NYU Langone Health

Neurosurgery

2019 HIGHLIGHTS

Restoring Function

Multidisciplinary expertise proves critical in the spinal resection of a complex vascular lesion

→ page 1

A Culture of Quality

Forward-thinking treatments and surgical precision set a new paradigm in neurosurgical care

→ page 3

Unprecedented Precision

Innovative approaches and advanced imaging redefine brain tumor treatment

→ page 5

#1
In the nation in Ability to Rescue

#7
In *U.S. News & World Report*

37%
Increase in total visit volume 2015–2019

5,600+
Neurosurgical cases in 2019

MESSAGE FROM THE CHAIR

JOHN G. GOLFINOS, MD

Joseph P. Ransohoff Professor and Chair of Neurosurgery
Professor of Neurosurgery and Otolaryngology

Quality in neurosurgery is the difference between a good outcome and a transformative one.

It's enabled by technological leadership, multidisciplinary partnerships, and advanced surgical expertise—all informing the most precise surgical approaches and complication-free hospital stays as our patients recover.

The pursuit of quality for our patients is our shared emphasis as we work to make resection more precise, treatments more effective, and outcomes more predictable—even in the most complex cases. New research is helping to more comprehensively target brain tumor tissue by distinguishing tumor cells from healthy ones, while advances in neuromodulation have recast how tremor is treated.

As quality and safety are enhanced, we continue to rethink conventional protocols and reimagine what neurosurgical outcomes can achieve—for the sake of the patients whose care is our foremost responsibility.

Cover image: 3D-rendered image of a neuron cell network
RENDERING: GETTY IMAGES

Multidisciplinary Surgical Expertise, Advanced Endovascular Imaging Prove Critical in the Spinal Resection of a Complex Vascular Lesion

When a 62-year-old patient with a history of thoracic myelopathy presented with progressive sensory and motor decline despite previous treatment for a complex vascular lesion, a surgical team with vast endovascular and spinal expertise successfully executed a challenging resection that both relieved the patient's symptoms and restored her function—and quality of life.

A CLOSER LOOK AT AN INTRACTABLE VASCULAR LESION

Treatment at another institution for the patient's previously diagnosed spinal arteriovenous malformation had ultimately proved unsuccessful. This was likely due to a mischaracterization in diagnosing the complex lesion, combined with the added complexities of extensive vascular disease and previous spinal surgeries. The patient's accelerating decline, with increasing loss of function in her legs, bladder, and bowel, prompted her referral to Anthony K. Frempong-Boadu, MD, associate professor of neurosurgery and orthopedic surgery, for reassessment.

A repeat MRI revealed extensive thoracic cord expansion and edema with enlarged spinal cord surface veins and flow voids from the T6 level down to the conus medullaris. "The appearance of this lesion mimicked a dural fistula, which is typically associated with cord venous congestion," explains Dr. Frempong-Boadu. However, a subsequent microcatheter-enabled angiogram performed by the neuroendovascular team and Erez Nossek, MD, associate professor of neurosurgery, demonstrated the presence of a pial, not a dural, fistula—supplied by both the posterior spinal artery and the anterior spinal artery. "Usually a pial fistula is drained by regional radicular veins into the epidural space, but we believe this patient's drainage mechanism had shut down, resulting in cord venous congestion over time," Dr. Frempong-Boadu says.

This nuance in diagnosis explained the other institution's attempts to embolize the lesion, as a dural fistula involves a more basic abnormal connection between arteries and veins. For true arteriovenous malformation cases such as this, in which the malformed connection also feeds the main vessel to the spine, greater precision via a more extensive surgical resection is needed to achieve the desired outcomes.

VASCULAR REARCHITECTURE REQUIRES ESSENTIAL EXPERTISE

In documented cases, Dr. Frempong-Boadu likens himself to a plumber brought in to rearchitect the highly complex vascular structure surrounding the spine through surgical resection. "A robust artery connected to a vein is like a water main connecting directly to a sewer in an apartment building," he notes. "Either the veins burst, causing paralysis, or they arterialize, becoming more robust and stealing from the apartment building—the spinal cord—and I need to come in and physically disconnect them."

The complexities of such a diagnosis warranted a collaborative approach shepherded by a multidisciplinary team of hyperspecialized experts. In this approach, Dr. Frempong-Boadu's focused spinal cord expertise was complemented by the neurovascular expertise of Dr. Nossek, enabling them to co-navigate the vascular anatomy and find the fistula point for resection.

Anthony K. Frempong-Boadu, MD
PHOTO: NYU LANGONE STAFF

"In addition to our neurosurgical expertise, finely tuned subspecialty training allows us to subdivide our expertise across the neurological system," says Dr. Frempong-Boadu. "By limiting our practice to focused parts of the anatomy, we each operate within the bounds of our training, thus ending up with both a vascular and spinal neurosurgeon on the same case."

ADVANCED IMAGING TECHNIQUES UNDERPIN SYSTEMATIC SURGICAL PLANNING

With further endovascular procedures ruled out due to the lesion's morphology, a multidisciplinary team of neurosurgeons, vascular surgeons, neurointerventional radiologists, and endovascular specialists architected a carefully planned resection. The lesion's delicate location near the spinal cord demanded a minimal approach to preserve function, aided by a combination of surgical expertise and a suite of high-fidelity endovascular imaging technologies. During surgery, an intraoperative angiogram was achieved via a technically challenging radial artery approach, entering via the wrist and navigating the complex path to the lesion via the aorta, in order to achieve uninterrupted precision in the context of the patient's extensive vascular disease.

