

Collaborative

MEDICINE

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Top Ten

IN U.S. NEWS &  
WORLD REPORT

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73%

REDUCTION IN  
STROKE MORTALITY

---

Doubled

SURGICAL CASE VOLUME  
IN PAST FIVE YEARS

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50,000+

NEUROLOGY  
PATIENT VISITS

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# Neurology and Neurosurgery

2015

**YEAR IN REVIEW**

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## Dear Colleagues and Friends:

We are pleased to share this 2015 Annual Report from the Departments of Neurology and Neurosurgery at NYU Langone Medical Center.

The past year has been one of ongoing, strong collaboration between our two departments, which provides a powerful synergy that informs and inspires every aspect of our clinical, research, and educational activities, as we work to provide our patients with the best possible medical care. For example, the close coordination between the neurology department's emergency stroke team and neuro-ICU and our interventional neurosurgeons has resulted in one of the lowest stroke mortality rates in the nation. At the same time, the combined efforts of our neurosurgery and neurology specialists at NYU Langone's Center for Neuromodulation have made us a world leader in the use of deep brain stimulation to relieve symptoms of severe Tourette's syndrome, Parkinson's disease, and other neurological disorders.

There were also important programmatic developments in 2015 that involved collaborations beyond our departments. In June, we launched the Marlene and Paolo Fresco Institute for Parkinson's & Movement Disorders. This new center, made possible by a \$25 million gift from the Paolo and Marlene Fresco Foundation, will feature a unique partnership between neurology and neuroscience and will include a clinical and research hub in Italy, giving our Parkinson's and movement disorders program an international scope. In another new collaboration, the neurosurgery department's division of spinal neurosurgery has joined with the spine specialists in NYU Langone's nationally ranked Department of Orthopaedic Surgery to establish a new comprehensive Spine Center, which will give patients access to the Medical Center's full range of spine services through a single entry point. Our Concussion Center has thrived as a multidisciplinary partnership evaluating over 1,000 new patients annually and serving as a hub for the investigation of visual dysfunction associated with mild traumatic brain injury.

Meanwhile, we are continuing to extend our cutting-edge translational and basic research: We're involved in clinical trials of novel therapies for a wide range of disorders, including multiple sclerosis, epilepsy, neurofibromatosis, and familial dysautonomia. Our translational researchers at NYU Langone's Center for Cognitive Neurology are working on promising new medications for Alzheimer's and other dementias. Our researchers are also uncovering new links between insulin and eating behaviors, and investigating whether implanted stem cells can regenerate brain neurons in stroke and TBI patients.

As an integral part of one of the nation's leading academic medical centers, another area we're excited about is the ongoing evolution of our educational programs. Both departments are in the process of expanding our already sizable residency programs, and we also added new fellowships in vascular medicine and multiple sclerosis.

With clinical and basic science knowledge growing at an unprecedented rate, this is an exciting time for the fields of neurology and neurosurgery. Our departments are honored to be part of these advances, and appreciate the chance to present our latest efforts in this important area of medicine.



A handwritten signature in black ink that reads "Steve Galetta".

**STEVEN L. GALETTA, MD**

Philip K. Moskowitz, MD Professor and Chair  
of Neurology, Department of Neurology  
Professor of Ophthalmology and Neurology



A handwritten signature in black ink that reads "John G. Golfinos".

**JOHN G. GOLFINOS, MD**

Chair, Department of Neurosurgery  
Associate Professor of Neurosurgery  
and Otolaryngology

## Neurology and Neurosurgery

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### PATIENT VOLUME

**4,790**  
neurosurgical  
procedures  
performed

**Doubled**  
surgical  
case volume  
in past five years

**50,000+**  
Neurology  
patient visits  
  
**6% increase**  
compared to the prior year

**Top 5**  
in Gamma Knife  
patient volume  
in the U.S.

### PHYSICIANS

**152**  
Neurology faculty  
including 14 new faculty members  
in the past year

**24**  
full-time  
Neurosurgery faculty  
with primary appointment

**51**  
Neurology and  
Neurosurgery residents

### RESEARCH AND FUNDING

**\$7M**  
in Neurosurgery  
grant funding  
over the past three years

**63 grants**  
to NYU Langone neurologists  
for current research

**250+**  
presentations  
delivered by neurologists and neurosurgeons  
in 2015 national and international conferences

### ACHIEVEMENTS AND HONORS

**73% reduction**  
in stroke mortality

**Top Ten**  
for Neurology and Neurosurgery in  
U.S. News & World Report's 2015–16 "Best Hospitals"





# NYU Langone Medical Center

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# #1

overall patient safety  
& quality for  
three years in a row

AND

ambulatory care quality  
& accountability

among leading academic medical centers  
across the nation that were included in the  
University HealthSystem Consortium 2015  
Quality and Accountability Study

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# Top 15

in *U.S. News & World Report*



# #12

**BEST HOSPITALS  
HONOR ROLL**



# #14

**BEST MEDICAL  
SCHOOLS FOR  
RESEARCH**

and nationally ranked in 12 specialties,  
including top 10 rankings in  
Orthopedics (#5), Geriatrics (#6),  
Neurology & Neurosurgery (#9),  
Rheumatology (#9),  
and Rehabilitation (#10)

# GROWTH, INNOVATION, AND COLLABORATION

## Brain Tumor Center to Advance Translational Research with New Co-Director, Andrew Chi, MD, PhD

In August 2015, Andrew Chi, MD, PhD, assistant professor of medicine, neurology, and neurosurgery, was named co-director of NYU Langone's Brain Tumor Center and chief of neuro-oncology at the Laura and Isaac Perlmutter Cancer Center. Dr. Chi brings a large number of clinical trials and new treatments to NYU Langone from his previous roles at Massachusetts General Hospital and the Dana-Farber/Harvard Cancer Center. His clinical work focuses on the neuro-oncologic treatment of primary brain tumors, metastatic tumors to the central nervous system, and neurologic complications of cancer. Dr. Chi and a team of researchers recently published research in *Cancer Cell* on their findings on experimental drugs that alter cell metabolism. These drugs also halted tumor growth and extended survival in mice with cancers caused by a gene mutated in several types of brain tumors. The study results focus on brain tumors linked by previous research to changes in the code making up the gene for the enzyme isocitrate dehydrogenase 1, or IDH1. Such changes or mutations occur in a third of gliomas in the brain, as well as in some blood, skin, soft tissue, and cartilage cancers.



▲ Howard A. Riina, MD

## Teaming with IBM's Watson Center to Understand Brain Signaling

A collaboration between NYU Langone's Department of Neurosurgery and IBM could yield new insights into the electrical and chemical activity in the brain's neural networks. The department's point person on the joint initiative, epilepsy surgeon Werner K. Doyle, MD, associate professor of neurosurgery, recently traveled to the main campus of IBM's Thomas J. Watson Research Center in Yorktown Heights, New York, for a preliminary meeting. "We're particularly interested in the miniaturized nanodevices IBM is developing," notes Dr. Doyle. The tiny devices include various electrical and chemical sensors that can theoretically be implanted in the brain to monitor intercellular signaling. "These sensors could help us learn more about how the brain's networks operate, including how and where epileptic seizures occur," says Dr. Doyle. "Ultimately, they may also be used to modify the brain's activities."

## Eyelid Incision Enables New Minimally Invasive Aneurysm Repair

In the past year, NYU Langone's cerebrovascular neurosurgeons and plastic surgeons have been collaborating on a new minimally invasive approach for aneurysm repair. In the new approach, surgeons enter the skull through an extremely small incision in the eyelid crease just above the eye. This technique supplants the previously favored minimally invasive approach through the eyebrow, which requires a somewhat larger incision and also leaves a more noticeable scar. "We're able to treat aneurysms very effectively using this new method," says Howard A. Riina, MD, professor of neurosurgery, neurology, and radiology. "At the same time, the cosmetic results are excellent, which our patients are very pleased about."





