluation of current and future trends and attributes. *World Neurosurgery* 170:e550-e557, 2023

Freeman MC, Lazzara A, Lennon T, McAteer J, Pease M, Sefcik R, Radovic-Stakic A, Milstone AM, Nowalk A, Trent M. Gonococcal infection and ventriculoperitoneal shunts. *Sexually Transmitted Diseases* 49(12):838-840, 2022

William H. Shuman, MD

PGY-2 Resident

William H. Shuman, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2022 after graduating from the Icahn School of Medicine at Mount Sinai, earning his MD with Distinction in Research. He received his undergraduate degree from The Johns Hopkins University in 2016, completing a BA in biophysics and receiving the Detlev Bronk Award for Outstanding Scholarship in Biophysics. During medical school, Dr. Shuman conducted clinical neurosurgical research focusing on patient outcomes primarily in spine surgery and skull base surgery, and he has presented his work at multiple national research conferences. He is interested in using his research experience to optimize postoperative outcomes for neurosurgical patients. Dr. Shuman was born and raised in Detroit, Mich. In his free time, he enjoys playing guitar, listening to blues rock and folk music, weight lifting and running, hiking, playing golf, pick-up basketball, bowling, cooking, and spending time with his family and friends.

Specialized Areas of Interest
Skull base surgery; spine surgery; pediatric neurosurgery; neurotrauma.

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons

Education & Training
BA, Biophysics, The Johns Hopkins University, 2016
MD, Icahn School of Medicine at Mount Sinai, 2022

Honors & Awards
Distinction in Research, Icahn School of Medicine at Mount Sinai, 2022
Healthcare Delivery and Outcomes Presentation Award, AANS/CNS Spine Summit, 2019
Detlev Bronk Award in Biophysics, The Johns Hopkins University, 2016
Phi Beta Kappa, 2016

Oliver Y. Tang, MD

PGY-1 Resident

Oliver Y. Tang, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2023 after earning his MD degree from the Warren Alpert Medical School of Brown University. Prior to medical school, he graduated magna cum laude from Brown University in 2019 with a BS in Neuroscience with Honors, studied in the selective Program in Liberal Medical Education, and was one of four students in his undergraduate class to receive the Harvey A. Baker Fellowship. Dr. Tang's clinical and academic interests include translational neuro-oncology, health policy and social determinants of health, artificial intelligence (AI) and big data in clinical medicine, medical education and global neurosurgery. He has published over 60 peer-reviewed publications in these fields. He has also received funding from the Neurosurgery Research & Education Foundation and the National Institutes of Health to study topics including CAR T therapy for glioblastoma and traumatic brain injury outcomes in Rwanda. During medical school, he was inducted into the Alpha Omega Alpha honor society and was also recognized with the Stanley Aronson Prize for excellence in the clinical neurosciences. Dr. Tang was born in New York, N.Y., but spent most of his childhood in New Jersey. Outside of neurosurgery, he enjoys swimming, musical theater, movie going, mystery and science fiction, video and board games, and spending time with family and friends.

Oliver Y. Tang, MD

Specialized Areas of Interest
Neuro-oncology; pediatric neurosurgery; health policy; big data and artificial intelligence; medical education; global neurosurgery.

Professional Organization Membership
American Association of Neurological Surgeons
Congress of Neurological Surgeons
Society of Neuro-Oncology

Education & Training
MD, The Warren Alpert Medical School of Brown University, 2023
BS, Brown University, 2019

Honors & Awards
The Stanley Aronson Prize, The Warren Alpert Medical School of Brown University, 2023
CNS Foundation DEI Abstract Award, Congress of Neurological Surgeons, 2022
Alpha Omega Alpha, The Warren Alpert Medical School of Brown University, 2022
Neurosurgery "Editor's Choice" Article, Congress of Neurological Surgeons, 2021
Framework in Global Health Program Scholarship, Brown University, 2021
Neurosurgery Research and Education Fund Medical Student Summer Research Fellowship, Neurosurgery Research and Education Fund, 2020
Best Clinical Research Award for Socioeconomic/CSNS Podium Presentation, Congress of Neurological Surgeons, 2019
Best Computational Health Systems Abstract Award at Computational Neuroscience Outcomes Center Symposium, Brigham & Women's Hospital, 2019
Third Place Socioeconomic E-Poster Award, American Association of Neurological Surgeons, 2019
Harvey A. Baker Fellowship, Brown University, 2019
The Milton Hamolsky Prize, Brown University, 2019

James Yoon, MD

PGY-2 Resident

James Yoon, MD, joined the University of Pittsburgh Department of Neurological Surgery residency program in July 2022 after earning his MD degree from Yale School of Medicine. Prior to medical school, he graduated manga cum laude from Brown University in 2017 with a BS in neuroscience with honors. Dr. Yoon's research focuses on value-based healthcare aimed at improving patient experiences through policy reforms, delivery system innovation, and outcomes research that informs safe, evidence-based clinical practices. During medical school, Dr. Yoon completed a health law and policy fellowship at the Solomon Center at Yale Law School. He is also active in organized neurosurgery and was elected to serve on the Young Neurosurgeons Committee in 2020 and co-president of the Cushing Society at Yale School of Medicine in 2021. Dr. Yoon was born in South Korea. Outside of neurosurgery, he enjoys fencing, cooking Korean food, playing the viola, hiking, traveling, and spending time with his family and friends.

Specialized Areas of Interest
Cerebrovascular neurosurgery; skull base neurosurgery; neuro-oncology; value-based healthcare; clinical outcomes research; socioeconomics in neurosurgery; organized neurosurgery; medical education.

Professional Organization Membership
American Association of Neurological Surgeons
American Medical Association

James Yoon, MD

Congress of Neurological Surgeons
Young Neurosurgeon's Committee of AANS

Education & Training
BS, Neuroscience, Brown University, 2017
MD, Yale School of Medicine, 2022

Honors & Awards
Forbes 30 Under 30, *Forbes Magazine*, 2022
Editor's Choice Manuscript, *Neurosurgery*, 2021
National Institutes of Health National Heart, Lung, and Blood Institute Research Fellowship, 2019
Yale School of Medicine Student Travel Award, 2018, 2019, 2022
Sigma Xi Honor Society, 2017
Magna cum laude, Brown University, 2017
Karen T. Romer Undergraduate Teaching and Research Award, Brown University, 2016
Presidential Linking Internships and Knowledge Award, Brown University, 2015
Entrepreneurship Program Synapse Fellowship, Brown University, 2015
Sheridan Center Certificate in Research Mentorship, Brown University, 2015
Texas Governor's Award, 2013

Congratulations to Hanna Algattas, MD; Edward Andrews, MD; Xiaoran Zhang, MD; and Kamil Nowicki, MD, PhD, on their successful completion of the University of Pittsburgh's seven-year neurological surgery residency program. Following graduation, Dr. Algattas joined the faculty at the University of Buffalo as an assistant professor; Dr. Andrews accepted a position as assistant professor at the University of Pittsburgh Department of Neurological Surgery; Dr. Zhang joined Memorial Sloan Kettering Cancer Institute in New York for a neurosurgical oncology fellowship; and Dr. Nowicki departed for Yale University to serve a one-year endovascular fellowship.


AXIAL
197 / 537
CORONAL
256 / 512
TOOLS
FILTERS
SLICES
CROP
ANCHOR
SCOUT
CUTPLANE
RESET

Research

The goal of the Department of Neurological Surgery at the University of Pittsburgh is to improve the care and treatment of patients with neurological disease. This goal is being achieved partly though the implementation and administration of state-of-the-art basic and translational research. Our department—with more than 60 faculty members and investigators—endeavors to be at the forefront of medical research. Numerous advances have already been achieved—research translated into practice.

Annually, the department has been highly ranked in total research funding, a direct result of the success and quality of our research and development. In the 2023 fiscal year, our faculty and residents were involved in almost 200 research projects having a total annual budget award of more than $15.6 million, an increase of almost 20% over the prior year.

Ongoing research includes the disciplines of molecular biology, neurophysiology, neurochemistry, neuroanatomy, neuroradiology and other neuroscience arenas. Specific questions addressed include research into the acute and chronic care following neurotrauma, neural recovery and plasticity, the neurobiologic and therapeutic response in neuro-oncology, the underlying mechanisms and treatment of epilepsy and movement disorders, cell death and radiation injury, and cerebrovascular physiology and modeling. The department provides an outstanding research environment for fellows, residents, and students seeking training in neurosurgical research.

Intramural research support for junior faculty and residents is available through the Walter L. Copeland Fund. The Copeland Fund was established at The Pittsburgh Foundation in 1961, with instructions that the entire annual proceeds support cranial research in the Department of Neurosurgery at the University of Pittsburgh. The fund has provided substantial seed money, often leading to millions of dollars in federal grants for the Department of Neurological Surgery. In fy 2023, researchers from our department were awarded $145,000 from the Copeland Fund.