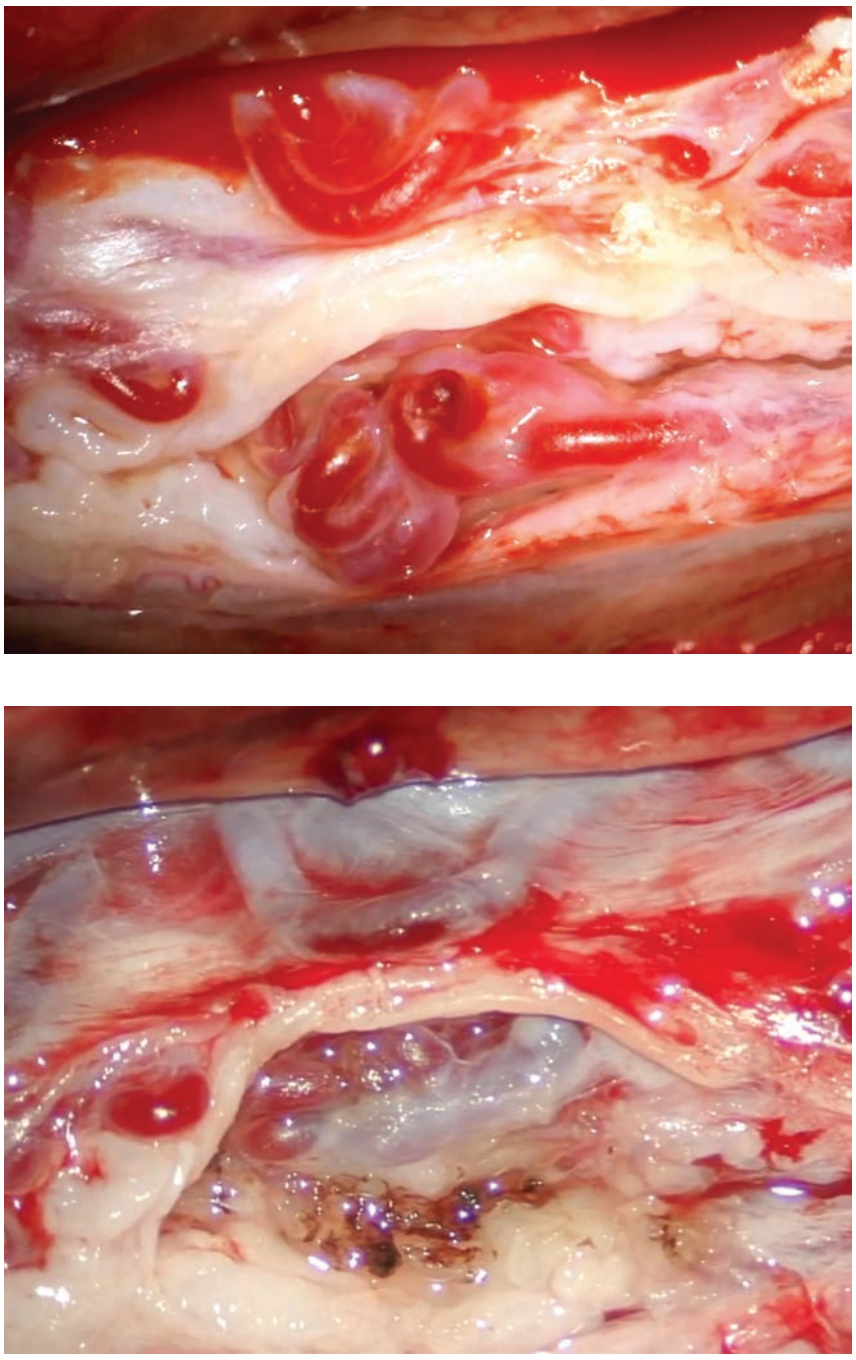
"The standard angiogram, via the groin, is made difficult during spinal surgery when we need to turn the patient to achieve surgical access," says Dr. Nossek. "Entering through the wrist requires greater technical agility since you have to first direct the catheter toward the head before entering the spinal cord, but it was necessary given this patient's vascular risk."

CAREFUL RESECTION ENCOMPASSES SYSTEMATIC APPROACH

In this case, with the intraoperative angiogram prepared, Dr. Frempong-Boadu began the surgical approach by performing a posterior T9 to T11 laminectomy and then opening the dura, careful to avoid the surrounding vasculature. Under high-resolution magnification, the engorged vein and feeders of the fistula were visible, along with the proximal venous pouch just distal to the fistula, bulging superficially from the spinal cord. "We bring in a microscope and align the microscope image and the endovascular image until we have a near overlay before we begin the dissection," notes Dr. Frempong-Boadu.

With the pial dissection technique, the arteriovenous fistula was carefully dissected and the feeders clipped. The main feeder was coagulated and separated, dissected slowly through the arteriovenous fistula and its main drainage, and detached from the spinal cord. "The dissection has to proceed in the correct order, with the inflow targeted before the outflow," explains Dr. Frempong-Boadu. "Otherwise, returning to the plumbing analogy, if you take out a pipe and there's still water coming in, the whole thing explodes when you cut the drain."

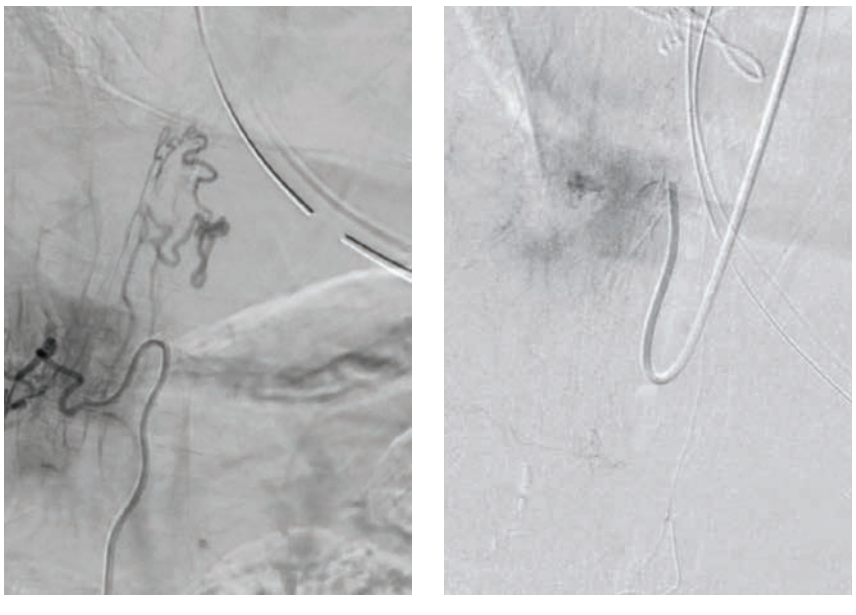
With continuous somatosensory evoked potential and periodical motor evoked potential monitoring stable, the resection and dissection continued to reach the recipient arterialized fistula vein. Indocyanine green (ICG) video angiography was performed, and there were no signs of fistulation or early vein drainage, so the clips were removed. A complete occlusion of the pial arteriovenous fistula was observed, and a previously engorged secondary draining vein appeared bluish in color. An intraoperative angiogram was performed via radial access, showing complete occlusion with no residual shunt.



Top: The arteriovenous malformation is seen along with its feeder and proximal venous pouch, distal to the fistula point, bulging superficially out of the spinal cord.