## Laura J. Balcer, MD, Named Winner of 2015 Barancik Prize for MS Research

A collaboration led by NYU Langone's Laura J. Balcer, MD, MSCE, vice chair and professor of neurology, ophthalmology and population health, was named winner of the 2015 Barancik Prize for Innovation in Multiple Sclerosis Research. The prize recognizes and encourages exceptional innovation and originality in scientific research related to multiple sclerosis (MS). Dr. Balcer shared the award with collaborators, Dr. Peter Calabresi from Johns Hopkins School of Medicine and Dr. Elliot Frohman from the University of Texas Southwestern School of Medicine. Introduced more than a decade ago by Steven L. Galetta, MD, the Philip K. Moskowitz, MD Professor and Chair of Neurology, this group has been a multi-center team using optical coherence tomography (OCT) to investigate the biology and anatomy of the retina and other eye structures in MS patients. Their work has established OCT's critical role in identifying unsuspected damage in nerve fibers at the back of the eye, echoing more global damage in the brain—making it an invaluable tool for measuring the success of new therapies.

**Neuro-Epidemiology Division established** to guide faculty and trainees on clinical research methodologies, including study design, biostatistical support, and issues around the ethical conduct of research.

## Pediatric Transition Program Grows

After a generous grant from KiDS of NYU Langone in 2014, a neurosurgery program to help older pediatric patients transition to independent care took firm shape in 2015. Melissa Mason, MSW, LCSW-R, presented information about the unique program in *Pediatric Nursing Journal* and at the 16th Annual Chronic Illness and Disability Conference. The program supports and educates young adult patients as they prepare to take on new and different responsibilities with respect to their healthcare. Utilizing a uniquely designed workbook and workshops, the program enhances patients' health literacy, medical adherence, and self-efficacy.

## Research News

### RESEARCHERS RECEIVE \$1.2 MILLION NY STATE GRANT TO STUDY CONCUSSION

Investigators from NYU Langone's Departments of Neurology and Radiology, and from Rusk Rehabilitation, were awarded a \$1.2 million Empire Clinical Research Investigator Program (ECRIP) "Center Grant" from the New York State Department of Health for a two-year study on concussion. Researchers will study the use of diagnostic vision-based performance measures, neuroimaging techniques, and blood tests to identify and validate structural, functional, and biological markers and sequelae of sports-related concussion relative to long-term exposure to contact sports. The hope is that markers identified in these projects can be applied across the spectrum of TBI/concussion medicine, from acute sideline diagnosis of concussion in youth and collegiate cohorts to monitoring the progress of concussion treatments, to the measurement of potential signs, *in vivo*, of chronic traumatic encephalopathy (CTE) among active and retired contact-sports athletes.

### INVESTIGATORS RECEIVE FUNDING TO EXPAND RARE DISEASE RESEARCH

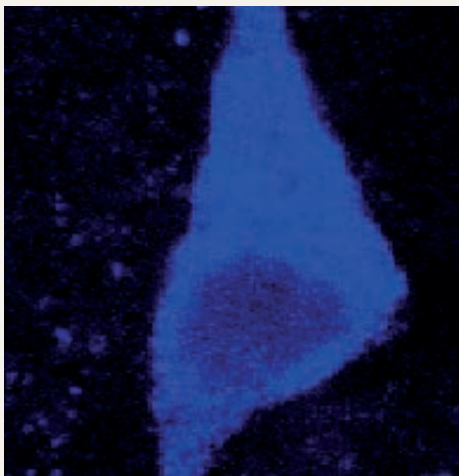
In September 2015, NYU Langone's Dysautonomia Center was awarded a \$1.1 million grant from the Food and Drug Administration (FDA) to conduct a phase II study of the enzyme inhibitor carbidopa for the treatment of familial dysautonomia (FD). The trials will be headed by Horacio Kaufmann, MD the Felicia B. Axelrod Professor of Dysautonomia Research. As the only U.S. center that treats FD, NYU Langone has pioneered the use of carbidopa to alleviate the severe vomiting attacks associated with FD. The Dysautonomia Foundation awarded Dr. Kaufmann \$1.1 million to support research and clinical care in patients with familial dysautonomia at NYU Langone. In October 2015, the Dysautonomia Center was awarded funding from the NIH to continue heading the international natural history study to define the clinical features of synuclein pathology. The project is part of the Autonomic Disorders Consortium, an initiative of the NINDS. Lucy Norcliffe-Kaufmann, PhD, assistant professor, received a grant award from the

Multiple System Atrophy (MSA) Coalition to support the international expansion of the project. In December 2015, the Center was awarded a four-year grant with Carlos Mendoza, MD, adjunct professor of neurology, from the Michael J. Fox Foundation to study the retina in patients with Parkinson's disease as a marker of neurodegeneration. Alberto Palma, MD, PhD, assistant professor of neurology, received the Don Summers' Memorial Multiple System Atrophy (MSA) Travel Award to present his work on a blood biomarker for the diagnosis of the rare disease MSA at the 2015 meeting of the International Society for Autonomic Neuroscience. Postdoctoral scientist Cristina Fuente Mora, PhD, received a travel fellowship award from the American Autonomic Society to present her research on the relationship between the brain's blood supply and low blood pressure in familial dysautonomia.

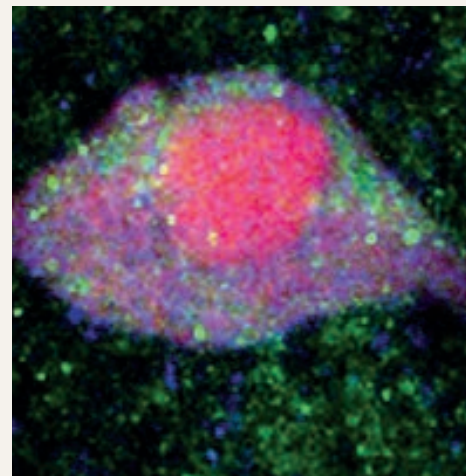
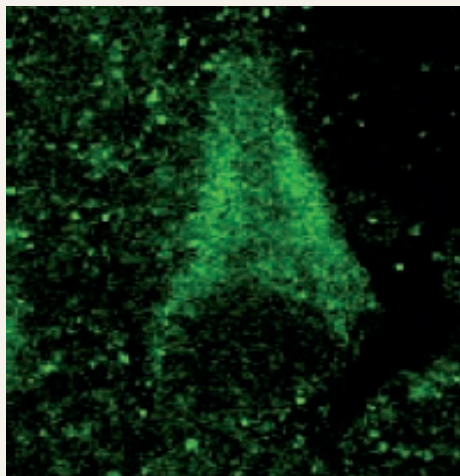
### STUDY FINDS PRIMARY CARE PHYSICIANS UNFAMILIAR WITH MIGRAINE GUIDELINES

A recent study by Mia T. Minen, MD, assistant professor of neurology and director of headache services at NYU Langone, found low levels of familiarity with migraine headache care guidelines among primary care physicians (PCPs). The study, comprising focus groups that assessed PCPs' awareness of current migraine prevention and treatment guidelines, found that only 28 percent of the physicians were familiar with American Academy of Neurology guidelines on preventive treatment, while 40 percent were familiar with the Institute of Medicine's Choosing Wisely Campaign recommendations on migraine treatment. PCPs surveyed tended to treat migraines exclusively with medication, with just 34 percent aware that opioids can cause medication-overuse headache. The researchers concluded there was a need to provide PCPs with innovative decision support and education on migraine treatment options.





▲ Insulin receptors (InsRs) on a striatal cholinergic interneuron (ChI). ChI identified by immunolabelling acetylcholine synthesis (blue, choline acetyltransferase) expresses InsRs. Activation of InsRs increases ChI excitability and enhances release of dopamine, a key reward pathway transmitter.



▲ Another striatal cholinergic interneuron (ChI) immunolabelled for insulin receptors (InsRs, green) and acetylcholine synthesis (blue), after loading with a red dye (pink staining of the ChI nucleus) during electrophysiological recording in a rodent brain slice.