The Walter L. Copeland Laboratory

The Walter L. Copeland Laboratory serves as a central facility for research and development within the Department of Neurological Surgery. Located on the ninth floor of Scaife Hall, the laboratory was dedicated on November 29, 2001 by L. Dade Lunsford, MD. The laboratory houses several research disciplines which provide resources for a wide range of neurosurgery faculty, residents, visiting fellows and students. Neurotrauma, brain imaging, and neuroanatomical research are the primary initiatives being conducted in the laboratory. A significant amount of this work is funded by The Walter L. Copeland Fund of The Pittsburgh Foundation, a fund that has provided resources for research at the University of Pittsburgh since 1961.

The Neurotrauma Clinical Trials Center (NCTC)—under the direction of David O. Okonkwo, MD, PhD, and co-director, Ava M. Puccio, RN, PhD—is located within the Copeland Laboratory. The NCTC team conducts innovative clinical research with a focus on biomarkers as well as the evaluation of neurotherapeutics for traumatic brain and spinal cord injury. In addition, annual resident training is performed every July for hands-on cadaver training of multi-modality intracranial monitoring insertions (i.e. external ventricular drain placement, and intracranial pressure and brain oxygenation/temperature monitoring). Instruction of lumbar puncture and Mayfield positioning for operating room stabilization is performed with simulation.

The Surgical Neuroanatomy Laboratory—under the direction of Paul Gardner, MD—specializes in training residents and fellows on advanced anatomy and neurosurgical skull-base approaches. The lab places a specific focus on the development, and subsequent training, of new methods of intraoperative cranial navigation and endoscopic techniques. The lab also hosts yearly

international visiting research fellows, where neurosurgeons from around the world participate in ground-breaking research regarding innovative neurosurgical methodology. Kyle Affolter, is the coordinator for these efforts.

The Fiber Tractography Lab, under the direction of Fang-Cheng (Frank) Yeh, MD, PhD, is focused on the application of HDFT for presurgical planning and intraoperative navigation to facilitate brain function preservation and improve resection rates in patients with complex brain lesions. The laboratory's work is also centered on studying the structure and connectivity of the fiber tracts forming the "normal" human brain, and their structural alteration in patients with brain tumors, vascular lesions, stroke, and neurodegenerative diseases.

Neurotrauma Research

The Brain Trauma Research Center (BTRC) at the University of Pittsburgh is a multidisciplinary research program aimed at improving outcome following severe traumatic brain injury. Research conducted both at our center and at other brain injury research programs clearly demonstrates the potential for improving outcomes using therapies designed to treat biochemical derangements that occur following impact to the brain. In order to identify the most critical of these sequelae of brain injury and to find newer therapies that are effective in treating them, the BTRC has established several basic science head injury laboratories and clinical research projects.

C. Edward Dixon, PhD, leads the Department of Neurological Surgery's efforts in preclinical traumatic brain injury research. The research focuses on basic and translational efforts to study mechanisms of cognitive deficits after TBI and to evaluate novel interventions. Shaun Carlson, PhD, leads efforts on synaptic dysfunction mechanisms of TBI. The Department of Neurological Surgery has pioneered efforts in the study of presynaptic mechanisms of cognitive deficits after TBI. Preclinical TBI research is supported by the National Institutes of Health, Veterans Administration, and the Department of Defense.

David O. Okonkwo, MD, PhD, leads the department's clinical research efforts as director of the Neurotrauma Clinical Trials Center (NCTC). The NCTC performs wide-ranging studies, including clinical trials funded by federal agencies and industry to study new therapies, novel brain monitoring devices, advanced neuroimaging, and biomarkers. The center also houses the National TBI Biospecimens Repository. This repository, under the direction of Ava Puccio, RN, PhD, is the largest centralized collection of biological samples from traumatic brain injury patients in the United States. The NCTC and the National TBI Biospecimens Repository have pioneered efforts in basic and clinical science which have substantially influenced clinical practice, including:

1. Evaluating the clinical utility of point-of-care assessment platforms for blood biomarkers of TBI;
2. Applying machine learning techniques to computed tomography scans to predict outcomes for severe TBI patients;
3. Establish the sensitivity and clinical utility of magnetoencephalography to image brain injury; and,
4. Assess the viability of hypothermia as a treatment of severe head injury.

The NCTC continues to play a pivotal role in large collaborative efforts, such as Transforming Research and Clinical Knowledge in TBI (TRACK-TBI), a multi-center study funded by the National Institute of Neurological Disorders at the NIH. The department is a key contributor to the next generation of TRACK-TBI studies, which seeks to improve the treatment and long-term outcomes of patients with TBI.

The NCTC is also actively enrolling research participants to examine the potential effects of repeated head impacts and/or TBIs on long-term neurological health. The goal of this research is to identify clinical, advanced imaging, and blood biomarker correlates for mild cognitive impairment.

Brain Tumor Research

Innovative and cutting-edge brain tumor research conducted at the University of Pittsburgh Department of Neurological Surgery occurs across multiple campuses at the University of Pittsburgh including the John Rangos Research Center at UPMC Children's Hospital of Pittsburgh, the University of Pittsburgh School of Medicine, and the UPMC Hillman Cancer Center.

Brain tumor research at the University of Pittsburgh is one of the largest clinical and most productive basic/translational brain tumor programs in the country, encompassing research across the adult and pediatric brain tumor science spectrum and supported heavily in funding from the National Institutes of Health and other generous foundations. University brain tumor research is collaborative with researchers and clinicians from diverse fields, including neurosurgery, radiation oncology, neuro-oncology, neuropathology, and neuroradiology, working together to tackle the complex challenges associated with brain tumors. This multidisciplinary collaboration fosters a comprehensive understanding of brain tumor biology, enables faster translation of discoveries into clinical practice, and ultimately improves patient care with clinical trials.

Brain Tumor Research Advances

Significant contributions to brain tumor research have occurred at the University of Pittsburgh, with numerous groundbreaking discoveries and innovations. Researchers have pioneered novel techniques for intraoperative brain tumor visualization for fluorescence-guided surgery (FGS). In addition, brain tumor imaging has been developed at the University of Pittsburgh, such as advanced MRI and PET imaging, which allow for better visualization and characterization of tumors. These imaging tools aid in precise tumor diagnosis, treatment planning, and monitoring of treatment response.

Brain tumors are inherently immunosuppressive. Previous work in our brain tumor program identified new vaccine strategies for the treatment of gliomas. Researchers in our group developed glioma-associated antigen peptide vaccines to boost tumor-specific immune responses. Phase I clinical trials of these vaccines demonstrate robust induction of antigen-specific immune responses and some clinical activity in both adult and pediatric patients with glioma. Recent studies have identified patterns of gene expression in peripheral blood mononuclear cells that are associated with response and resistance to peptide-based vaccination in pediatric low-grade gliomas.

Another strategy in brain tumor research is to inhibit the pathways that promote tumor growth or to stimulate those that promote tumor cell killing. The poor response of malignant gliomas to conventional therapies, such as cytotoxic chemotherapy or radiotherapy, reflects resistance of these tumors to undergoing apoptosis in response to DNA damage or mitogen depletion. Through a large-scale screening study, we have identified several exploitable targets, which when inhibited induce tumor cytotoxicity. We have been examining pharmacological agents to inhibit these targets, alone and in combination with agents that induce apoptotic signaling in these tumors.

The Brain Tumor Biology and Therapy Laboratory, led by Dr. Agnihotri, has recently identified novel and clinically actionable pathways in diffuse midline gliomas (DMG), pediatric gliomas, and glioblastoma multiforme (GBM) with publications in JCI Insight, Molecular Oncology, and Developmental Cell. Dr. Agnihotri was one of a handful of international researchers awarded a 2022

Distinguished Scientist Award and Grant from the Sontag Foundation for study of pediatric brain tumors. He also received an Idea Development Award from the Department of Defense and a V-Foundation grant to support his brain tumor research.

The Brain Tumor Evolution Therapy Lab, led by Dr. Hu, has focused on developing a new class of drugs for targeting the immune-suppressive microenvironment in glioblastoma and understanding molecular mechanisms of medulloblastoma metastatic dissemination. An important publication in Nature Cell Biology was published this year. This work in the lab has been supported by NIH/National Cancer Institute (NCI) R01 and NINDS R21 grants.

The Brain Tumor Metabolism and Functional Genomics lab, led by Dr. MichaelRaj, were involved in multiple high impact journal publications in Science and Nature Communications. Dr. MichaelRaj was the recipient of a new research grant by the Matthew Larson Foundation studying pediatric ependymomas.

The Pediatric Neurosurgery ImmunoOncology lab, led by Dr. Kohanbash, advanced research across multiple focus areas including preclinical testing of immunotherapies, big data generation and analysis, and radiochemistry. The lab published two primary research articles including a manuscript in Cancer Research Communications demonstrating the potential for a new PET imaging agent to be used for monitoring immunotherapy responses. The lab obtained new NIH R01 and R21 grant funding from the NCI and NINDS, respectively and received a grant from the Ian's Friends Foundation to develop a novel swine model of DIPG.

Brain Tumor Translational Advances

The Department of Neurological Surgery brain research efforts have been at the forefront of developing innovative treatment strategies for brain tumors. Researchers have conducted extensive investigations into targeted therapies, immunotherapies, and gene therapies that hold great promise for improving patient outcomes. Their work has led to the development of clinical trials testing novel treatments, providing hope for patients who have limited options.