Bottom: With complete occlusion of the arteriovenous malformation, the previously engorged secondary draining vein now appears blue in color.

PHOTOS: DR. ANTHONY FREMPONG-BOADU



T10 angiogram before (left) and after (right) arteriovenous fistula resection.

PHOTOS: DR. ANTHONY FREMPONG-BOADU

AN EXCELLENT OUTCOME, ACHIEVED COLLECTIVELY

Postsurgical recovery, notes Dr. Frempong-Boadu, can vary based on the extent of each patient's condition and spinal cord involvement. This patient's initial symptoms were relieved, and with bilateral improvement of weakness in her legs, she is now fully mobile without the need for assistive devices, continuing to achieve progress with ongoing rehabilitation. That outcome, he adds, is the result of a carefully calibrated approach enabled through meticulous planning by a multidisciplinary team representing complementary surgical expertise. "Guided by real-time imaging and the expertise across an array of specialists, we are able to approach these cases tactically—almost militarily," concludes Dr. Frempong-Boadu. "Preserving and restoring function, safely, is our absolute priority as we approach these complex cases with an eye toward continually higher-quality outcomes."

Donato R. Pacione, MD
PHOTO: NYU LANGONE STAFF

Quality Initiatives Set a New Standard for Neurosurgical Excellence

Enhanced by complementary expertise and leading-edge technology, a culture of quality and safety is driving decision-making across the Department of Neurosurgery. With forward-thinking treatment approaches and innovation-led advances in surgical precision, neurosurgeons are setting the standard for neurosurgical outcomes and enhancing patients' quality of life—even as cases grow in both volume and complexity.

A SHARED DEFINITION OF QUALITY ACROSS THE CARE SPECTRUM

Propelled by a strong culture of quality and safety that permeates all levels of the institution, department-led initiatives build on a record of category-leading neurosurgical outcomes. At the same time, maintaining and enhancing the safety of patients' postoperative care remains a critical emphasis as surgical volume continues to grow across locations.

"To set the standard for great neurosurgery, we take a deeper dive beneath the broader picture of medical quality and look carefully at quality care from both the surgeon's and the patient's viewpoint," explains John G. Golfinos, MD, the Joseph P. Ransohoff Professor and Chair of the Department of Neurosurgery and professor of otolaryngology—head and neck surgery. "We want to create the best possible outcomes from our surgeries, then prevent the things that can happen during a patient's hospital stay."

Such a spectrum of continuous improvement includes adoption of the standard metrics of quality shared across NYU Langone Health, such as reduction of surgical site infections and venous thromboembolisms, as well as the enhancement of individual patient outcomes through neurosurgical advances, imaging innovation, and multidisciplinary partnerships. These goals are reinforced through quality and high-reliability organization rounds, along with regular quality improvement meetings to ensure that the emphasis on excellence is shared and reinforced.

These and other enhancement measures are impacting overall quality metrics, supporting high performance in such categories as observed-to-expected mortality and ability to rescue, in which the department is ranked number one in the country for its ability to lead a patient who experiences complications to full recovery.

ADVANCED TOOLS INFORM SURGICAL APPROACH

Investments in advanced intraoperative technologies, such as MRI scans, CT scans, and robotics, provide unprecedented visualization and precision, enabling highly skilled surgeons to more thoroughly resect tumors in less time. These technologies work together to clarify the margins of tumor versus normal tissue, elucidating the limits of the pathology in order to enable greater moderation in the surgical approach. "These tools are synergistic—they work better together to make tumor resection faster, smoother, and more accurate," notes Dr. Golfinos.

For example, the pairing of intraoperative MRI with the department's intraoperative frozen section microscope—one of just two nationwide—has substantially enhanced gross total resection rates while reducing repeat surgeries.

"You can take a specimen and, within five minutes, know whether you've reached gland tissue or there's residual tumor," notes Donato R. Pacione, MD, assistant professor of neurosurgery and director of Quality Assurance. "With these tools together, you have greater confidence that you're taking the bad and leaving behind the good."

For benign pituitary adenomas, enhanced visualization of tumor margins, enabled by intraoperative imaging, has reduced the need for any additional surgery to address residual tumor to 0 over 12 months. For some pituitary tumors, advanced intraoperative imaging helps clarify the boundary between normal gland

RANKED
#1
BY VIZIENT FOR BRAIN TUMOR TREATMENT

ZERO
RETURN TO THE OR FOR PITUITARY ADENOMAS

5,600+
NEUROSURGICAL CASES

and tumor. This has not only improved rates of gross total resection but also reduced the rate of postoperative endocrinopathy. "This technology allows us to better balance aggressive resection with gland preservation," notes Dr. Pacione. "And that impacts quality of life for our patients, who can avoid taking lifetime supplementation for a compromised pituitary."

RETHINKING TREATMENT TO REDUCE HARM

Following surgery, the emphasis on quality shifts to calibrating widely accepted treatment methodologies in order to prevent hospital-associated complications and enhance outcomes. With an evidence-based approach, the department is reexamining standard approaches to morbidities, such as infection, to identify whether they are effective in preventing harm—or costly, unnecessary interventions.

Dr. Golfinos and his team of neurosurgeons have reexamined the broad use of prophylactic antibiotics for the duration of the hospital stay in patients who undergo brain or spine surgery. "The axiom of treatment has been that if you cover everything with antibiotics, you'll prevent infections," notes Dr. Golfinos. "But who decided you have to put patients on antibiotics when they have drains put in? There was never any evidence behind that."

To explore whether such antibiotic use reduces infection—or whether it puts patients at greater risk through drug resistance—the NYU Langone neurosurgical team began administering antibiotics only at the time of surgery, which is the minimal best practice recommendation from the American College of Surgeons. The new protocol was implemented using a stepwise approach starting with lower-risk patients and procedures: first cranial surgery, then minimally invasive spinal surgeries, all spinal surgeries, spinal drain catheters, and finally endonasal surgeries, thought to be the highest risk in terms of bacterial exposure.

In studying more than 1,100 patients, 30-day infection monitoring revealed a reduction in postoperative infections along with a concurrent reduction in drug-resistant organisms. Additionally, antibiotic-associated *C. difficile* infections have been significantly reduced to just a single case in the last year, with a notable reduction in unnecessary care costs. Results of the initiative have been published in the *Journal of Neurosurgery*, *Journal of Neurosurgery: Spine*, and the *British Journal of Neurosurgery*. The department is working internally within the health system and externally with specialty societies to identify ways to disseminate its findings and transform standards of care in neurosurgery across other institutions.