#### NEUROSURGERY RESEARCH LABS REPORT FINDINGS ON TUMOR GROWTH AND BRAIN ACTIVITY

**Key findings published in 2015 from the NYU Langone Department of Neurosurgery basic research labs produced key insights that may fuel new therapeutic approaches.**

→ A *Journal of Neuroscience* paper from the lab of Mitchell Chesler, MD, PhD, professor of neurosurgery and neuroscience & physiology, reported on *ex-vivo* mouse studies showing that the postsynaptic NMDA receptor current in hippocampal pyramidal cells is boosted in an autocrine fashion by a perisynaptic rise in surface pH. The extracellular alkaline shift was shown to be generated by the plasma membrane  $\text{Ca}^{2+}$ -ATPase (PMCA) of the same cell generating the NMDA receptor current. This indicated that modulation of NMDA receptor responses via pH does not require massive synchronous neural discharge. Rather, it occurs normally at the level of single neurons and single synapses. These results may provide a means of regulating NMDA receptor responses by targeting the generation and regulation of the alkalosis in pathological conditions such as seizure and during spreading depression, which plays a deleterious role in stroke and traumatic brain injury.

→ A study from the lab of Margaret E. Rice, PhD, professor of neurosurgery and neuroscience and physiology, published in *Nature Communications*, noted a 20 to 55 percent increase in dopamine released in the striatal region of the rodent brain (where dopamine's "reward" effects are felt) that coincided with post-meal increases in insulin activity. The study also found this dopamine response was enhanced by a low-calorie diet and blunted by a high-calorie diet. This finding suggests that rodents, and presumably people, may choose to consume high-carb or low-fat meals that release more insulin—all to heighten dopamine release. Dr. Rice's team plans further investigations into how insulin influences the mammalian brain's control over food motivation and reward pathways, and whether changes in insulin sensitivity brought about by obesity can be reversed or even prevented.

→ The lab headed by Dimitris Placantonakis, MD, PhD, assistant professor of neurosurgery, presented evidence in *Nature Communications* that the stem cell transcription factor Sox2 maintains cancer stem cells (CSCs) in osteosarcomas and glioblastomas by repressing the tumor-suppressive Hippo pathway, which in turn increases the growth-promoting function of the transcriptional coactivator, YAP. The work was done in collaboration with labs led by Claudio Basilico, MD, the Jan T. Vilcek Professor of Molecular Pathogenesis, and Alka Mansukhani, PhD, associate professor of microbiology. This finding suggests that disrupting YAP transcriptional activity could be a therapeutic strategy for Sox2-dependent tumors.



## New Breakthroughs for Neurogenetic Diseases

Under Emergency Investigational New Drug (EIND) application, NYU Langone neurologists were the first in the world to treat an infant diagnosed with Mucopolysaccharidosis type VII (MPS VII) with an infusion of UX003 rhGUS enzyme. This advancement is indicative of the groundbreaking research led by Heather Lau, MD, assistant professor of neurology, and the department's neurogenetics division, to find new treatments for inherited neurodegenerative disorders.

Dr. Lau and her team launched new clinical trials in 2015, working with drug-maker, Ultragenyx: a Phase 3 randomized, double-blind, placebo-controlled study to evaluate the efficacy and safety of sialic acid extended-

release tablets in patients with GNE Myopathy (GNEM) or Hereditary Inclusion Body Myopathy (HIBM) and an open label study of UX003 rhGUS enzyme replacement therapy in MPS VII patients younger than five. Ongoing trials include longitudinal studies of brain structure and function in MPS disorders and open-label extension study of the long-term effects of Migalastat HCL in patients with Fabry Disease.

Dr. Lau was also awarded two grants this year: one to help develop an international natural history database for Canavan Disease, and another to determine the prevalence of Gaucher disease in a patients with reduced bone density.

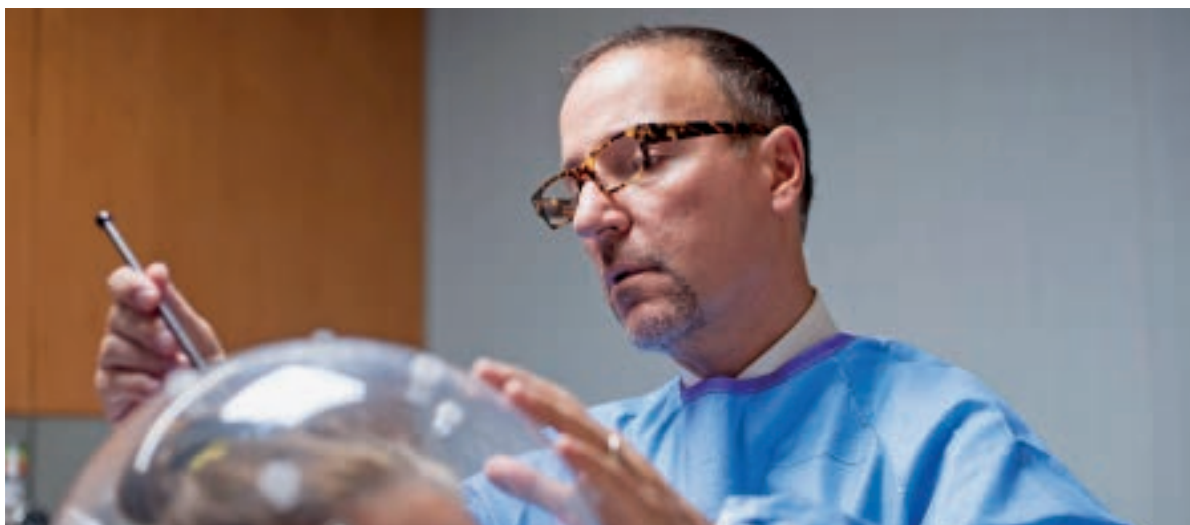
### NYU LANGONE MEDICAL CENTER NEWS

## Groundbreaking Face Transplant Exemplifies Expertise and Multidisciplinary Collaboration

In August 2015, surgeons at NYU Langone Medical Center performed the most complex face transplant to date. The patient, former firefighter Patrick Hardison, had lost all of the skin around his entire face, scalp and neck, including his eyelids, ears, lips, and nose, while trapped in a burning building. Led by Eduardo Rodriguez, MD, DDS, the Helen L. Kimmel Professor of Reconstructive Plastic Surgery and chair of the Hansjörg Wyss Department of Plastic Surgery, the successful 26-hour operation—the first to include transplantation of eyelids capable of blinking as well as functional ears, among other milestones—involved more than 100 physicians, nurses, and technical and support staff. More than a dozen departments contributed to the planning and execution of the procedure, or to postoperative care.

## Awards and Honors


- **Jori Fleisher, MD**, was appointed to the American Academy of Neurology Government Relations Committee, and to the American Academy of Neurology Meeting Management Committee.
- **Farng-Yang A. Foo, MD**, was presented with the “Doctor of the Year 2014” award by the National American Taiwanese Medical Association.
- **Jacqueline A. French, MD**, was appointed Chief Scientific Officer of the Epilepsy Foundation.
- **John G. Golfinos, MD**, was honored at the 2014 Perlmutter Cancer Center Gala, and was the winner of the Wholeness of Life Award.
- **David H. Harter, MD**, was named an executive board member of the pediatric section of the American Association of Neurological Surgeons (AANS)/CNS.
- **Douglas S. Kondziolka, MD, MSc**, was recently named a director of the American Board of Neurological Surgery (ABNS), joining nine other surgeons.
- **Dimitris Placantonakis, MD, PhD**, was a presenter at the 3rd Annual New York City Tumor Microenvironment Symposium.
- **Howard A. Riina, MD**, was named a recipient of the American Heart Association Heart Saver Hero Award.
- **Howard L. Weiner, MD**, was elected to the editorial board of the *Journal of Neurosurgery* and to the Executive Council of the American Society of Pediatric Neurosurgeons. Dr. Weiner was also the only U.S. neurosurgeon invited to participate in the National Institute of Neurological Disorders and Stroke 2015 research strategy meeting on treatments of tethered spinal cord syndrome.
- **Jeffrey H. Wisoff, MD**, was named to the Board of Directors for the Posterior Fossa Society.
- **Thomas M. Wisniewski, MD**, received an endowed chair: Lulu P. and David J. Levidow Neurology Professorship. He also was elected chair and member of the 2014–15 Peer Reviewed Alzheimer’s Research Program (PRARP) for the Department of Defense Congressionally Directed Medical Research Programs (CDMRP). He was also elected to the editorial board of the *Alzheimer’s & Dementia: Translational Research & Clinical Interventions* and to the *Journal of the Alzheimer’s Disease Association*, and was elected a Distinguished Fellow of the Kosciuszko Foundation Collegium of Eminent Scientists.