An important new clinical trial, which will be the first in the U.S. for newly diagnosed GBM patients, will be intraoperative photodynamic therapy (PDT). Patients will initially undergo a maximal resection of their GBM tumor with the use of 5-ALA fluorescence-guided surgery (FGS). After completion of tumor removal during surgery, intraoperative 5-ALA PDT will then be performed. Patients will then go onto their standard of care treatment options after their tumor removal and PDT. Enrollment of the first GBM patients will occur in late 2023, with Jan Drappatz, MD, associate director of neuro-oncology at UPMC, serving as the principal investigator.

In 2022, the University of Pittsburgh Department of Neurological Surgery became an integral part of the Glioblastoma Therapeutics Network, a collaborative effort by the National Cancer Institute (NCI). This program, led at UPMC by Kalil Abdullah, MD, and his Translational NeuroOncology Lab is designed to stimulate scientific and clinical teams from select institutions across the country to develop promising drugs in the laboratory and then design clinical trials that can be performed at multiple sites. As a component of this NIH-funded effort, researchers are currently evaluating new drugs that may be used to treat the most difficult brain cancer, glioblastoma. One of these drugs targets IDH-mutant gliomas, which are more common in younger adults. In addition to laboratory work, clinical trials are being planned for both new drugs.

A new form of treatment—magnetic hyperthermia therapy (MHT)—for GBM, is now under development at the UPMC Hillman Cancer Center in the Brain Tumor Nanotechnology Laboratory, directed by Dr. Hadjipanayis. MHT relies on the intratumoral delivery of magnetic iron-oxide nanoparticles (MIONPs) for the generation of local hyperthermia after application of an alternat-

ing magnetic field (AMF). MHT is currently being studied in preclinical brain tumor models in combination with adjuvant therapies (chemoradiation). A trial has been launched for studying MHT for treatment of canines with spontaneous gliomas with Johns Hopkins University. Treatment planning is also under development with Penn State University. A new collaboration with Blue Pearl Pet Hospital in Pittsburgh is being established for further study of MHT in canine brain tumor patients prior to launching a clinical trial for human brain tumor patients.

Clinical Care Advances

As one of the highest volume tumor centers in the country, care of our neurooncology patients is facilitated by an emphasis on cutting-edge technology and clinical advances. Currently, clinical care of patients with skull base tumors, primary brain tumors and metastatic brain tumors related to systemic cancer represent a major focus for our department's activities. During the last 41 years, the UPMC Center for Image-Guided Neurosurgery has provided care to more than 20,000 patients using minimally invasive options to biopsy, resect, or provide adjuvant therapies. One of the most important adjuvant strategies to control brain tumor progression is optimization of radiation delivery techniques. Using technologies such as Gamma Knife® radiosurgery at UPMC Presbyterian (over 18,000 patients have been treated and over 1,400 articles, books, or chapters have been published) and linear accelerator radiation technologies at UPMC Shadyside, methods to enhance the efficacy and safety of radiation delivery have been pioneered.

Since 1975 the department has been noted as a source of innovation in brain tumor diagnosis and management. In 1981 the first dedicated CT scanner was installed in a unique operating room at UPMC Presbyterian to facilitate minimally invasive surgical techniques. Now updated this facility also serves as a site to explore less invasive strategies for tumor removal such as the endoscopic endonasal approaches, endoport resection using guiding technologies coupled with endoscopic removal, and transorbital approaches. Working hand in hand with our skull base program, innovative combined strategies for tumor biopsy or removal followed by adjuvant radiosurgery, chemotherapy, or immunotherapy has offered new advances in patient care resulting in ever longer high-quality outcomes. This year, the UPMC Hillman Cancer Center obtained the AIRO/BrainLab system, allowing for intraoperative CT scanning to allow navigated instrumentation during oncologic spinal reconstruction, and high-fidelity intraoperative frameless registration for patients with brain tumors. This substantial investment is a foundational commitment to advancing state-of-the-art brain neurosurgical oncology care.

In 2023, Laser Interstitial Thermal Therapy (LITT) has been an area of emphasis at UPMC. Both the UPMC Hillman Cancer Center and UPMC Presbyterian utilize this technology for patients with brain tumors and radiation necrosis across our region and worldwide. One of the primary advantages of LITT is its minimally invasive nature, as it involves the use of a thin laser probe inserted directly into the target tissue. This allows for precise and localized treatment, reducing the risk of damage to surrounding healthy tissues. LITT is particularly beneficial for brain tumors and lesions, as it provides an alternative to open surgery, thereby minimizing the risk of complications, reducing hospital stays, and promoting quicker recovery times. Moreover, LITT is performed under real-time MRI guidance, enabling the neurosurgical team to monitor and adjust the treatment as necessary, ensuring optimal outcomes. Additionally, LITT is associated with lower morbidity rates and improved quality of life for patients, as it preserves neurological function and avoids the need for traditional open craniotomy procedures.

In 2023, a new academic-industrial partnership is being launched by the UPMC Department of Neurological Surgery, the University of Pennsylvania and Synaptive Medical. This new initiative entitled "Diffusion MRI-Guided Pre-Operative Planning for Supra-Total Resection of High-Grade Gliomas" will be led by Ragini Varma, PhD, professor of radiology at the University of Pennsylvania, and Constantinos Hadjipanayis, MD, PhD, in partnership with Wes Hodges, founder of

Synaptive Medical, to provide an enhanced preoperative planning tool for brain tumor surgery that will facilitate extended safe resection of glioblastoma tumors that are not evident with conventional imaging. The tool will be created by integrating diffusion MRI based methods to visualize white matter pathways in edematous and infiltrated regions of the brain, into a commercial neuro planning and navigational software with Synaptive Medical Inc. that will be used by clinical partners at UPMC, the University of Pennsylvania, the University of Nebraska, and the Ochsner Clinic Foundation for evaluation of clinical utility and patient safety. The extended resection facilitated by the enhanced tool is expected to lead to better patient outcomes.

Focused ultrasound will now be available at UPMC for treatment of patients in 2024. Research efforts are underway to establish important clinical trials utilizing focused ultrasound for treatment of brain tumors by opening of the blood brain barrier and sonodynamic therapy in combination with 5-ALA administration.

Innovative imaging techniques are being developed and applied to better understand brain tumors and their structural relationship with surrounding white matter tracts. High-Definition Fiber Tractography (HDFT) provides a superior presurgical evaluation of the fiber tracts for patients with complex brain lesions, allowing us to reconstruct fiber tracts and design a less invasive trajectory into the target lesion. We are currently investigating its potential for not only presurgical planning and intraoperative navigation but also for neurostructural damage assessment, estimation of postsurgical neural pathway damage and recovery, and tracking of postsurgical changes, neuroplasticity, and responses to rehabilitation therapy. The ability to obtain fiber-tracking preoperatively has now been expanded to the UPMC Hillman Cancer Center at UPMC Shadyside, allowing a multimodal approach to tumor resection. The goal is to facilitate brain function preservation and recovery in patients undergoing complex brain tumor surgery.

For brain tumor patients, presurgical brain mapping is performed using magnetoencephalography (MEG), a cutting-edge technology and the most advanced method of functional brain imaging. MEG recordings provide a direct measurement of brain functions allowing brain surgeons to view critical functional areas of brain to determine the best way for removing brain tumors, while preserving brain function and improving recovery.

Alba Tull Center for Neuro Imaging and Therapeutics
Impactful healthcare innovation results from an idea that progresses through the stages of clinical need identification, solution conception, prototyping, and commercialization. Additional progression through patent filing, FDA submission and approval, and partnering with industry may be necessary.

A center focused on fostering healthcare innovation provides the means to achieve this progression, either in the form of funding, informational resources, or expertise in a certain field, such as law or business, to assist with intellectual property disclosure or business development. Prior to reaching this stage, however, there is prerequisite prototyping, preliminary proof-of-concept work, validation of initial work, and team building.

The Alba Tull Center for Neuro Imaging and Therapeutics provides unmet needs in certain key areas not addressed in the current innovation ecosystem at the University of Pittsburgh. The center will occupy a unique niche that combines all the following characteristics:

1. *A multidisciplinary community with an integrated physical and digital space.* This is the key aspect of the AT Center, as it will serve as the initial starting point for innovators to gather. This can be a clinician with an unmet clinical need who otherwise does not have the time or expertise to prototype a solution. This can also be health science students who have

strong interests in medical innovation and wish to get more involved but are unsure where to start or are overwhelmed by the current landscape of innovation at Pitt. This can be a law student with an interest in medical patenting but without formal access to such learning in their school, even though their expertise would be desperately needed by those in the health sciences who wish to start a company and patent their product. In addition, the creation of an online community and robust digital infrastructure, discussed in more detail below, is paramount to the success of this center in the modern era.