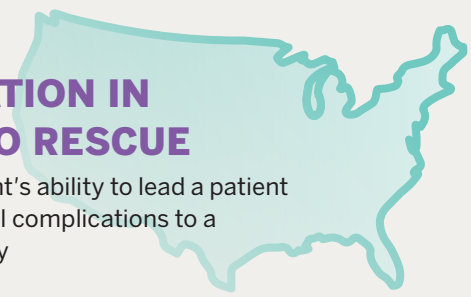
"Not only are we using fewer antibiotics, but now we don't have to worry about resistance as much, and when patients do get infections, now they're less virulent," adds Dr. Golfinos. "We can avoid unnecessary treatment and our patients do better—that's good antibiotic stewardship."

A SUPPORTIVE SHIFT IN CULTURE

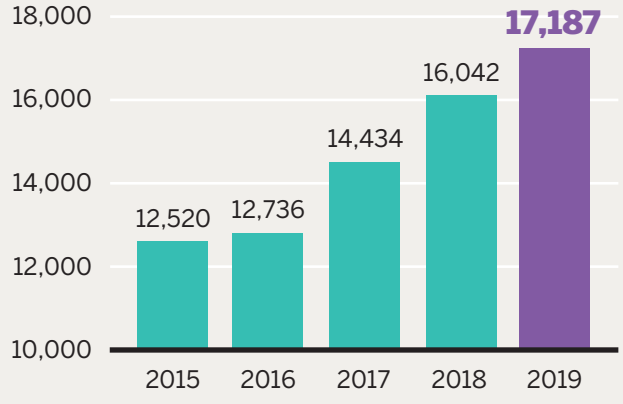
These evolutions in care, notes Dr. Pacione, are a result of the structure of the department, where complications are met with immediate treatment or surgery, as well as an emphasis on patient quality at the cultural level. Such shifts, core to all neurosurgical practices within NYU Langone, require forward thinking, top-down leadership—and constant reassessment.

"It's in the fabric of our department to identify what great neurosurgery looks like and continue to work toward that," says Dr. Pacione. "It means doing things others aren't doing because there's a return in that for our patients—and we're beginning to see the metrics to support that these efforts are creating better outcomes."

#1
IN THE NATION IN ABILITY TO RESCUE
for the department's ability to lead a patient with neurosurgical complications to a complete recovery



37% INCREASE
IN TOTAL OUTPATIENT VISIT VOLUME 2015–2019



"To set the standard for great neurosurgery, we take a deeper dive beneath the broader picture of medical quality and look carefully at quality care from both the surgeon's and the patient's viewpoint."

John G. Golfinos, MD

Daniel A. Orringer, MD
PHOTO: NYU LANGONE STAFF

Refining Brain Tumor Treatment with Cell-Level Precision

Recent advances at NYU Langone's Brain and Spine Tumor Center—part of Perlmutter Cancer Center—are set to refine brain tumor treatment by targeting tumor tissue more precisely. With a novel intraoperative imaging system and collaborative drug trials, center experts are homing in on the nature and location of tumor cells in order to sharpen surgical and therapeutic treatment.

REAL-TIME TUMOR VISUALIZATION INFORMS A COMPREHENSIVE SURGICAL APPROACH

A leading-edge imaging approach, developed by Daniel A. Orringer, MD, associate professor of neurosurgery and pathology, provides unprecedented, near real-time insight into tumor classification and visualization to ensure that no tumor tissue is left behind.

The laser-based imaging technique, stimulated Raman histology (SRH), is able to detect the degree of brain tumor infiltration in fresh, unprocessed human tissues by taking real-time microscopic images akin to traditional histologic slides. The imaging technique overcomes two long-standing challenges inherent to surgical brain tumor management: correct diagnosis of the tumor subtype at the time of surgery and accurate detection of residual tumor following resection.

"We know that patient survival and quality of life heavily rely on a safe and complete resection," says Dr. Orringer. "Unfortunately, imperfect surgical outcomes are common, in part because of how difficult it is to visualize the margins of a tumor in the brain."

SRH provides a new layer of intraoperative insight, shedding light on hidden tumor tissue that, despite traditional imaging and surgical prowess, can go undetected. Once the bulk of a tumor has been resected, SRH creates submicron-resolution images that reveal any remaining tumor tissue. Tissue samples are exposed to a laser beam, which detects and analyzes the light-scattering properties of biomolecules such as proteins, lipids, and nucleic acids. Tumor-infiltrated areas, abundant with protein and DNA, scatter light differently from normal, lipid-rich tissue, and the resulting contrast image provides more detailed information than histologic slides—without tissue processing, freezing, or staining.

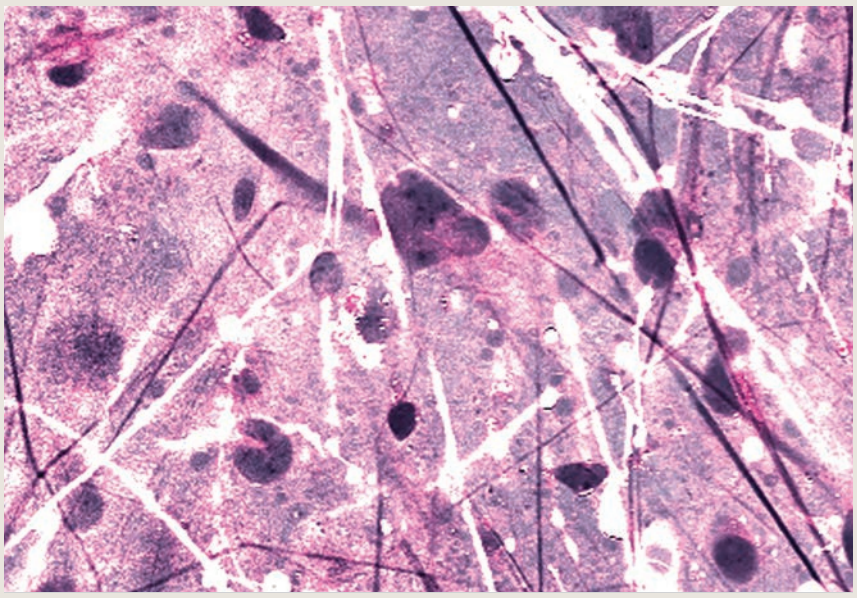
Equipped with these virtual histologic images intraoperatively, surgeons can assess remaining tumor burden in surrounding tissues with unprecedented precision, completing surgical cases with previously unattainable levels of confidence in a tumor's complete resection.