▲ Douglas S. Kondziolka, MD, MSc



# CLINICAL AND RESEARCH EXPERTISE MEETS INNOVATION

A photograph of two male neurosurgeons in a hospital hallway. They are both wearing blue surgical scrubs and blue bouffant caps. The surgeon on the left is looking towards the surgeon on the right, who is looking slightly away. They appear to be in conversation. In the background, other medical staff in scrubs are visible, and the hallway is brightly lit with overhead lights. The overall tone is professional and collaborative.

The extensive training and experience of NYU Langone's neurologists and neurosurgeons are supported by a collaborative infrastructure that utilizes the world's most advanced medical technologies. This combination is enabling our faculty to break new ground in the diagnosis, treatment, and research of complex neurological conditions.



# Advanced Technologies Enhance Ability to Look Inside the Brain

## 3D MODELS GUIDING SURGICAL APPROACHES

“The brain tumor was lodged here,” says Donato R. Pacione, MD, assistant professor of neurosurgery. As he speaks, he picks up a lime-sized lump of gray plastic and sets it in the bottom of a white bowl, where it fits neatly into place. The gray lump is actually a detailed reproduction of a benign tumor that Dr. Pacione surgically excised last spring. The bowl is an exact replica of the bottom half of the patient’s skull. The interlocking models, created with a three-dimensional printer using the patient’s MRI and CT scan data, are a marvel to look at. More importantly, they demonstrate the exciting potential of a powerful new tool for planning and executing neurosurgical procedures.

“A colleague in the Department of Radiology had brought some 3D print models of blood vessels to our conferences,” Dr. Pacione recalls. “I was preparing to operate on a skull base tumor in a patient with a huge defect in his skull, and I wanted to be sure of the landmarks I’d be using. So I asked if it was possible to print the entire skull base, plus the tumor and the carotid artery attached to it.”

Once his colleague confirmed it was possible to recreate virtually any body tissue using digital imaging data, a new world opened up. Since then, Dr. Pacione has ordered up to four additional models as planning aids for particularly difficult cases. He has also used post-operative models to analyze his outcomes. With average costs similar to that of a CT scan, Dr. Pacione predicts the use of 3D models will eventually become widespread.

“These models let us plan complex skull base and spine procedures more efficiently—helping us figure out if a minimally invasive approach will work, for example,” he explains. “As neurosurgeons, we often make inferences based on two-dimensional images. But looking at a screen, you can’t always see around the corner. Now we’re actually bringing the 3D models with us into the operating room to help guide our surgical approaches.”

Dr. Pacione believes the technology could one day be used to design pre-fitted synthetic bone grafts. He also sees it as a valuable educational and research tool. “These models help residents study complex procedures outside the operating room, especially combined with video recordings,” he says. And since the 3D prints can be archived either as actual models or as data sets to be printed as needed, the technology offers a way to preserve unusual anatomical cases.

“The printers are also getting better at reproducing the exact density and textures of different body tissues,” Dr. Pacione adds. “That means we could eventually use these models to simulate actual surgery.”

## NOVEL SOFTWARE LETS VIEWERS ‘FLY’ THROUGH THE BRAIN

Over the past year, NYU Langone neurosurgeons have also extended their use of another type of 3D planning tool—a software platform that creates a virtual, 3D-like image of a patient’s tissues on a computer monitor. The images, based on MRI and CT scan data, can be manipulated onscreen, allowing the user to view brain or spinal tissue at any location from any angle. The imaged tissues react in a lifelike way when “touched” with a virtual instrument. The software also allows users to introduce tubes, clamps, and other equipment into the scenario. That enables surgeons to walk through an entire procedure trying different approaches and techniques.

The technology was developed by the company Surgical Theater. It is now being used extensively by NYU Langone brain surgeons, both as a planning tool and in actual operations. Since the system can be integrated with stereotactic navigation technology, Surgical Theater images can be overlaid on the navigational map of the brain used during intracranial surgery. Recently, the spinal neurosurgery division has also begun using the technology as a planning tool for difficult deformity and tumor cases.

The Medical Center’s neurosurgery department continues to work closely with Surgical Theater to refine the technology. For example, faculty recently conferred with the company to add a capability that tracks white matter neural networks within the brain. In addition, NYU Langone neurosurgeons have been testing demo versions of the technology’s next iteration. As described in a recent *Smithsonian* magazine article, the next iteration features visual headsets—similar to those used by video gamers—that let the viewer “fly” through the interior of a patient’s brain. This allows users to look directly at tissue from every angle, rather than having to manipulate the image on a screen. The headset version is expected to be available for clinical use within the next six months.

#### NEW MRI TECHNOLOGY DEVELOPED AT NYU LANGONE REVEALS BRAIN REGIONS IN LIVING COLOR

In yet another brain imaging advance, NYU Langone's neurosurgeons have teamed with the Medical Center's neuroradiologists to create a type of MRI scan that directly detects various functional areas of the brain in different colors—providing images that illuminate different brain regions with unprecedented clarity.

“Standard MRI scans of the brain have always been black, white, or gray,” says Douglas S. Kondziolka, MD, MSc, professor of neurosurgery and radiation oncology and director of NYU Langone's Gamma Knife program. “The thalamus, important for movement disorder surgery, is a uniformly gray structure. That meant we essentially had to indirectly identify individual thalamic sub-nuclei through navigational coordinates, with only limited assistance from the MRI scan. Now we can see the location of different groups of neurons that have different functions.”

The breakthrough, spearheaded by Timothy Shepherd, MD, PhD, assistant professor of radiology, involved combining recently developed simultaneous multislice acquisitions and track density imaging to detect differences in the orientation of water movement along axons within individual gray matter structures, such as the thalamus, at 500-micron isotropic super-resolution. Once this directional component is known, the MRI software then assigns a color to each orientation.

“The computer uses a red color for elements running left to right, blue for up and down, green for front to back,” explains Dr. Kondziolka, indicating a brightly hued image of a brain on his computer screen. “Axons running at various angles take on a combination of these colors, showing up as different shades of purple or orange or blue-green.”

Since different functional areas of the thalamus tend to have groups of axons running in a similar direction, these areas take on specific tones. “This is what we consider the brain's tremor area,” adds Dr. Kondziolka, pointing to a distinctly violet section of the brain scan. “To alleviate tremors in a patient, we might target that area with the Gamma Knife or insert a deep brain stimulation electrode into the structure. But we could never actually see the area before this.”

This work has been presented at several scientific meetings and a paper has been submitted. This innovation is clinically feasible to acquire in real clinical patients in less than 10 minutes. Drs. Kondziolka and Shepherd have applied it to patients with essential tremor and obsessive-compulsive disorder both before and after Gamma Knife radiosurgery treatment. “People are truly amazed when they see these images,” says Dr. Kondziolka. “Not only will this technology help in surgical mapping, but it also will make a major contribution to our basic understanding of the brain and its connections.”



▲ 500-micron isotropic resolution diffusion color orientation map of the in vivo thalamus using 3-T MRI (red = LR, green = AP, blue = CC) compared to poor contrast in corresponding axial T2. This approach offers the unique ability to recognize thalamic substructures for functional neurosurgery and/or anatomic correlation of pathology.

## Using 3D Imaging Options to Determine the Surgical Approach

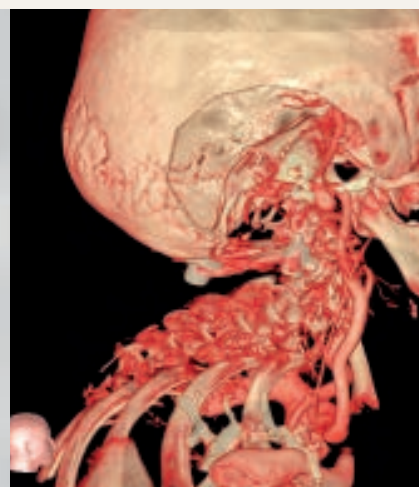
Dr. Pacione and David H. Harter, MD, assistant professor of neurosurgery, recently performed surgeries on two patients with the guidance of 3D imaging—with both a 3D printed model and the use of Surgical Theater's virtual 3D images.