2. *An inter-institutional community.* Pittsburgh has a rich community with over nine different colleges in the area, yet there are very few ways to formally link students and faculty. Especially with CMU as our closest and most resource-rich neighbor, current connections exist informally and are disjointed. As will be discussed below, a symbiotic relationship specifically in the realm of medical innovation will be established, serving as a catalyst for extending the reach of the AT Center to the entire Pittsburgh area.

3. *A focus on extended reality and artificial intelligence/machine learning (AI/ML).* These so-called "exponential technologies" are widely utilized in the modern tech industry and business, while medicine has lagged in applying these technologies. Reasons for this include a culture reticent to adopt new technology, especially if current methods are acceptably accomplishing the job; a need to robustly validate emerging technology that can impact human lives; and overall lack of knowledge about new technological trends. This center will support technological development by taking advantage of our expertise in extended reality and AI/ML applications in medicine. The AT Center will help make these technologies more accessible to everyone.

4. *A robust digital infrastructure that has embedded discussion feeds, project repository, and users.* In the modern age and with increased remote work, this has become more crucial than ever. Creation of an online community allows discussion to happen anywhere and with anyone, minimizing barriers to entry for those with interest in medical innovation but would otherwise have no access to this community. A project repository serves as a database of all available and ongoing projects, allowing any user to introduce new ideas or explore existing projects while other users can join ongoing projects based on their skillset or interests. This is the heart of the AT Center's operations, serving as a "digital meeting space" for all members and acting as a platform to recruit new innovators.

5. *An ability to rapidly prototype, demo, and test a clinical solution.* Many maker spaces, machine shops, or labs exist throughout the Pitt community. Our space exists as an initial starting point that offers basic prototyping capabilities for those innovators/innovation teams who are starting. We can then redirect those members who require more extensive prototyping capabilities to our partnered innovation spaces across campus, or to the larger innovation institutes around Pitt. In the case of the latter, we will assist with grant applications for funding. This space is meant to invite in anyone with an innovative solution to a clinical problem, no matter where that idea is on its path to implementation and nurture its growth.

6. *Accessibility due* to its physical proximity to clinicians and members of the health sciences community. At the core of all medical innovation, need, effectiveness, and minimal disruption in clinical flow (at least in the adoption stage) drive the outcome and success of an idea. Ideas tend to originate in the clinic and validation tends to occur in the clinic. Therefore, having proximity to both clinicians and their clinics is integral for success and growth. This will increase the AT Center's chances of capturing clinicians with an innovative idea since the space is physically easy to visit and is digitally accessible. This should reduce risk of 'idea

launch failure', which may in turn increase innovation output from the health science that we can direct the surrounding innovation community.

7. *Biomedical focus.* Many maker spaces and innovation centers exist on campus, but this will be the first all encompassing, "one-stop-shop" for all biomedical specific innovation and entrepreneurial activities on campus. This center serves to integrate established innovation institutes by creating a coherent, immersive, collaborative medical innovation community.

Magnetoencephalography (MEG) Research

The aim of MEG research, directed by Avniel Ghuman, PhD, is to facilitate, develop, and advance clinical and basic neuroscience research using magnetoencephalography (MEG). To this end, Dr. Ghuman is helping to develop new research applications for MEG in collaboration with researchers throughout the community.

MEG is the most powerful functional neuroimaging technique for noninvasively recording magnetic fields generated by electrophysiological brain activity, providing millisecond temporal resolution and adequate spatial resolution of neural events.

MEG is currently being used to study the healthy brain—both in adults and during development—in order to understand the neural basis of cognitive processes, including reading, vision, audition, motor control, semantic memory, executive functioning, emotional processing, and working memory. Furthermore, groups in the community are also using MEG to understand how neural processing is disturbed in a host of pathologies, including TBI, schizophrenia, spinal cord injury, HIV-AIDS, epilepsy, autism spectrum disorders, Alzheimer's disease, and Parkinson's disease. MEG currently supports both presurgical clinical services and several major (R01 or equivalent) NIH grants.

National TBI Biospecimens Repository

A national repository of biological samples from patients who have sustained traumatic brain injuries (TBIs) has been established in the Department of Neurological Surgery at the University of Pittsburgh. This biorepository supports the Transforming Research and Clinical Knowledge in Traumatic Brain Injury (TRACK-TBI) study, a multi-center initiative funded by the National Institutes of Health (NIH) that has been revolutionizing clinical care for brain-injured patients. A central goal of the TRACK-TBI biorepository is to identify blood-based biomarkers that can assist hospital-based clinicians in diagnosing TBIs and allow industry partners in the laboratory to identify new, effective treatments. Three thousand participants who have sustained a TBI have been recruited into the TRACK-TBI study, and a large, high-quality database of clinical, imaging, biomarker, and outcome data has been generated.

In collaboration with the TRACK-TBI coordinating center at the University of California, San Francisco (led by Geoff Manley, MD) and our 17 U.S. partner sites, David Okonkwo, MD, PhD, and Ava Puccio, RN, PhD, at the University of Pittsburgh received a large supplemental award from the U.S. Department of Defense (DoD) to establish the TRACK-TBI biorepository. Following laboratory renovations and certification in February 2016, the Department of Neurological Surgery at the University of Pittsburgh became the official new home of the TRACK-TBI biospecimens repository. Current collaborative research with industry and DoD funded projects investigating a FDA-pivotal trial examining acute blood-based biomarker studies in an aid to diagnosis positive intracranial computed tomography findings (Abbott Laboratories). The results of this study will assist in the future, revolutionary point-of-care testing for TBI diagnostics.

The TRACK-TBI biorepository is the largest centralized collection of biological samples from TBI patients in the United States. For a complex disorder like TBI, which has global incidence but

lacks definitive clinical classification for diagnosis and therapy, multicenter collaboration is key for progress in research. Only with large numbers of patients and samples will researchers be able to address the many variations of TBIs. Similar to other disease processes, such as cardiovascular disease and cancer, diagnoses must be matched with a biomarker of injury and genetic markers for treatment directives.

Additional NIH and DoD studies have recognized the expertise of the biorepository and are utilizing the biorepository efforts for their storage needs.

Faculty Research Laboratories

Brain Tumor Biology and Therapy Laboratory
The Brain Tumor Biology and Therapy Laboratory, is under the direction of Sameer Agnihotri, PhD, and has a focus on several topics:

- It is now appreciated that HGG glioma comprises of several molecular subgroups and that the genetics of pediatric and adult HGG are distinct. Therefore a "one size that fits all" approach to therapy will not be successful. The Agnihotri Laboratory interests include using next-generation sequencing technology to identify and validate driver alterations of various HGG with a focus on DIPG and non-histone mutated "RTK" Glioblastoma (GBM).

- A defining hallmark of glioblastoma and DIPG is altered tumor metabolism. The metabolic shift towards aerobic glycolysis with reprogramming of mitochondrial oxidative phosphorylation, regardless of oxygen availability, is a phenomenon known as the Warburg effect. In addition to the Warburg effect, glioblastoma tumor cells also utilize the tricarboxylic acid cycle/oxidative phosphorylation in a different capacity than normal tissue. The Agnihotri Laboratory investigates the metabolic dependencies of brain tumors and if they can provide therapeutic vulnerabilities.

- The lab uses the genomic and metabolic information to build better representative brain tumor pre-clinical models for testing of novel therapies. Working closely with a clinical team use of these accurate models are essential to start early phase clinical trials.

Brain Tumor Evolution & Therapy Laboratory
The Laboratory of Brain Tumor Evolution & Therapy, under the direction of Baoli Hu, PhD, is interested in the genetic and epigenetic events contributing to the evolution of brain tumors. The long-term goal of the lab is to achieve a better understanding of brain tumor biology and to develop more effective diagnoses and therapeutic strategies for the treatment of brain cancer.

Cancer is increasingly being viewed as an ecosystem where the cancer cells dynamically evolve and spatiotemporally communicate with surrounding cells and environmental factors. Deciphering this evolutionary complexity allows us to better understand brain tumor initiation, progression, recurrence, and drug resistance. The Brain Tumor Evolution & Therapy Lab is focusing on glioma which is the most common malignant brain tumor in adults, and the most common type of embryonal tumor arising in the central nervous system in childhood. Specific projects are as follows:

- *Modeling the evolution and complexity of brain tumors.* Intratumor genetic heterogeneity and phenotypic diversity are the hallmarks of glioma and medulloblastoma, which predict the risk of tumor development, progression, and response to treatment. To delineate the crosstalk mechanisms of these factors, Dr. Hu's lab is interested in generating various sophisticated models, which can faithfully recapitulate the molecular diversity, cellular hetero-

geneity, and microenvironmental complexity seen in patient tumors. These models include genetically engineered mouse brain tumor models, syngeneic and humanized mouse brain tumor models, ex vivo brain tumor models (e.g., brain slices), human-in-mouse model systems based on malignant transformation of human neural/cerebellar stem cells driven by subtype-specific genetic/epigenetic alterations, and so on. These models will deepen our understanding of tumor evolutionary dynamics at the molecular and cellular levels. The key regulators in this process are validated as diagnostic biomarkers and therapeutic targets for clinical application.