The newest addition to the center's comprehensive suite of innovative neurosurgical imaging technologies, SRH works in concert with intraoperative MRI and fluorescence-guided surgery for high-resolution precision guidance. The technique can also help distinguish whether postresection MRI findings correspond to residual tumor or are simply the results of temporary inflammation due to resection.

"We've created a new paradigm for the way that we think about brain tumor surgery, one that integrates microscopic tissue architecture with our existing technology," notes Dr. Orringer. "There is no other technology that allows for faster microscopic evaluation of tissue in the operating room."

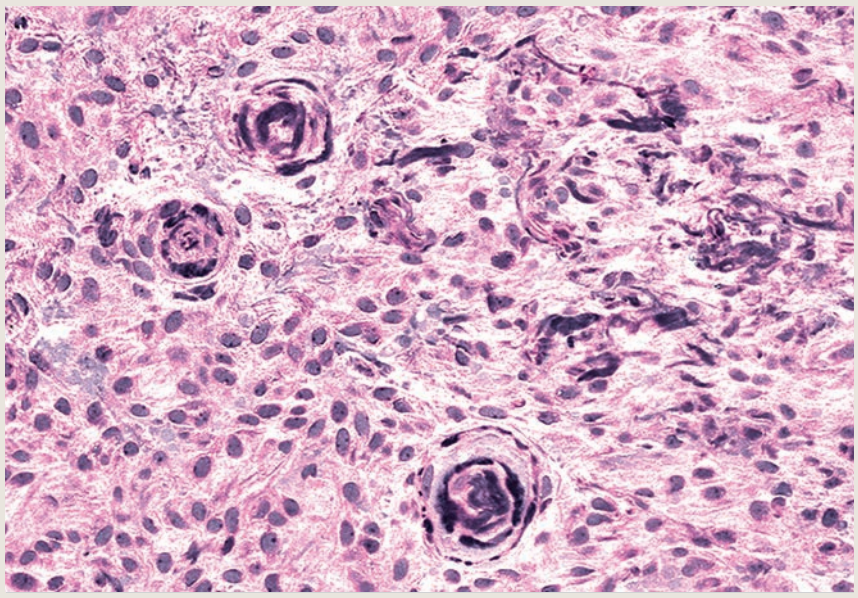
IMAGING COMBINES WITH ARTIFICIAL INTELLIGENCE FOR AUTOMATIC DIAGNOSIS

In addition to conveying surgical treatment confidence with intraoperative insight, SRH delivers a wealth of pathology information regarding a brain tumor's subtype. Dr. Orringer and colleagues have paired SRH with state-of-the-art artificial intelligence (AI) algorithms to automatically categorize tumor tissue into 1 of 13 subtypes to inform their surgical management. In a prospective clinical trial of 278 patients at three institutions, the algorithm correctly classified 94 percent of tumors. Notably, the margin of error was in line with the findings of expert neuropathologists, with entirely nonoverlapping errors. "If pathologists were able to incorporate the insights from the algorithm, their accuracy would approach 100 percent," Dr. Orringer says.



In this SRH image of a diffuse astrocytoma, gray spheres are individual tumor cells, and the fine, dark-colored, hairlike elements are processes the tumor cells send out into the tissue as they infiltrate. Surgeons and pathologists can get an understanding of whether tissue they encounter contains tumor based in part on the number and shape of cells in the tissue being imaged.

PHOTO: DR. DANIEL A. ORRINGER



This SRH image of a meningioma demonstrates the whorled pattern of growth, which is classic for this type of tumor.

PHOTO: DR. DANIEL A. ORRINGER

This precise diagnostic capacity is particularly beneficial for many centers nationwide that lack access to high-quality pathology labs and expert neuropathologists. "With our system," says Dr. Orringer, "we can close that gap and essentially deliver out-of-the-box capacity to detect and diagnose brain tumors with accuracy traditionally found only in the most well-resourced centers."

Even for well-resourced centers, the fast, accurate tumor diagnosis provided by SRH combined with AI can enhance rapid, real-time decision-making. "If we have a patient with a tumor of unknown etiology, making the distinction in the operating room is extremely important," notes Dr. Orringer. With the conventional workflow, surgeons often wait 30 to 40 minutes for pathology, whereas AI and SRH together can make that information available in less than 2 minutes. Rapid access to accurate pathology information will elucidate when tumor margins are best treated with further resection versus chemoradiation therapy—especially when tumor subtypes are known to respond to adjunct therapy—bringing surgical outcomes to new levels of quality and safety.

DEVELOPING NOVEL THERAPEUTICS TO TARGET BRAIN-INFILTRATING TUMOR CELLS

As imaging and diagnostic breakthroughs improve surgical precision, investigators at the Brain and Spine Tumor Center are closing in on another line of attack on the brain-infiltrating tumor cells that may lie beyond surgical reach.

The newest advance builds on a previous discovery by a research team led by Dimitris G. Placantonakis, MD, PhD, associate professor of neurosurgery and director of the Neurosurgical Laboratory for Stem Cell Research. In 2017, the team identified a cell surface receptor, GPR133, expressed in glioblastoma cells but not in normal brain cells. "We know this receptor is necessary for glioblastomas to grow. When we take it away from the cells, they arrest and eventually die," says Dr. Placantonakis.

In new work, the team described the expression profile of this receptor in glioma subtypes taken from a cohort of 67 archived glioma specimens at the center. The profile found that the receptor is de novo expressed in all gliomas, with the highest levels found in glioblastomas. While GPR133 was absent in the subventricular zone that harbors neural progenitors thought to give rise to gliomas, it was ubiquitously expressed in both the tumor bulk and in the brain-infiltrating tumor cells of gliomas, making it both a binary diagnostic tool and a promising therapeutic target.

As a G-protein–coupled receptor, GPR133 belongs to a receptor family whose members collectively make up the targets of one-third of therapeutics on the market. But like many receptors in this family, GPR133 does not have any known ligand, as it is unclear what molecules it binds to.

"GPR133 has been classified as an orphan receptor because no one has looked for its ligand before," Dr. Placantonakis says. "We are the first to do so, looking to understand which proteins or molecules may interact with this receptor." The results of this search will help develop therapeutics that target only the glioma cells, with the goal of stopping their growth by shutting down the receptor.

Disclosure: Dr. Placantonakis and Sosei Heptares have filed a patent application, "Method for treating high grade glioma," for the use of GPR133 as a treatment target in gliomas.