### **A child with multiple congenital abnormalities whose spine had become compressed into the bottom of its skull**

Given the complex variables under consideration, including hardware already in place from a previous spinal procedure, the surgeons used virtual 3D images of the child's spine and skull to plan an approach, and found that none of the skull base approaches were ideal. To study the problem in real three-dimensional space, the surgical team then ordered a 3D print model, using the patient's MRI and CT scan data to recreate the skull, the cervical spine, adjacent blood vessels, and the patient's spinal hardware. "After looking at the 3D model and the relationships of the various parts it became clear that the best option was to translate the spine posteriorly and inferiorly so as to restore normal alignment," says Dr. Pacione.



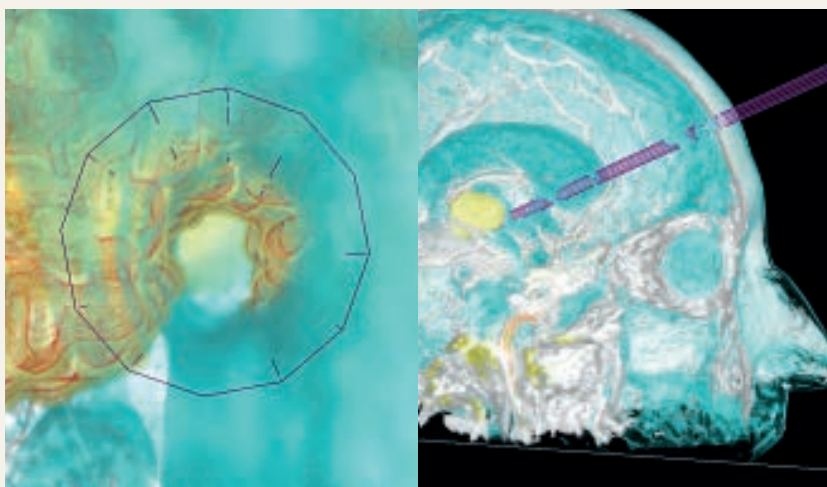
▲ TOP: 3D printed model used to determine best surgical approach for patient with spine and skull base abnormalities. BOTTOM: Postoperative construct print model, demonstrating the improved spinal alignment.



▲ A lateral view demonstrating the degree to which the C1/C2 complex had settled into the skull base.

### **A 35 year old woman with a pineal cyst**

Using virtual 3D images, the simulated cannula allowed Drs. Pacione and Harter to review whether or not they would be able to maneuver underneath normal tissue (pictured as orange) to get to the cyst (yellow). With the guidance of the surgical simulation, they determined that they would be able to do so safely, and they removed the cyst using an endoscopic approach (purple).



▲ LEFT: Close-up view from the surgeons' perspective down an endoscope. The enlarged massa intermedia is seen in orange and the pineal cyst is seen in yellow. RIGHT: Sagittal view demonstrating the planned endoscopic approach (purple structure). The pineal cyst is seen in yellow.

## With Launch of New Fresco Institute, Parkinson's Clinical and Research Programs Take on an International Scope

In 2015, NYU Langone's division for the treatment and research of Parkinson's and movement disorders gained a new name and an international presence. Last June, the center was officially renamed the Marlene and Paolo Fresco Institute for Parkinson's and Movement Disorders, after a \$25 million gift from the Paolo and Marlene Fresco Foundation. In carrying on NYU Langone's renowned Parkinson's program—designated a National Parkinson Foundation Center of Excellence since 2009—the Fresco Institute's clinical operations will be led by Alessandro Di Rocco, MD, Founders Professor of Neurology and chief of movement disorders, who serves as the institute's executive director. The institute will also be opening a fully integrated operation in Italy, and will continue to expand its research programs under the guidance of its scientific director, Richard Tsien, Druckenmiller Professor of Neuroscience and chair of neuroscience and physiology.

"The Fresco Institute will establish stronger bridges between clinical science and basic science of movement disorders, particularly Parkinson's disease," notes

Dr. Tsien, who is also director of the Neuroscience Institute at NYU Langone. "It will also build vibrant connections between scientists in the United States and in Italy, working on disorders of the brain."

The institute's branch in Italy will be a medical, research, and educational center that will act as a centralized hub, coordinating efforts with movement disorder programs in that nation. "Through fellowships and clinical and scientific collaborations with Italian Parkinson's institutions, our aim is to develop better treatments and understanding of the disease," says Dr. Di Rocco.

### STUDYING EXERCISE AND BRINGING TELEMEDICINE TO HOMEBOUND PARKINSON'S PATIENTS

One research project now underway is a study to better understand the potential benefits of exercise and repetitive transcranial magnetic stimulation (rTMS) for Parkinson's patients. The project will study differences in how brain-derived neurotrophic factor (BDNF)—a protein factor that can induce the growth of new neurons and



▲ Alessandro Di Rocco, MD



synapses and prevent the death of existing brain cells—impacts brain function in people with and without Parkinson's, as well as how exercise and noninvasive rTMS affect this marker and brain function in general in Parkinson's patients.

The study is one of several that Fresco Institute researchers are now conducting on the ability of rTMS to control the motor symptoms of Parkinson's. Previous trials at NYU Langone have demonstrated that the technology can reduce levodopa-induced dyskinesias. The Fresco Institute's neurostimulation lab currently utilizes three state-of-the-art TMS machines along with a neuronavigation system that allows specific brain regions to be stimulated with high accuracy.

In another important advance, the Fresco Institute has spent the past year working with NYU Langone's IT group to develop a telemedicine component for its pioneering home care program. In the program, launched in 2014 for patients with advanced Parkinson's who have difficulty traveling, Fresco Institute physicians evaluate patients in their homes, and a social worker and nurse make regular follow-up visits. The telemedicine element, scheduled to launch in January 2016, will enable Fresco Institute physicians to confer with the patients remotely during these follow-up visits, using a laptop and mobile Wi-Fi connection provided to the home care team.

"This capability will allow me to join the team virtually to perform Parkinson's-specific neurological and cognitive examinations—both of which have been validated for telemedicine," says the Fresco Institute's Jori E. Fleischer, MD, assistant professor of neurology and population health. "I'll also be able to ask questions of the patient and the family, answer questions they may have, provide counseling, and observe the social worker's psychosocial evaluation and counseling, the nurse's medication reconciliation and counseling, and the home safety assessment."

In addition, she notes, the team will have the ability to document the visit in real time on NYU Langone's electronic medical records system, create an after-visit summary for the patient and the family, and print out the summary for the family on the spot.

### **The DBS Option: Using Electrical Stimulation to Calm Parkinson's Symptoms**

NYU Langone's Center for Neuromodulation, a collaboration between the Medical Center's neurosurgery and neurology departments, is a regional leader in another important treatment approach for Parkinson's, involving the surgical implantation of deep brain stimulation (DBS) devices. Each device contains a set of tiny electrodes that are placed in the subthalamic nucleus (STN) or globus pallidus internus (GPI) and then stimulated via an implanted pacemaker according to settings tailored to the patient.

"This technique can significantly alleviate motor symptoms in Parkinson's patients who are not adequately treated by medication, or are experiencing problematic medication side effects," notes Alon Mogilner, MD, PhD, associate professor of neurosurgery and anesthesiology, who is the center's co-director, along with Michael H. Pourfar, MD, assistant professor of neurosurgery and neurology (both photographed on page 8).

The center, which is also a worldwide leader in the use of DBS for severe Tourette's syndrome, recently published the lead article in the journal *Stereotactic and Functional Neurosurgery* on its investigational work with a new computerized system from Boston Scientific that automatically programs DBS settings for Parkinson's patients.

"We found that the software can calculate the initial settings almost as well as a DBS specialist," says Dr. Mogilner. While the initial adjustment session typically takes several hours without computer assistance and requires a very experienced neurologist, he adds, the new technology allows adjustments to be made more quickly and provides valuable support to less experienced physicians—a combination that should ultimately give more Parkinson's patients access to the technology.