• *Interrogating consequences of neural stem cell/tumor cell plasticity within the brain tumor microenvironment.* Dr. Hu's lab previously found that glioblastoma stem cells (GSCs) differentiate into endothelial-like cells (GdECs), which recruit host endothelial cells (ECs) to form an invasive niche, resulting in tumor invasiveness and recurrence. They are continuing their efforts to gain a better understanding of the molecular mechanisms of these cancer stem cells, and how they communicate with their surrounding cells (e.g., endothelial cells, microglia/macrophages, astrocytes, etc.), which allows us to develop novel and more effective therapies by targeting critical components of the tumor microenvironment.

• *Targeting glioblastoma immunosuppression in brain tumor immunotherapy.* Glioblastoma is highly immunosuppressive and resistant to immunotherapy because glioma cells escape from effective antitumor immunity through programing the tumor microenvironment (TME). Dr. Hu's lab has recently found that cancer cell-intrinsic signaling reprograms tumor-associated macrophages (TAMs) to mediate tumor suppression by novel protein binding complexes CHI3L1-Gal3-Gal3BP. Their interest is focused on understanding how these protein complexes regulate TAM recruitment, polarization, cytokine production, tumor-infiltrating lymphocyte inactivation, and how to target these protein complexes by developing new drugs in brain tumor immunotherapy.

• *Illuminating mechanisms governing cancer cell invasion and dissemination in the brain.* The major challenge in the clinical management of glioblastoma is that cancer cells extensively infiltrate into the surrounding tissue, leading to nearly universal recurrence. Group 3 medulloblastoma is characterized by frequent metastasis at diagnosis and the worst prognosis among all the subgroups. Dr. Hu's lab aim is to elucidate molecular mechanisms of de novo invasion and treatment-induced invasion (e.g. TMZ, bevacizumab, etc.), which enables us to identify "drivers" mediating cancer cell invasion and dissemination and to aid in the development of new therapies.

Brain Tumor Nanotechnology Laboratory

The Brain Tumor Nanotechnology (BTN) Laboratory at the UPMC Hillman Cancer Center is a bench top and translational lab with a focus on the preclinical testing of nanoparticle constructs for the targeted imaging and therapy of patient-based brain tumor models both in cell culture and in animal models. Led by principal investigator Constantinos Hadjipanayis MD, PhD—executive vice-chair of the University of Pittsburgh Department of Neurological Surgery, director of the UPMC Center for Image-Guided Neurosurgery, and co-director of the UPMC Hillman Brain Tumor Center—current activities include brain tumor cell targeting, uptake, downstream signaling pathways, imaging, and therapy efficacy evaluation. The main goal of the lab is to facilitate translation of preclinical work into human clinical studies for brain tumor patients. The BTN lab is comprised of postdoctoral fellows, medical students, and a laboratory technician. Current daily activities of the BTN lab are overseen by Alexandros Bouras, MD, who is the BTN lab manager.

The lab is actively studying the use of alternating magnetic fields (AMFs) with magnetic iron-oxide nanoparticles (MIONPs) for magnetic hyperthermia therapy (MHT) of brain tumors. MHT is felt to enhance the effects of radiation therapy (RT)/chemotherapy and disrupt the blood

brain barrier (BBB). As part of an established NIH R01 grant, the lab has established a multidisciplinary (neurosurgery, radiation oncology, biomedical engineering, neuroimaging, and veterinary medicine) and interinstitutional collaboration with Johns Hopkins University and Pennsylvania State University to translate MHT in combination with adjuvant therapies to GBM patients. This effort includes a clinical proof-of-concept trial in spontaneous canine glioma patients. A new collaboration with BluePearl Vet Hospital in Pittsburgh is now being established to further study MHT in canine glioma patients and further define the tumor immune microenvironment with sophisticated imaging and tissue-based studies. This vet hospital is a major referral center for neuro-oncology and offers comprehensive clinical care through an integrative approach which will further facilitate and optimize the translational potential for MHT of GBM.

The BTN lab is also involved in the study of photodynamic therapy (PDT) as a potential adjuvant therapy for malignant brain tumors. PDT is a two-step treatment involving the administration of a photosensitive agent followed by its activation at a specific light wavelength. 5-aminolevulinic acid (5-ALA) is a photosensitizing precursor that can be used for PDT and as an intraoperative imaging agent for fluorescence-guided visualization of malignant tissue during glioma surgery. The porphyrin derivate verteporfin (VP) can penetrate the brain, pharmacologically target glioma cells, inhibit tumor invasion and is a potent chemotherapeutic agent that is also FDA approved for PDT in macular degeneration. The lab is actively studying both 5-ALA- and VP-mediated PDT in combination with RT and chemotherapy in cell culture and rodent models for the treatment of GBM. In this context, the BTN lab has established a collaboration with Huang Chiao Huang, PhD, a professor of bioengineering at the University of Maryland, to perform preclinical studies to test a proprietary formulation of VP, which may be a more potent PDT agent compared to the existing FDA approved formulation. The lab is planning to assess the feasibility and safety of intraoperative PDT utilizing VP after partial surgical resection in canine patients with spontaneous gliomas in collaboration with BluePearl Vet Hospital.

Combination therapies resulting in both radiosensitivity and chemosensitivity enhancement of malignant brain tumors are studied as well in the BTN lab. Various patient-based rodent brain tumor models are used for therapeutic efficacy and safety studies. Another focus of the lab is the study of DNA damage signaling and response to therapy. Inhibitors of the DNA damage signaling kinase ATR (ATRis) can potentiate tumor cell killing induced by both chemotherapy and radiation therapy (RT). Moreover, ATRis in combination with RT have exhibited immunomodulatory effects in mouse tumor models. In this context, the lab has established a collaboration with Christopher Bakkenist, PhD, a professor of radiation oncology at UPMC Hillman Cancer Center, to evaluate the potential therapeutic efficacy of ATRis in combination with RT and chemotherapy in the treatment of glioblastoma (GBM). Preclinical studies will be conducted in patient-derived brain tumor models both in cell culture and in rodent models to determine therapeutic efficacy and toxicity.

Clinical Neurophysiology Laboratory

The Clinical Neurophysiology Laboratory, under the direction of Parthasarathy Thirumala, MD, MS, studies the diagnostic value of intraoperative neuromonitoring (IONM) during surgery to detect perioperative neurological disorders like stroke, spinal cord, peripheral nerve injury, delirium and cognitive dysfunction. Neuromonitoring during surgery utilizes electroencephalography (EEG), somatosensory evoked potential (SSEP), motor evoked potentials (MEP), and electromyography (EMG). The focus of research is in three specific areas:

1) *Preoperative Risk Assessment*. We plan to develop preoperative risk assessment models so patients can utilize neuromonitoring in patients at risk for stroke during surgery. Patients who undergo non-cardiac, non-neurosurgery mortality after stroke are six times higher than mortality in patients with myocardial infarction.

2) *Intraoperative Diagnosis.* Our primary focus is to improve the diagnostic accuracy of SSEP, EEG, MEP, EMG in perioperative neurological disorders. In collaboration with Shyam Visweswaran, MD, PhD, and Kayhan Batmanghelich, PhD, we are developing novel patented methods to analyze real time neuromonitoring data to provide alerts.

3) *Post Operative Management.* We plan to study immediate interventions based on intraoperative diagnosis of stroke, spinal cord and peripheral nerve injury. For example, based on changes in EEG and SSEP during cardiac surgery, we can diagnose stroke and recommend interventions during surgery or immediately after the surgery.

Cognitive Neurodynamics Laboratory

The Laboratory of Cognitive Neurodynamics, under the direction of Avniel Ghuman, PhD, studies how our brain turns what falls upon our eyes into the rich meaningful experience that we perceive in the world around us. Specifically, the goal of these studies is to examine the spatiotemporal dynamics of how neural activity reflects the stages of information processing and how information flows through brain networks responsible for visual perception. The lab is particularly interested in the dynamic neural representation of faces, bodies, objects, words, and social and affective visual images. Furthermore, the lab studies the neural basis of real-world cognition and visual perception. The lab recently received major research funding (R01) to support this work.

In collaboration with pediatric neurosurgeon Taylor Abel, MD, and José-Alain Sahel, MD, chair of the University of Pittsburgh Department of Ophthalmology, the Laboratory of Cognitive Neurodynamics is also embarking on a project to use a combination of functional neurosurgery, artificial intelligence and computational neuroscience approaches to restore sight to blind individuals.

Cortical Systems Laboratory

The Cortical Systems Lab, under the direction of Jorge A. González-Martínez, MD, PhD, is a neuroscience laboratory studying brain electrophysiology, cognition and language in patients undergoing epilepsy and movement disorder surgery. The overreaching goal of our work is to better understand the neurobiology of cortical-subcortical interactions in the normal and pathological human brain. The lab aims to develop new methods for brain mapping and therapeutic options for patients with medically refractory epilepsy and movement disorders, including neuromodulatory and resective procedures. The laboratory is highly integrated with the University of Pittsburgh Epilepsy Center, The Physical Medicine and Rehabilitation Department at the University of Pittsburgh and the Carnegie Mellon University Department of Biomedical Engineering.