Dimitris G. Placantonakis, MD, PhD

PHOTO: NYU LANGONE STAFF

Resection of an Aggressive Acoustic Neuroma in a Pregnant Patient

A 32-year-old patient consulted with experts at NYU Langone to evaluate her surgical options to address a large acoustic neuroma discovered despite a highly uncommon presentation. Here, a multidisciplinary team of surgeons rapidly mobilized to help her weigh the inherent surgical risks and develop a treatment plan in the context of additional complexity: The patient was 21 weeks pregnant.

As the patient's symptoms continued to intensify, the decision was made to move forward with resection. With a carefully planned multidisciplinary approach, informed by extensive surgical expertise, preoperative planning, and advanced intraoperative monitoring, the life-threatening tumor was resected without complication, optimizing outcomes and quality of life for both the patient and her baby.

ATYPICAL PRESENTATION OF AN AGGRESSIVE TUMOR

Unusual numbness and painlike symptoms on the palate prompted the patient, herself a physician, to seek evaluation at another institution. There, an MRI revealed a 5-centimeter acoustic neuroma that was significantly compressing her brainstem. "She didn't have the usual presentation for this kind of tumor—hearing loss and ringing in the ear," notes J. Thomas Roland Jr., MD, the Mendik Foundation Professor of Otolaryngology, chair of the Department of Otolaryngology—Head and Neck Surgery, and co-director of the Cochlear Implant Center. "Instead, she had fifth nerve symptoms because the tumor compressed the trigeminal nerve." This delayed the diagnosis, which enabled tumor growth and added to the complexity of the treatment approach.

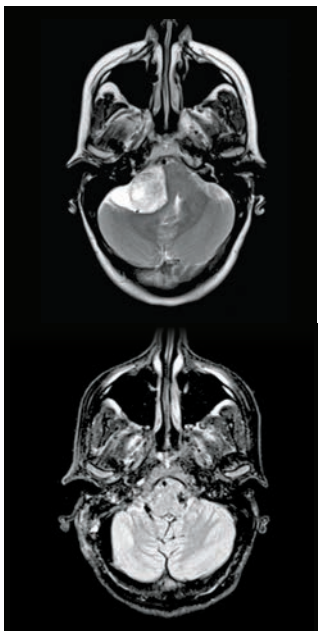
For this patient, the large tumor grew superior to the eighth nerve, which was entangled with the anterior and posterior inferior cerebellar arteries (AICA and PICA) distally. The tumor size, incipient hydrocephalus, and compression of the facial and trigeminal nerves would significantly increase the difficulty and duration of surgical resection. "Such complex acoustic neuroma cases are best managed with a multidisciplinary team approach combining the complementary expertise and surgical skill of two highly subspecialized surgeons, ensuring the best possible outcomes," says John G. Golfinos, MD, the Joseph P. Ransohoff Professor and Chair of the Department of Neurosurgery and professor of otolaryngology—head and neck surgery.

The patient's pregnancy added an additional layer to the complexity of treating such a large, aggressive tumor. Though there were no guarantees that the pregnancy would survive the surgery, delaying intervention until fetal viability was contraindicated as the tumor presented life-threatening risks such as hydrocephalus and stroke if allowed to grow. Radiation was also ruled out, due to the dose requirements of such a sizable tumor.

WEIGHING TREATMENT OPTIONS WITH TWO PATIENTS IN MIND

Together, Dr. Roland and Dr. Golfinos helped the patient weigh her options. Surgery could be delayed until fetal viability using steroid treatment, or a shunt could be placed to temporarily reduce the pressure on her brain until 36 weeks of pregnancy. The other option: they could proceed with surgery as soon as possible, despite fetal risk. If surgery were elected, the team's advanced neurophysiologic monitoring capabilities would be critical to maximize preservation of facial nerve and other brain function during the operation. With these considerations in mind and a plan carefully crafted, the patient opted for immediate surgery, which was scheduled for later that same week.

Throughout the consult, Dr. Roland and Dr. Golfinos were transparent with the patient about the certainty of single-sided hearing loss, which occurs in about 40 percent of acoustic neuroma resections. Though the risk was unavoidable given the size and location



Preoperative imaging (top) shows a large acoustic neuroma compressing the patient's brainstem, and postoperative imaging (bottom) shows restoration of the patient's brainstem to normal size.
PHOTO: DR. JOHN G. GOLFINOS

John G. Golfinos, MD, and J. Thomas Roland Jr., MD
PHOTO: NYU LANGONE STAFF

of this patient's tumor, the team offered unique expertise in leading-edge single-sided deafness technologies.

A TEAM APPROACH IN COMBINATION WITH CAREFUL MONITORING

The patient was prepped, and an ultrasound confirmed fetal heartbeat. Intervention on the previable fetus would not be possible in case of distress, so intraoperative fetal monitoring was not elected. The team's neuro-anesthesiologists administered neural anesthesia, avoiding fetal risks of traditional paralytic agents and enabling intrasurgical monitoring of the patient's brain activity.

The surgical team performed the opening and exposure of the site through the mastoid, using the translabyrinthine approach. Resection of the tumor began after the stimulating probe was used to explore the posterior face of the tumor, confirming the facial nerve was not aberrantly located. Dr. Golfinos and Dr. Roland worked in tandem to debulk and dissect the tumor, freeing it from the facial nerve and the brainstem.

Using a facial nerve function measurement technique as well as traditional facial nerve monitoring, the team performed the tumor dissection without complication. Neurophysiologists monitored brainstem and motor function during the procedure to confirm the tumor was resected while cranial nerves were maintained and pressure from the brainstem was relieved.

"This type of tumor stretches and thins out the facial nerve, so if you're using traditional nerve stimulation you might incorrectly assume that the facial nerve has become dysfunctional because you are stimulating the edge of the nerve," notes Dr. Golfinos. "If you can stimulate from the cortex and get the whole nerve stimulated, as we do, it gives you confidence that the nerve is still OK—and actually speeds up the operation."

With the resection complete and the facial nerve stimulating well at the brainstem with robust response, the patient was sent to recovery, where postoperative ultrasound revealed a fetal heartbeat.

COMPLEXITY NAVIGATED, SURGICAL RISK REWARDED

An MRI two weeks after surgery confirmed total tumor removal and a restoration of the previously compressed brainstem to its normal size. As the team had cautioned, the patient lost hearing on the right side and experienced facial weakness, which has improved over time. Her recovery has been otherwise unremarkable, and months after the operation, the team received photos of the patient's healthy baby girl. "Our unique collaboration between otolaryngologists and neurosurgeons offers the expertise needed to remove a tumor like this safely and completely," says Dr. Roland. "Further, we had prepared this patient for the certainty of hearing loss, and she knew we had the most advanced approaches needed to address her single-sided deafness. We're continuing to work with her to restore her hearing and quality of life to the greatest extent possible, as she takes on parenthood."