### **Four Additional Cities for Wellness Program**

The Edmond J. Safra National Parkinson's Wellness Initiative brought the elements of NYU Langone's groundbreaking Parkinson's wellness program to Boston and Washington, D.C., in 2015. This was followed in November by the awarding of grants to Chicago and Tampa for programs that will start in January 2016. The program, led by managing director and Fresco Institute program director, Amy C. Lemen, LCSW, is supported by the National Parkinson's Foundation (NPF) and the Philanthropic Foundation.

## Neurofibromatosis Center Pushes Boundaries with Multidisciplinary Treatment and Molecularly Targeted Therapies

### TEAM APPROACH PRESERVES HEARING WHILE REMOVING ACOUSTIC TUMOR

When a 38-year-old woman with neurofibromatosis type II (NF2) experienced a sudden, left-side deterioration in hearing, the cause was clearly revealed by an MRI scan: A small acoustic neuroma inside her left ear was compressing the auditory nerve. The patient, who had suffered progressive bilateral hearing loss starting in early childhood and used hearing aids in both ears, had virtually no hearing in her right ear and just 16 percent word recognition. Without prompt treatment, she now stood to lose what little hearing she had left.

Radiation and surgery were options to shrink or remove the tumor, but there was a risk that these approaches would also destroy any remaining hearing in that ear, says John G. Golfinos, MD, associate professor of neurosurgery and otolaryngology and chair of the Department of Neurosurgery. Looking for options, Dr. Golfinos consulted his frequent

operating room colleague J. Thomas Roland, MD, FACS, a neurotologist and chair of the Department of Otolaryngology—Head and Neck Surgery, about placing a cochlear implant in the patient's right ear. "A successful cochlear implantation would alleviate our anxiety about operating on the left ear," explains Dr. Golfinos, "because the patient would then have some hearing regardless of the surgical outcome."

This kind of surgical teamwork between neurosurgeons and neurotologists is commonplace at NYU Langone's Comprehensive Neurofibromatosis Center—the only center in New York City built around such multidisciplinary collaborations. In this case, as a first step, Dr. Roland performed a promontory stimulation test of the auditory nerve, sending electrical pulses via a needle threaded through the eardrum. When the results indicated the patient had enough auditory perception to benefit from a cochlear implant, she decided to go ahead with the procedure.



▲ John G. Golfinos, MD, and J. Thomas Roland, MD, FACS

Once the cochlear implant restored hearing in her right ear, the patient was willing to undergo surgery to remove the tumor on her left side. Dr. Golfinos took a middle fossa approach, making an incision above the ear in the lateral skull bone to uncover the internal auditory canal and access the tumor. The successful operation not only saved her residual hearing, but also improved it by relieving pressure on the auditory nerve.

“After fearing she would never hear again,” says Dr. Golfinos, “she walked out of the hospital tumor-free with 80 percent word recognition.”

#### **New Study Highlights the Importance of Psychosocial Support for NF2 Patients**

Although NF2 is a benign disease, patients often report high levels of stress and anxiety, according to a study led by NYU Langone researchers.

The study’s authors used a 61-item questionnaire to assess NF2 patients’ quality of life (QOL) in 11 different domains, finding that psychosocial factors, future uncertainty, and pain most impacted overall QOL. Many patients who completed the questionnaire added comments describing their significant depression and guilt about passing on the genetic disease to their children. The results are published in the October 2015 issue of *Otolaryngology—Head and Neck Surgery*.

Their findings suggest that psychosocial support should be a key part of effective clinical management. While the questionnaire used in the current study required a significant time commitment, practitioners can effectively use simpler tools to assess QOL, the authors noted. The NF2 Impact of QOL, or NFTI-QOL, for example, includes eight items and takes less than three minutes to complete.



▲ Kaleb H. Yohay, MD, pediatric neurologist and specialist in neurofibromatosis, examining a young patient

#### **NEUROFIBROMATOSIS SURGERIES SUPPORT DRUG THERAPY RESEARCH**

In addition to performing cutting-edge brain procedures to remove tumors caused by NF2, NYU Langone’s neurosurgeons are also experts at removing neurofibromatosis type I (NF1) tumors that can grow anywhere in the body’s nervous system—a capability that offers additional benefits in fighting the disease.

“These procedures let us provide NF tissue to NYU Langone researchers in a very organized fashion, which they can then use to develop new drug therapies,” says Anthony K. Frempong-Boadu, MD, associate professor of neurosurgery and co-director of NYU Langone’s newly established Spine Center. “While it’s important that we’re able to remove these tumors surgically, at the end of the day, our hope is to prevent them from growing in the first place.”

These tissue specimens are fueling research on several fronts; NYU Langone is one of 13 U.S. clinical trial sites—and the only site in New York—collaborating with the Neurofibromatosis Clinical Trials Consortium (NFCTC) to test new therapies for NF1 and NF2. NYU Langone physicians have been particularly visible in pioneering drug treatments for NF2 patients with bilateral vestibular schwannomas, which cause gradual hearing loss. Matthias A. Karajannis, MD, associate professor in the Departments of Pediatrics and Otolaryngology, led the first prospective clinical trial of lapatinib, a drug already approved for breast cancer that inhibits epidermal growth factor receptors EGFR and ErbB, which are overexpressed in vestibular schwannomas. That study found that the drug promoted anti-tumor activity and improved hearing in some patients.

Recently, Dr. Karajannis also completed the first phase II prospective randomized controlled trial of the angiogenesis inhibitor bevacizumab in NF2 patients with symptomatic vestibular schwannomas. Bevacizumab, which is approved to treat several other types of cancer, works by binding to the vascular endothelial growth factor protein (VEGF)—expressed in NF2-associated schwannomas—to inhibit cancer cell growth. He’s now leading a similar phase II study, sponsored by the NFCTC, testing bevacizumab to treat children and young adults with NF2 and progressive vestibular schwannomas.

# Age-Related Dementia: Moving Beyond Symptomatic Therapy

## NYU LANGONE RESEARCHERS ARE DEVELOPING TOOLS FOR DETECTING AND CLEARING BRAIN TOXINS

Current therapies for age-related dementia treat the symptoms of neurodegenerative disease, but not the underlying pathology. That could soon change, thanks to the work of NYU Langone researchers investigating several novel agents now in the drug development pipeline. “I think we’re reaching the point in Alzheimer’s and other neurodegenerative diseases where there’s a good expectation that we’ll soon be able to offer something beyond just symptomatic therapy,” says Thomas M. Wisniewski, MD, the Lulu P. and David J. Levidow Professor of Neurology, and professor of pathology and psychiatry.

Dr. Wisniewski, an internationally renowned Alzheimer’s researcher, is the director of NYU Langone’s Center for Cognitive Neurology (CCN). In 2015, the center’s investigators pushed forward with several innovative therapies that target the brain toxins associated with age-related dementia. They also continued to develop a novel imaging technique for detecting early buildup of brain toxins. These and other discoveries could soon allow neurologists to identify neurodegenerative diseases early and treat them before they progress to symptomatic dementia.

## ATTACKING TOXINS THROUGH THE IMMUNE SYSTEM

Two new dementia therapies developed at NYU Langone harness the immune system to attack brain toxins associated with neurodegenerative disorders.

One is a type B CpG oligodeoxynucleotide (ODN), a ligand that stimulates Toll-like receptor 9 to enhance the ability of macrophages and microglia to clear Alzheimer’s-related pathology. “Alzheimer’s occurs partly because the body’s immune activity declines with age and can no longer remove the toxic proteins that cause neuronal damage,” Dr. Wisniewski explains. “This agent addresses that decline by enhancing the activity of macrophages and microglia just a notch.”

A paper published by Dr. Wisniewski and his team in September 2014 showed that monthly CpG ODN injections in mice bred for dementia reduced formation of amyloid plaque and tau aggregates associated with Alzheimer’s by 50 percent or more. There were equivalent improvements in brain inflammation and cognitive performance.

## NYU Langone’s Barlow Center: Treating Cognitive Impairment in the Clinic

As the clinical arm of NYU Langone’s cognitive neurology program, the Pearl I. Barlow Center for Memory Evaluation and Treatment provides state-of-the-art diagnosis and care to patients suffering from cognitive disorders.