The laboratory clinical arm is the Epilepsy Monitoring Unit (EMU), part of the University of Pittsburgh Epilepsy Center. The epilepsy center at the University of Pittsburgh is one of the leading epilepsy surgery programs in the world, with more than 5,000 adult patient-visit annually. The program offers the opportunity for comprehensive evaluation in a self-contained, eight-bed, adult epilepsy monitoring unit (EMU). The EMU features the latest technology including state-of-the-art, all digital video EEG equipment in private rooms. Operating around the clock, seven days a week, the unit is staffed by a dedicated team of nurses and EEG technologists specializing in epilepsy and overseen by staff epileptologists. The unit is part of the Comprehensive Epilepsy Center, a multi-disciplinary group of neurosurgeons, neurologists neuroradiologist, neuropsychologist, nurses, residents, and fellows who coordinate the care and research related topics for patients with medically refractory epilepsy. Patient Management Conference Meetings (PMCs) are performed weekly, on Mondays, where all aspects of patient care are discussed in an academic and teaching environment. Approximately 50 to 60 invasive monitoring procedures (SEEG) are performed per year in our center.

Current research projects include:

- ***Establishing Novel Properties of Dynamic Systems Models to Identify Epileptogenic Networks in Patients with Drug Resistant Epilepsy***
  The objectives of the proposed computational approaches and experiments are to (i) develop and validate a new EEG marker based on dynamical systems modeling, and (ii) develop a method to guide periodic cortical stimulation to elicit seizures for EZ localization which, if successful, have the potential to significantly reduce invasive monitoring times, avoiding further risks to patients and reducing costs.

- ***Influence of Task Complexity and Sensory Feedback on Cortical Control of Grasp Force***
  The overall goal of the proposal is to uncover motor cortical dynamics underlying grasp control by performing bidirectional clinical trial in human subjects implanted with Utah array.

- ***The Role of Basal Ganglia in Language and Motor Control***
  The goal of this proposal is to explore the role of subcortical nodes in the basal ganglia-thalamocortical network and the cortex in coding various aspects of motor control, through electrophysiological study of networks targeted during deep brain stimulation surgery.

- ***Neuromodulation of Motor Cortical Circuits via Thalamic Deep Brain Stimulation to Improve Face and Speech Motor Functions***
  Researchers propose to refine the mapping of the motor thalamus to identify the optimal target of stimulation and optimize the stimulation parameters to improve face and speech motor functions.

Fiber Tractography Laboratory

The Fiber Tractography Lab, led by Fang-Cheng (Frank) Yeh, MD, PhD, focuses on the exploration of connectomics as a promising imaging biomarker for understanding and diagnosing brain disorders. The lab's primary research interest lies in method development, which involves collaboration with esteemed experts from diverse disciplines, including radiologists, psychologists, psychiatrists, neurologists, and neurosurgeons. Through these collaborations, the lab strives to discover novel applications of diffusion MRI, pushing the boundaries of knowledge in this domain. The ultimate goal of the lab is to leverage innovative imaging methods to unravel the intricate mechanisms underlying both normal and dysfunctional brain function in translational neuroscience.

With dedicated work in the tractography and structural connectome field, the lab has played an instrumental role in introducing groundbreaking concepts that have revolutionized the field. Notable contributions include the development of the tract-to-region connectome, shape analysis of tracts, and differential tractography. These novel approaches have significantly enhanced the utility of connectomics in research and clinical applications, driving advancements and fostering innovation in the field.

The Fiber Tractography Lab's extensive experience, multidisciplinary collaborations, and unwavering dedication to innovative research make it a compelling candidate for grants in the field. The lab is committed to making substantial contributions to the understanding of brain disorders, with the aim of improving diagnostics and interventions.

These are the main areas of research in the Fiber Tractography Lab:

• Novel Tractography Modalities: Correlational Tractography and Differential Tractography
The Fiber Tractography Lab is honored to have made pioneering contributions to the field of tractography-based connectomics. The lab's groundbreaking concepts have transformed the understanding and analysis of brain connectivity. Notably, the lab's development of correlational tractography has been a significant innovation. This approach has enabled the mapping of pathways strongly correlated with specific study variables, providing valuable insights into the relationship between brain connectivity and clinical and cognitive factors. These insights have the potential to greatly impact the diagnosis and treatment of neurological disorders.

In addition to correlational tractography, the lab has been at the forefront of utilizing differential tractography. This technique has allowed the identification and mapping of pathways undergoing significant neuronal changes over time. By capturing and analyzing these changes, the lab has gained unprecedented understanding of brain plasticity and pathology. These findings have advanced our knowledge of neurological conditions and their progression.

To further enhance tractography analysis, the lab has successfully integrated shape analysis techniques from the field of computer vision. This innovative approach has provided a more comprehensive analysis of fiber pathway architecture, surpassing traditional connectivity measures. By examining the structural characteristics of neural connections, the lab has uncovered novel insights into the organization and function of the brain's intricate network. The integration of shape analysis has received widespread recognition and has been cited in numerous high-impact publications, solidifying the lab's position as a trailblazer in the field.

The lab is committed to advancing the field of tractography-based connectomics by sharing its innovative approaches and providing invaluable tools and methodologies to researchers worldwide. Through this collaborative effort, the lab aims to drive advancements in the understanding of brain connectivity and its implications for neurological disorders. The team remains dedicated to pioneering research and looks forward to continuing its journey of unraveling the complexities of the human brain.

• Construction of Diffusion MRI Templates, Tractography Atlases, and Structural Connectome
The Fiber Tractography Lab has made significant and unique contributions to the field of tractography connectomics and templates, reshaping the landscape of diffusion MRI-based research. Through its efforts, the lab has introduced innovative concepts such as the tract-to-region connectome and beyond-tensor templates, pushing the boundaries of exploration and understanding.

Recognizing the limitations of traditional diffusion tensor imaging (DTI) templates with low-angular resolution, the lab embarked on a transformative journey to develop beyond-tensor templates that transcend the constraints of DTI. These advanced templates provide diffusion distribution at significantly higher angular resolution, unlocking the potential for unprecedented template-space fiber tracking. The lab's methodology has yielded remarkable outcomes, allowing researchers to conduct spatial geometry studies of major white matter pathways with unparalleled precision and fidelity. By harnessing the power of its beyond-tensor templates, the lab has surpassed existing templates based on DTI, providing researchers with the tools to explore the intricacies of brain connectivity and unravel enigmatic pathways.

The lab's beyond-tensor diffusion MRI templates and tractography atlases have propelled the field of connectomics into a new era of accuracy and detail. By offering enhanced resolution and accuracy, methodologies have enabled researchers to investigate complex fiber pathways with unprecedented precision, shedding light on the fundamental organization of the brain. These

resources have opened up avenues for more accurate diagnoses, targeted interventions, and improved patient outcomes in the realm of neurological disorders. The insights gained from these beyond-tensor templates and atlases have the potential to drive advancements in personalized medicine, paving the way for tailored treatments and therapies.

The Fiber Tractography Lab remains committed to fostering collaboration and sharing its contributions to the field. Through its endeavors, the lab hopes to empower researchers and clinicians worldwide to further unravel the mysteries of brain connectivity, ultimately improving the lives of individuals affected by neurological disorders.

• High Accuracy Tractography

The Fiber Tractography Lab has taken on the challenge of addressing the limitations of conventional diffusion MRI methods in accurately tracking fiber pathways. The lab's team has pioneered a novel density-based measurement that significantly enhances the accuracy of fiber tracking algorithms.

Compared to traditional diffusivity-based measurements like fractional anisotropy, the lab's method has demonstrated remarkable improvements in accuracy. To validate its effectiveness, the lab has participated in a global competition organized by the International Society for Magnetic Resonance in Medicine (ISMRM). Among the numerous approaches submitted by esteemed groups worldwide, the lab's density-based measurement achieved the highest valid connection score of 92.49% (ID#03). This exceptional performance stands as a testament to the efficacy of the Fiber Tractography Lab's method in substantially improving the accuracy of diffusion MRI fiber tracking.

Building upon this success, the lab has recently integrated its high-accuracy fiber tracking method with a topology-informed approach. By incorporating topological information, lab researchers have further enhanced accuracy and expanded its clinical applicability. This breakthrough advancement enables more robust and reliable fiber tracking, allowing for a deeper understanding of the complex connectivity patterns within the brain.

The integration of the lab's density-based measurement and topology-informed approach represents a significant milestone in diffusion MRI-based research. By overcoming the limitations of traditional methods, the lab's researchers have paved the way for more precise and reliable fiber tracking. This empowers researchers and clinicians in their investigations of brain connectivity, providing them with valuable tools to advance the diagnosis, treatment, and understanding of neurological disorders.

The Fiber Tractography Lab remains committed to humility and continued progress in the field. The lab's researchers strive to collaborate with fellow researchers and clinicians, sharing knowledge and methodologies to collectively drive advancements in diffusion MRI-based research. By humbly contributing to the field, they aspire to make a lasting impact on the understanding and management of neurological disorders, ultimately improving patient outcomes and quality of life.