High-Intensity Focused Ultrasound Offers Minimally Invasive, Targeted Treatment for Tremor

Alon Y. Mogilner, MD, PhD
PHOTO: NYU LANGONE STAFF

With MRI-enabled precision emerging from a collaboration with neuroradiology, clinicians at the Center for Neuromodulation continue to pioneer high-intensity focused ultrasound (HIFU) as a minimally invasive alternative to treat essential tremor. Like surgical ablation and deep brain stimulation, HIFU similarly targets the thalamus, instead using a noninvasive focused ultrasound beam that creates a lesion, eliminating the abnormal signaling at the root of tremor and thus normalizing the region's circuitry. Requiring only a few hours to complete, HIFU is a safer, noninvasive treatment option with a much lower risk of complications and minimal recovery.

BREAKING NEW GROUND WITH HIFU

The safe use of HIFU requires close partnership among neurosurgery, neurology, and neuroradiology to monitor brain response. "The combination of ultrasound with MRI thermography enables real-time visualization and temperature feedback—safely limiting risk of injury by precisely targeting the tremor," notes center co-director Alon Y. Mogilner, MD, PhD, associate professor of neurosurgery and anesthesiology. The multidisciplinary partnership with neuroradiology has fostered new imaging modalities that achieve even more finely tuned targeting, including an advanced protocol developed by Timothy M. Shepherd, MD, assistant professor of radiology, honing the beam's range to 0.5 millimeters.

This multidisciplinary approach extends to new HIFU applications, with investigations underway into factors behind its efficacy. In one study, Dr. Shepherd and team are applying novel imaging sequences to pre- and post-HIFU MRIs to compare outcomes and individual recoveries. Center clinicians also received FDA approval in 2019 to join a multicenter study applying HIFU to Parkinson's-associated stiffness and slowness—potentially establishing HIFU efficacy for a different brain region. Protocols for other targets could also unlock potential applications for HIFU in Alzheimer's disease and glioblastomas.

SYMPTOMS ABATED, A PATIENT RETURNS TO EVERYDAY FUNCTION

In a recent HIFU case, a 77-year-old retired physician traveled from North Carolina for treatment of his tremor, which had progressed to significantly impact his quality of life. Once the center team confirmed the patient was a candidate, HIFU was scheduled. Progressive improvement during the three-hour procedure led to a dramatic and immediate resolution of the patient's pre-HIFU symptoms. "It's remarkable to see a patient who has been suffering for years walk out the same day with his tremor gone," Dr. Mogilner says. For more patients like this, and those with other brain-based conditions, the development of refined and expanded applications, supported by the center's expertise and patient volume, has made HIFU a promising treatment option when few others are available or viable.

For more on this story and other topics, visit
nyulangone.org/neurosurgery2019

Awards & Recognition

Jafar J. Jafar, MD, received the NYU Langone Neurosurgery Faculty Teaching Award.

Douglas Kondziolka, MD, is the principal investigator of Stroke and Traumatic Brain Injury (TBI) Stem Cell Therapy Trials. NYU Langone's Stroke Center is the only comprehensive center in the U.S. to host both stroke and TBI cell therapy trials, bringing together experts in the field of rehabilitation medicine, neurology, and neurosurgery.

Dimitris G. Placantonakis, MD, PhD, was appointed director of the Embryonic Stem Cell Research Oversight (ESCRO) committee to oversee activities related to human embryonic stem cell research.

Margaret Rice, PhD, was elected co-chair of the 2020 Basal Ganglia Gordon Research Conference.

Selected Publications

Benjamin CG, Frempong-Boadu A, Hoch M, Bruno M, Shepherd T, Pacione D. Combined use of diffusion tractography and advanced intraoperative imaging for resection of cervical intramedullary spinal cord neoplasms: A case series and technical note. *Operative Neurosurgery*. November 1, 2019; 17(5): 525–530.

Benjamin CG, Sen RD, Golfinos JG, Sen C, Roland JT Jr., McMenomey S, Pacione D. Postoperative cerebral venous sinus thrombosis in the setting of surgery adjacent to the major dural venous sinuses. *Journal of Neurosurgery*. October 2019; 131(4):1 317–1323.

Bledea R, Vasudevaraja V, Patel S, Stafford J, Serrano J, Esposito G, Tredwin LM, Goodman N, Kloetgen A, Golfinos JG, Zagzag D, Weigelt B, Iafrate AJ, Sulman EP, Chi AS, Dogan S, Reis-Filho JS, Chiang S, Placantonakis D, Tsirigos A, Snuderl M. Functional and topographic effects on DNA methylation in IDH1/2 mutant cancers. *Scientific Reports*. November 14, 2019; 9(16830).

Falowski SM, Conti KR, Mogilner AY. Analysis of S1 DRG programming to determine location of the DRG and ideal anatomic positioning of the electrode. *Neuromodulation*. September 2, 2019; epub ahead of print.

Haynes J, Shapiro M, Raz E, Frempong-Boadu A, Nossek E. Microsurgical resection of a spinal cord pial arteriovenous fistula: 2-dimensional operative video. *Operative Neurosurgery*. December 7, 2019; opz388: epub ahead of print.

Hollon TC, Pandian B, Adapa AR, Urias E, Save AV, Khalsa SSS, Eichberg DG, D'Amico RS, Farooq ZU, Lewis S, Petridis PD, Marie T, Shah AH, Garton HJL, Maher CO, Heth JA, McKean EL, Sullivan SE, Hervey-Jumper SL, Patil PG, Thompson BG, Sagher O, McKhann GM II, Komotar RJ, Ivan ME, Snuderl M, Otten ML, Johnson TD, Sisti MB, Bruce JN, Muraszko KM, Trautman J, Freudiger CW, Canoll P, Lee H, Camelo-Piragua S, Orringer DA. Near real-time intraoperative brain tumor diagnosis using stimulated Raman histology and deep neural networks. *Nature Medicine*. January 6, 2020; 26: 52–58.