The Barlow Center gives patients access to a variety of investigational drugs and research studies. The studies currently underway include:

- ➔ Clinical trials of promising antibodies that target dementia—including aducanumab (which recently reported positive results across a range of cognitive measures in a phase Ib trial and is now entering phase III trials), and solanezumab (a drug now getting a second look after reanalysis of its phase III results showed potential benefits for early-onset Alzheimer’s patients).
- ➔ Research on the use of FDG-PET imaging of brain metabolism together with cerebrospinal fluid (CSF) biomarkers and PET amyloid imaging to predict cognitive decline.
- ➔ Investigation of the relationship between plasma amyloid beta levels and MRI measurements of brain vascular response to CO<sub>2</sub>.
- ➔ Research on using CSF and blood biomarkers combined with novel MRI monitoring of cerebral blood flow as a possible mechanism-based marker for early-stage Alzheimer’s.
- ➔ Investigation of the effect of aging on hippocampal perfusion via a new imaging technique called “arterial spin labeling MRI,” which uses magnetized water to image blood flow.
- ➔ Research assessing the neurological impact of sleep-disordered breathing in the elderly.

## \$7.5 million grant

awarded to NYU Langone to provide caregivers for individuals with Alzheimer’s disease and other dementias access to state-of-the-art support programs and services designed to improve quality of life, part of New York State’s Alzheimer’s Caregiver Support Initiative



In late 2015, the drug completed a two-year trial in squirrel monkeys, a species naturally prone to Alzheimer's disease. "Preliminary evidence from that study shows significant cognitive improvement and no apparent toxicity," Dr. Wisniewski says. One reason to be hopeful that the drug will be safe as well as efficacious, he adds, is that it is already being used in humans as an adjuvant treatment for cancer and hepatitis.

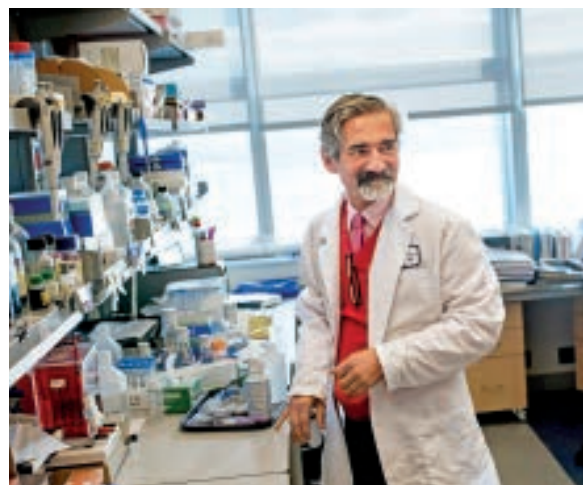
A second dementia therapy now in development at the CCN involves an NYU Langone-patented class of conformational monoclonal antibodies. A team led by Dr. Wisniewski and Fernando Goni, PhD, adjunct associate professor of neurology, presented promising data on this new treatment approach at the 2015 Alzheimer's Association International Conference.

The novel antibodies recognize the common structure of toxic oligomers produced by a variety of similarly misshapen neurodegenerative proteins, meaning that they could be effective against several brain disorders. "These antibodies recognize not only amyloid beta and tau oligomers, but also the oligomers associated with frontal temporal dementia, Parkinson's disease, and prion disease," Dr. Wisniewski says. "We're on the cusp of testing these agents clinically and hope to launch trials in the near future."

#### NOVEL VACCINE FENDS OFF PRION DISEASE

In 2015, Dr. Wisniewski's lab also published groundbreaking research confirming the efficacy of the first-ever vaccine for chronic wasting disease (CWD), a neurodegenerative disease that affects wild deer and elk.

CWD is spreading rapidly among wild deer herds in the U.S. The CCN's oral vaccine uses attenuated salmonella bacteria to which a prion-like protein has been attached. This stimulates production of prion antibodies in the animal's digestive tract. The antibodies then attack CWD prions once they're ingested. The study, published in *Vaccine* in January 2015, found CWD onset was significantly delayed in all vaccinated deer. In addition, the individual animal with the highest antibody levels remained disease-free. "This is the first time any agent has been shown effective against natural prion disease," Dr. Wisniewski says. "It could potentially be a game-changer."



#### NEW TOOLS AID DETECTION AND ANALYSIS OF ALZHEIMER'S

NYU Langone researchers are also developing techniques that allow earlier diagnosis of Alzheimer's and other dementias. One technique uses patented novel ligands that enhance the ability of PET scans to detect early evidence of brain toxin buildup. "Alzheimer's-related brain changes are known to begin 10 to 20 years before symptoms of dementia appear," Dr. Wisniewski notes.

The center also recently published a paper in *Scientific Reports* describing positive results from a new method of conducting proteomics on individual neuronal populations within small amounts of formalin-fixed, paraffin-embedded archival brain tissue. This novel approach, which uses laser capture microdissection, is expected to yield new information about Alzheimer's pathology and treatment targets.

"Because the new drugs now under investigation work synergistically, we could eventually have a menu of treatments for age-related dementia," Dr. Wisniewski says.

"The ultimate goal is to combine these medications with early detection, and stop dementia from progressing before it can cause significant neural damage," he says. "With the various novel approaches that are in development for both early detection and potential disease modification, I think there is reason to be optimistic about the future of Alzheimer's treatment."

## Using Stereotactic Imaging to Navigate the Spine

### SPINAL NEUROSURGEONS BRING CUTTING-EDGE TECHNOLOGY TO BEAR IN COMPLEX CASES

Last spring, Anthony K. Frempong-Boadu, MD, associate professor of neurosurgery, was in the early stage of an especially difficult spinal alignment procedure when he got his first direct look at the patient's spinal column. "For a moment, I wasn't sure what I was seeing," he recalls. "The patient had recurring ependymoma, which had dislocated his spine to where one section was completely in front of the other. When we opened him up, the spine was a jumbled mass of bone."

NYU Langone's spinal neurosurgeons, who perform hundreds of complex spinal surgeries annually, are accustomed to working through such challenges. This time, however, Dr. Frempong-Boadu also got an assist from a recently acquired technology—intraoperative computer-assisted stereotactic navigation, which projects a 3D fluoroscopic image of the patient's spine onto high-definition monitors in the operating room. The image can be enlarged and rotated in any direction, giving the surgeon a detailed view from every angle while also tracking the surgeon's movements within the imaged anatomy.

Long used by brain surgeons to navigate safely through the tissue of patients' brains, the technology was recently adapted for the spine and is coming into increasing use for complex spinal procedures. The Medical Center's spinal neurosurgery program added intraoperative navigation in late 2014. "There's good research showing that it increases accuracy in the placement of hardware," says Dr. Frempong-Boadu. "We've used it intensively over the past year for high-acuity cases where the anatomy is obscured."

The technology provides several benefits. By allowing hardware to be placed more precisely, it improves patient safety and also decreases the likelihood of repeat surgeries. And because this approach avoids the need for fluoroscopy during the procedure itself, the surgical team has significantly less radiation exposure.

### INTRAOPERATIVE NAVIGATION FACILITATES NOVEL HARDWARE TECHNIQUES

Navigation technology has also facilitated the Medical Center's growing use of other advanced spinal neurosurgery approaches, including innovative cortical bone trajectory screw techniques, which improve purchase in the bone of osteoporotic patients. In the May 2015 issue of *Journal of Clinical Neuroscience*, Donato R. Pacione, MD, assistant professor of neurosurgery, was the lead author on an article describing a navigation-guided decompressive laminectomy that he performed using a cortical screw trajectory along with kyphoplasty in a patient with an osteoporotic compression fracture.

"Navigation helps us safely place C2 laminar screws as well, and also makes it easy to perform minimally invasive midline lumbar fusions," says Dr. Frempong-Boadu. In this novel surgical approach, less muscle is opened, resulting in shorter hospital stays and faster recovery.

The spinal neurosurgery division's navigational capabilities will only improve in years to come, adds Dr. Frempong-Boadu, with NYU Langone preparing to add an intraoperative CT scan capability to the program in the near future.