• DSI Studio: An Integrative Platform for Tractography Analysis

For over a decade, the dedicated efforts of the research team have been centered around the development of DSI Studio—a remarkable diffusion MRI analysis tool that has revolutionized brain connectivity research. The lab's unwavering commitment has resulted in the creation of a powerful, integrative, and cutting-edge software that has transformed the field.

DSI Studio has gained widespread acclaim within the neuroscience community, standing as a widely recognized and respected software tool. Its advanced functionalities enable comprehensive diffusion MRI analysis, encompassing image preprocessing, tensor estimation, and fiber tractography. By providing diverse tractography algorithms and templates, DSI Studio offers a flexible and customizable framework for investigating brain connectivity. Researchers can leverage its versatility to optimize their analyses, with additional features such as automatic quality control, region-of-interest (ROI) editing, and clustering analysis.

The scope of DSI Studio extends beyond its standard capabilities, accommodating multiple diffusion MRI data types, including conventional diffusion tensor imaging (DTI) and Q-space imaging. This broad compatibility ensures its suitability for a wide range of research studies, enhancing its utility within the scientific community.

The significant impact of DSI Studio is evident through its extensive citation count, surpassing 2,000 publications. This impressive usage attests to the tool's widespread recognition and its contribution to advancing neuroscience. The development team has continually enhanced and updated DSI Studio, incorporating features such as GPU acceleration, parallel computing, and cloud-based computing. These advancements have facilitated the processing of larger datasets and reduced computation time, empowering researchers in their investigations.

DSI Studio is the culmination of years of diligent research and development. Its comprehensive functionalities, advanced tools, and compatibility with various diffusion MRI data types have propelled it to the forefront of diffusion MRI analysis. Its broad adoption and continuous improvement have solidified DSI Studio as an indispensable tool for researchers worldwide, fostering groundbreaking discoveries and driving advancements in the field of brain connectivity.

Molecular Tumor Personalized Precision Laboratory

The Molecular Tumor Biology and Personalized Precision Therapy Lab, under the direction of Pascal Zinn, MD, PhD, focuses on patient-centered care for brain and spinal tumors. Every patient is unique and so is every tumor; therefore, a personalized precision approach is fundamental to the treatment of tumors.

Utilizing humanoid brain disease avatars or so-called brain organoid models, Dr. Zinn replicates the patient's condition in the laboratory and thus studies how tumors form and how tumors can be treated using tumor genetics precision approaches.

Furthermore, Dr. Zinn is developing personalized biologically-adaptable and patient-tailored, virus-based therapies for brain cancer.

Neuroapoptosis Laboratory

The Neuroapoptosis Laboratory at the University of Pittsburgh Department of Neurological Surgery, under the direction of Robert Friedlander, MD, focuses on the study of the basic mechanisms of apoptosis as mediated by the caspase apoptotic family in neurologic diseases. In addition, discovering novel approaches to ameliorate the impact of cell death in a variety of neurological diseases is a central theme of the laboratory. The role of synaptic mitochondrial vulnerability, specifically as it relates to synaptic degeneration, has been a recent emphasis.

The laboratory is evaluating the impact of apoptotic cell death, and in particular, neuronal death mediated by the caspase cascade on the pathogenesis of neurodegenerative diseases. Neurodegenerative diseases presently being investigated are Huntington's Disease (HD), Alzheimer's Disease (AD) and Amyotrophic Lateral Sclerosis (ALS). Given that ageing plays a role in all of these diseases, the impact of normal and pathological ageing is also being evaluated.

Activation of the caspase cascade appears to play an important role in a variety of neurodegenerative diseases. Researchers have demonstrated that inhibition of the caspase-1 (also known as ICE) apoptotic protein slows disease progression and delays mortality in transgenic mouse models of ALS and Huntington's disease. Furthermore, delivering caspase inhibitors directly into the brain of these transgenic mice prolongs their survival. This was the first intervention demonstrated to be efficacious in a HD model. Adding relevancy to these findings, researchers have also demonstrated that caspase-1 is activated in the brain and spinal cord of humans with HD and ALS respectively. They also have demonstrated that minocycline demonstrates neuroprotection in a mouse model of HD by inhibiting caspases.

Apoptotic cell death plays a significant role in stroke as well as traumatic brain and spinal cord injury. Researchers are evaluating the impact of caspase activation has on apoptotic cell death in these conditions. The relationship between caspases and free radical production is also being investigated as well as targeted through caspase-mediated pharmacoprotection.

Using in vitro models, researchers are evaluating both the mechanisms involved in the activation of caspases, as well as the post-caspase activation pathways involved in cell death. The role of inflammation in neurodegeneration continues to be a focus of research.

An additional focus of the Neuroapoptosis Laboratory has been the demonstration that neuronal melatonin is synthesized exclusively in mitochondria. This initiated a paradigm shift regarding our understanding of melatonin's mechanisms of action. The laboratory demonstrated that melatonin receptors are located on the mitochondrial outer membrane. Together, these new findings suggest melatonin is made in the mitochondrial where it is secreted and then binds to its high affinity receptor. This "automitocrine" pathways modulates mitochondrial stability and neuroprotection. To better understand the automitocrine pathway and its effect on neuronal function, we have generated a new mouse model where the rate limiting step of melatonin synthesis has been knocked out. This model has features of accelerated ageing and is an important tool in our ongoing studies.

Pediatric Neurosurgery ImmunoOncology Laboratory

The Pediatric Neurosurgery ImmunoOncology Laboratory (PNIO) at the University of Pittsburgh, under the direction of Gary Kohanbash, PhD, seeks to develop novel immuno-oncology approaches to treat deadly pediatric central nervous system tumors. With over a decade of experience in translational brain tumor immunology and involvement in numerous clinical trials, the laboratory has a specific focus on high-grade and low-grade gliomas, and diffuse intrinsic pontine glioma (DIPG).

It is now known that immune cells can traffic into the central nervous system (CNS) and mediate anti-tumor responses. However, owing to its immune-privileged status and delicate brain structures, safety and efficacy must be considered in a different manner than tumors occurring outside of the CNS. With significant developments in next-generation sequencing, novel targets targeting pediatric CNS tumors are being identified.

The PNIO seeks to bridge the gaps between bioinformatics, non-invasive PET imaging, theranostics, preclinical studies, and patient care. Specific emphasis in the PNIO involve improving peptide vaccine immunotherapy through the following projects:

- Identification of novel targetable tumor antigens and neoantigens.
- Employing novel combination therapies with peptide vaccine immunotherapy.
- Identification of biomarkers for CNS immuno-oncology clinical trials.
- Development of non-invasive immunoPET imaging of activated T-cells to predict response or resistance to immunotherapy.

- Theranostic targeting and monitoring of tumor-associated myeloid cells (TAMCs) including MDSCs and TAMs in brain tumors.
- Single-cell RNA-sequencing to identify immune-cell and tumor cross-talk as well as T-cell clonal expansion.
- Development of T-cell receptor engineered T-cell (TCR-T) adoptive cell therapies
- Generation of intraoperative molecular imaging (IMI) agents
- Applying targeted radiopharmaceutical therapy (RPT) to reduce immune-suppression in brain tumors.

Spinal Cord Stimulation Laboratory

The Spinal Cord Stimulation Laboratory, under the direction of Marco Capogrosso, PhD, and part of the University of Pittsburgh Rehab and Neural Engineering Labs, broadly studies the interactions between electrical stimulation and the dynamics of spinal circuits. Specifically, laboratory activities are focused on three areas of interest:

• Area 1: Clinical Applications of Spinal Cord Stimulation in Motor Disorders

Dr. Capogrosso applies the results his basic scientific work in translational clinical trials in patients that suffer from motor disorders such as stroke, spinal cord injury and motoneuron diseases. Specifically, he aims to test new implantable technologies to improve motor and sensory functions in people with arm and hand paralysis. He currently has two open clinical trials, one investigating the potential of spinal cord stimulation to restore arm and hand movement after post-stroke hemiparesis, and the second exploring the use of spinal cord stimulation to revert motoneuron degeneration in spinal muscular atrophy.

• Area 2: Biophysics of Electrical Stimulation

Dr. Capogrosso uses computational biophysics and modern AI strategies to decipher the computational principles underlying the interaction of artificial electrical stimulation and the neural dynamics of spinal circuits. Specifically, he aims to understand how artificial electrical pulses influence the neural activity of neurons.

• Area 3: Electrophysiology of Spinal Circuits and Mechanisms of Neuromodulation

Dr. Capogrosso performs electrophysiology in animal models such as mice and monkeys to understand how the spinal cord and the brain reacts to electrical stimulation. He aims to combine results from computer models with experimental data to optimize neurostimulation technologies and design new effective therapies to motor paralysis.

Surgical Neuroanatomy Laboratory

The Surgical Neuroanatomy Lab (SNL) has a dual educational and research role aiming to improve surgical techniques and outcomes by mastering knowledge of relevant surgical neuroanatomy. Under the joint direction of Paul Gardner, MD, and George Zenonos, MD, in the Department of Neurological Surgery, and Carl Snyderman, MD, MBA, and Eric Wang, MD, in the Department of Otolaryngology, the lab follows our clinical philosophies of teamwork and innovation.