Johnson KA, Fletcher PT, Servello D, Bona A, Porta M, Ostrem JL, Bardinet E, Welter ML, Lozano AM, Baldermann JC, Kuhn J, Huys D, Foltynie T, Hariz M, Joyce EM, Zrinzo L, Kefalopoulou Z, Zhang JG, Meng FG, Zhang CC, Ling Z, Xu X, Yu X, Smeets AY, Ackermans L, Visser-Vandewalle V, Mogilner AY, Pourfar MH, Almeida L, Gunduz A, Hu W, Foote KD, Okun MS, Butson CR. Image-based analysis and long-term clinical outcomes of deep brain stimulation for Tourette syndrome: A multisite study. *Journal of Neurology, Neurosurgery & Psychiatry*. October 2019; 90(10): 1078–1090.

Lewis A, Lin J, James H; Krok AC, Zeoli N, Healy J, Lewis T, Pacione D. A single-center intervention to discontinue postoperative antibiotics after spinal fusion. *British Journal of Neurosurgery*. 2018; 32(2): 177–181.

Lewis A, Rothstein A, Pacione D. Results of a quality improvement initiative reassessing an institutional lumbar drain infection prevention protocol. *Journal of Neurosurgery: Spine*. July 2018; 29(1): 54–58.

Wu CC, Jain R, Neto L, Patel S, Poisson LM, Serrano J, Ng V, Patel SH, Placantonakis DG, Zagzag D, Golfinos J, Chi AS, Snuderl M. MR imaging phenotype correlates with extent of genome-wide copy number abundance in IDH mutant gliomas. *Neuroradiology*. September 2019; 61(9): 1023–1031.

For more information about our physicians, services, and locations, visit **nyulangone.org**

Produced by the Office of Communications and Marketing, NYU Langone Health
Primary Writer: Jennifer Handt
Design: Ideas On Purpose, www.ideasonpurpose.com
Primary Photographer: NYU Langone Staff
Printing: Allied Printing Services, Inc.

ABOUT NYU LANGONE HEALTH

Leader in Quality

NYU Langone has achieved top rankings by Vizient, and is the only full-service health system in New York City with an "A" Leapfrog safety grade and a CMS 5-star rating in 2020. These accolades are reflective of a shared culture of quality that permeates our growing network, now inclusive of NYU Winthrop Hospital and its ambulatory sites on Long Island. All of our sites are held to the highest quality standards set at an institutional level.

#9 in the Nation

Ranked ninth by *U.S. News and World Report* for both Best Hospitals and Best Medical Schools (Research)

Transforming Medical Education

To address some of today's most pressing issues in medical education such as physician shortages, debt burden, and lack of diversity, we have introduced accelerated pathways to the MD degree and full-tuition scholarships regardless of need or merit at the recently renamed **NYU Grossman School of Medicine** and the new primary-care focused **NYU Long Island School of Medicine**.

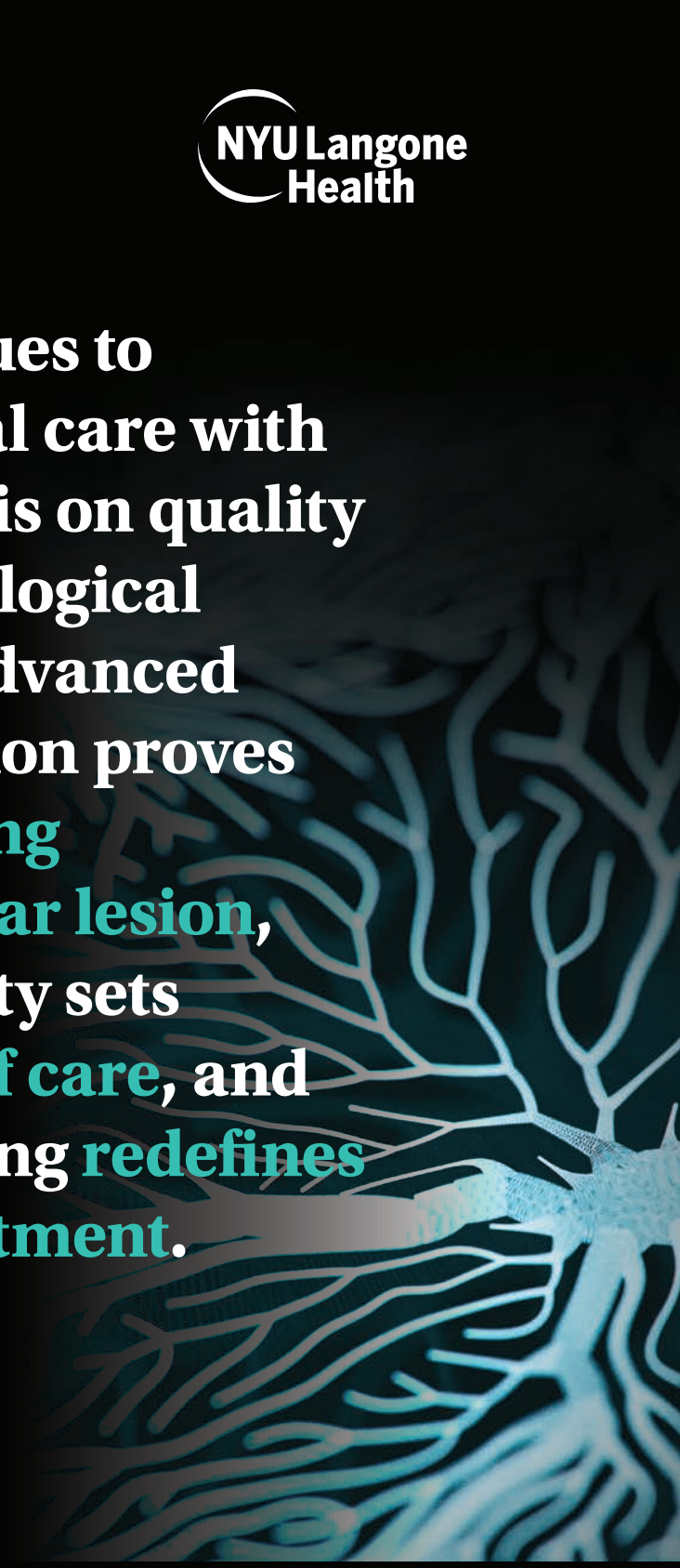
NYU Langone Health

NYU LANGONE HEALTH
550 First Avenue, New York, NY 10016
NYULANGONE.ORG

NYU Langone Health

Our team continues to transform clinical care with a shared emphasis on quality guided by technological leadership and advanced expertise. Precision proves pivotal in resecting a complex vascular lesion, a culture of quality sets a new standard of care, and innovative imaging redefines brain tumor treatment.

Read More



Neurosurgery

2019 HIGHLIGHTS