Many national and international students, residents, and fellows have conducted training and research at the SNL. The working philosophy at the SNL is that of Albert L. Rhoton, Jr., MD, handed down from Juan Fernandez-Miranda, MD: meticulous and exquisite anatomical microdissections to better understand the intricacies of the complex anatomy of the human brain and skull base.

The lab has four main research/educational areas: endoscopic skull base anatomy, microsurgical neuroanatomy, new approach development, and white matter anatomy/brain connectivity/surgical planning.

• Endoscopic Skull Base Anatomy
The Endoscopic Endonasal Approach (EEA) has revolutionized skull base surgery. The EEA has anatomical and technical advantages over open skull base approaches for the treatment of selected lesions. EEA is not minimally invasive but designed to be a maximally effective corridor for the treatment of a wide variety of ventral skull base lesions. The Surgical Neuroanatomy Laboratory at the University of Pittsburgh has pioneered anatomical work on the area of skull base endoscopy, and its goal is to continue providing landmark contributions to the skull base community. Meticulous knowledge of the ventral skull base anatomy as seen from the endoscopic perspective is critical to apply endonasal endoscopic surgery in an effective and safe manner.

• Microsurgical Neuroanatomy
Conventional skull base approaches are being compared with novel endoscopic endonasal approaches to aid in understanding indications and limitations of different but complementary skull base approaches. Contemporary skull base surgeons should combine expertise in open and endoscopic skull base approaches to select the most appropriate approach and technique for each particular case. Emphasis is made on the circumferential conceptualization of the skull base and the selection of "anatomically-favorable" surgical routes.

• New Approach Development
Following our philosophy of constant evaluation and innovation between the anatomy lab and the operating room, the SNL is used to develop and examine new approaches or expand known approaches to help define modern skull base surgery. Examples include the expansion of the lateral orbitotomy to the cavernous sinus and middle fossa, the development of the contralateral transmaxillary (CTM) approach and the anterior transmaxillary approach for temporal lobectomy (ATM-TL) for epilepsy.

• White Matter Anatomy
Dissection of the white matter fiber tracts provides a unique insight into the complex intrinsic architecture of the brain and builds up an essential knowledge for operating on intra-axial tumors. A unique feature of our white matter studies is the combination with advanced imaging techniques, such as High-Definition Fiber Tractography (HDFT), to facilitate greater understanding of brain connectivity "in-vivo" and in neurosurgery patients. These techniques are also being studied to try to improve the imaging of cranial nerves.

Translational Neuro Oncology Laboratory
The Laboratory for Translational Neuro-Oncology at the UPMC Hillman Cancer Center, under the direction of Kalil Abdullah, MD, MSc, is focused on developing novel clinical models of glioma and identifying druggable targets to facilitate early phase clinical trials.

Gliomas are intensely heterogenous tumors that not only contain numerous cell types, but also demonstrate the ability to transition between different phenotypic states. This complexity has made developing model systems that recapitulate human tumor biology both difficult and essential. Traditionally, models of gliomas are 2-dimensional cell lines and only represent certain subtypes of the highest-grade glioma, glioblastoma. This is because the unique biology of lower grade gliomas has prevented them from being studied either outside of the lab or in animals. Ex-vivo culture systems have been created allowing researchers to investigate critical aspects of the tumor microenvironment, immune response, and discover targets for therapy. The laboratory has previously shown the ability to establish lower grade glioma organoids in vitro, maintain those cultures for extended periods of time, hibernate, and then reanimate tumor tissue without loss of either genetic or phenotypic fidelity. This work also includes extensive and sophisticated live-cell imaging analysis that allows for longitudinal, non-invasive assessment of organoid response to treatment.

The organoid model systems, in addition to glioma stem cell and mouse models, allows researchers to perform highly sophisticated assessments of drug response across platforms, and identify rare but critical druggable targets in gliomas. These analyses include complex metabolic tracing and immune cell response assessment. Despite the fundamental principles of genomics, immunology, and cellular cancer biology that underlie this work, the Translational Neuro-Oncology Lab group focuses on projects that have high potential for immediate clinical translation.

A major area of focus in our lab is exploiting metabolic vulnerabilities in glioma. We have identified a series of critical metabolic targets through large-scale multi-omic screens that are promising drug targets. Our work in this area represents a synergy between comprehensive molecular and mechanistic approaches and cancer neuroscience.

Studying metabolic vulnerabilities in glioma, a type of brain tumor, has the potential to yield significant advances in our understanding of tumor biology and the development of novel therapeutic strategies. Gliomas exhibit distinct metabolic alterations compared to normal brain tissue, which can be exploited to target and treat these tumors more effectively. Here are key advances that can be made from studying metabolic vulnerabilities in glioma:

1. Identification of metabolic alterations: Investigating the metabolic profile of glioma cells can reveal specific alterations in metabolic pathways compared to normal brain cells. This includes changes in glucose metabolism, amino acid metabolism, lipid metabolism, and mitochondrial function. Understanding these alterations provides valuable insights into the tumor's unique metabolic requirements and vulnerabilities.

2. Targeting altered glucose metabolism: Glioma cells often exhibit increased glucose uptake and utilization, known as the Warburg effect. Exploiting this metabolic dependency, researchers can develop targeted therapies that interfere with glucose metabolism. For example, inhibiting key enzymes involved in glucose metabolism or employing drugs that selectively target glucose transporters on tumor cells can impair their energy production and growth.

3. Exploiting amino acid metabolism: Glioma cells have distinct amino acid requirements for survival and growth. Studying the altered amino acid metabolism in gliomas can lead to the identification of vulnerabilities that can be targeted therapeutically. For instance, specific amino acid transporters or enzymes involved in amino acid metabolism can be targeted to disrupt the tumor's nutrient supply and inhibit its proliferation.

4. Targeting lipid metabolism: Altered lipid metabolism is another characteristic feature of gliomas. Tumor cells may rely on increased lipid synthesis to meet their energy and membrane synthesis needs. Understanding the specific alterations in lipid metabolism pathways within glioma cells can open avenues for developing therapies that disrupt lipid synthesis or utilization, effectively targeting tumor growth.

5. Expanding therapeutic options: The study of metabolic vulnerabilities in glioma can provide new avenues for developing targeted therapies beyond traditional approaches like surgery, radiation, and chemotherapy. By exploiting the unique metabolic features of glioma cells, researchers can identify and develop drugs or combination therapies that specifically target these vulnerabilities, potentially leading to more effective and less toxic treatment options.

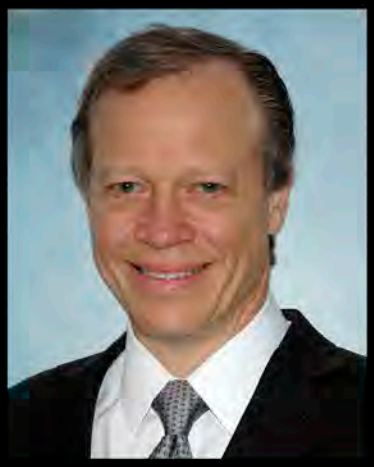
6. Personalized medicine approaches: Metabolic profiling of glioma tumors can provide valuable information for personalized medicine approaches. Analyzing the metabolic char-

acteristics of individual tumors can help identify patient-specific vulnerabilities and guide the selection of targeted therapies. This approach allows for tailored treatment strategies that consider the unique metabolic profile of each patient's tumor, potentially improving treatment outcomes.

7. Overcoming therapeutic resistance: Gliomas often develop resistance to conventional therapies, posing a significant challenge for successful treatment. Investigating metabolic vulnerabilities can offer insights into the mechanisms underlying treatment resistance and help develop strategies to overcome it. By targeting the metabolic alterations that drive therapy resistance, researchers can enhance the effectiveness of existing treatments or develop new therapeutic approaches to combat resistant gliomas.

By targeting the altered metabolic pathways and vulnerabilities specific to glioma cells, researchers can potentially improve treatment outcomes, overcome therapeutic resistance, and pave the way for more personalized and effective approaches to managing this challenging form of brain tumor. To that end, the TNO maintains active collaboration with other laboratories and pharmaceutical companies worldwide. Because of the nature of their research, a close interplay between the neurosurgical operating room and the laboratory is paramount. As such, they have an expansive team of highly motivated scientists and clinical research coordinators that facilitate tissue acquisition, processing, and analysis.

Pitt
NEUROLOGICAL SURGERY



Robert M. Friedlander, MD, MA
Chair and Walter E. Dandy Distinguished Professor of Neurological Surgery
University of Pittsburgh School of Medicine

Department of Neurological Surgery
UPMC Presbyterian • 200 Lothrop Street • Suite B-400 • Pittsburgh, Pa. 15213
(412) 647-3685
www.neurosurgery.pitt.edu • neuroinfo@upmc.edu

linkedin.com/company/pitt-neurosurgery
facebook.com/pitt.neurosurgery
youtube.com/user/neuroPitt
twitter.com/PittNeurosurg
instagram.com/pittneurosurgery