### NEW SPINAL NEURO-ONCOLOGY INITIATIVE

In the past year, NYU Langone's spinal neurosurgeons also launched a new spinal neuro-oncology division that will work closely with the Medical Center's radiation oncologists, oncologists, and interventional radiologists to provide the most effective and minimally invasive treatment of spinal tumors. "The idea is to treat appropriate spinal tumors with stereotactic radiation, using a body-immobilizing frame and high-resolution CT imaging to provide the treatment dose," explains Dr. Pacione, who is spearheading the program for the spinal neurosurgery group. "We've already started using the protocol, and anticipate seeing an increased volume over time."

The new endeavor includes a monthly spinal oncology conference that brings together clinicians from all participating disciplines to present cases and discuss appropriate treatment options. "Attendance is growing every month," says Dr. Frempong-Boadu. "Currently, it's an internal conference, but we look forward to having our oncology colleagues from other institutions present their cases as well."

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## New Spine Center Links Neurosurgical and Orthopaedic Services

In late 2015, the spinal neurosurgery division participated in the official launch of NYU Langone's new comprehensive Spine Center, a formalization of a longtime collaboration with spine specialists in the Medical Center's nationally ranked Orthopaedic Surgery Department. The center, co-directed by Dr. Frempong-Boadu and Thomas J. Errico, MD, professor of orthopaedic surgery and neurosurgery, leverages the skills of both departments to provide across-the-board spinal

care. Patients with spine problems call a single referral number and are then directed to the appropriate NYU Langone spine specialist.

Besides steering patients to the right surgeons as needed, the center also includes physiatrists from NYU Langone's Rusk Rehabilitation who may provide first-line treatment to patients in nonsurgical cases. They also often carry out postsurgical rehabilitation in conjunction with Rusk Rehabilitation physical therapists, as well as pain management specialists and other clinicians.

"One of the center's strengths is that we have the expertise and resources to help patients avoid surgery where possible, or at least postpone it," notes Dr. Frempong-Boadu. "At the same time, when it comes to providing surgical care, there's literally no condition related to the spine—or the nerves and bones that support the spine—that the NYU Langone Spine Center's surgeons can't handle at a very high level."



▲ Anthony K. Frempong-Boadu, MD

## On the Clock: A Medical Center-Wide Push to Streamline Stroke Care

### WITH COORDINATED CARE, A 73 PERCENT REDUCTION IN STROKE MORTALITY

When NYU Langone was ranked number one by the University HealthSystem Consortium (UHC) in 2015 for overall patient safety and quality, one statistic stood out: The Medical Center's already low stroke mortality rate dropped a stunning 73 percent from 2013 to 2014, with a best-in-the-U.S. stroke mortality index score for the year's final quarter. Even more impressive, this occurred amid a 30 percent increase in overall volume of stroke patients.

While recognizing that many factors contribute to the index score, Koto Ishida, MD, assistant professor of neurology and medical director of the stroke service at NYU Langone's Tisch Hospital, gives much of the credit to NYU Langone's new neuro-ICU for this achievement. The unit, which opened in mid-2014, is headed by Aaron Lord, MD, assistant professor of neurology.

"They care for our sickest patients, who are the most likely to die," Dr. Ishida explains. "The impact of having a dedicated team of neurointensivists and specialized nursing staff, who are trained to immediately spot any change in a patient's neurological status, has been huge."

### SPEEDING TREATMENT, SAVING BRAIN CELLS

In addition to reducing mortality, the NYU Langone Stroke Center is also committed to optimizing function and quality of life for the patients in its care. Because an untreated stroke patient loses about 2 million brain neurons per minute, the stroke team, led by Albert Favate, MD, chief of vascular neurology, and Dr. Ishida's group at Tisch Hospital, focuses on streamlining every aspect of their intake, diagnosis, and treatment.

"Our data showed that while we were moving patients from ambulance to CT scan fairly quickly, our average time from CT scan to administering tPA could be improved," says Dr. Favate. To speed the clot-busting drug's delivery to patients with confirmed ischemic stroke, Dr. Ishida's team performed the medical equivalent of a full-court press. "Every stakeholder—the emergency medicine physicians who have conversations with

patients about tPA treatment, the pharmacists who mix the tPA, and the CT scan technologists—came together to expedite each step," adds Dr. Ishida. A similar approach was used to tighten up checks of vital signs and neurologic function in the first 24 post-stroke hours.

The stroke care team is also piloting a system to accelerate the transfer of patients who need their clot removed mechanically by an NYU Langone neurointerventionalist. Referring hospitals now connect directly with the attending vascular neurologist through a single central phone number, speeding the time to patient intervention. Once patients arrive, they benefit from stent retrievers, a new class of surgical devices that improve outcomes by rapidly revascularizing blocked blood vessels. "The stent retrievers, as their name implies, restore perfusion by restoring flow. The stent opens the blocked segment, and at the same time allows the body's own flow and lysis to occur. In addition, they can be used to manually extract the clot through mechanical thrombectomy," notes Howard A. Riina, MD, professor of neurosurgery, neurology, and radiology, one of four neurointerventionalists with the Medical Center's stroke service.

### NYU Lutheran Merger Brings Inter-Borough Excellence in Stroke Care

It hasn't taken long for the Stroke Center team at NYU Langone Medical Center to form a close relationship with their counterparts at NYU Lutheran Medical Center in Sunset Park, Brooklyn, which merged with NYU Langone in the spring of 2015. "NYU Lutheran gets a very high volume of stroke patients, and has an extremely well-designed, streamlined stroke care process," says Dr. Koto Ishida, head of the stroke service at NYU Langone's Tisch Hospital. "This merger has created an exciting opportunity for collaboration between our hospitals around stroke medicine."

The institutions have already established a weekly joint conference between the two campuses, using video conferencing to discuss various aspects of stroke care, and are also discussing plans to pursue joint certification. "We've been sharing a lot of ideas with Dr. Salman Azhar—the neurology chair at NYU Lutheran, who is also a stroke specialist—and his team," adds Dr. Ishida. "These are two robust, sophisticated stroke programs, and there's going to be a great synergy from our alliance."





**73% reduction**

in stroke mortality

**1 of 25**

national regional coordinating centers  
in StrokeNet, the NIH's stroke  
research consortium

**The stroke service is collaborating on stroke research projects, with:**

- Rusk Rehabilitation, on new approaches to stroke rehabilitation
- NYU Langone's divisions of neuroradiology, on radiologic appearance of stroke
- The division of cardiothoracic surgery, on stroke as a complication of different surgical procedures
- NYU's College of Global Public Health, on studies of stroke epidemiology

#### UNIFORM CARE, AROUND THE CLOCK

The stroke service is also ensuring that the same high standard of care applies at any hour of the day or night, with uniform teams of skilled stroke clinicians on-site 24/7 at Tisch Hospital. “Strokes can happen any time,” says Dr. Ishida. “If a patient arrives here at three o’clock on a Sunday morning and needs emergency tPA or a clot-removing procedure, they’ll get exactly the same skilled care they’d get on a Tuesday afternoon.”

To further standardize care, the stroke service developed more than 30 specific stroke protocols during the past year—from dealing with an intracerebral

hemorrhage to properly managing hypertension in stroke patients—and intensively trained the entire Tisch Hospital staff on their individual roles in implementing them. While putting these standards into place was a labor-intensive process, notes Dr. Ishida, it’s paying off in improved patient outcomes.

“Good stroke care depends on making sure everyone in the hospital—not only who is on call—is aware of what our processes are,” she says. “We significantly improved our care delivery by making sure the entire Tisch staff, from our lab technicians to our security personnel, know how to recognize and respond to signs of a stroke.”

## Combining Genetics and Novel Medications for Customized Epilepsy Care

### NYU LANGONE'S COMPREHENSIVE EPILEPSY CENTER CHARTS THE PATH TO PRECISION MEDICINE

Sometime in early 2016, the Comprehensive Epilepsy Center (CEC) at NYU Langone will launch a single-site clinical trial of Ataluren, a drug that helps the body's RNA replication mechanism "read through" abnormal proteins that have premature stop codons in their genetic code—a mutation that ordinarily renders these proteins useless. Already approved in Europe for Duchenne muscular dystrophy, Ataluren is being investigated in the U.S. as a treatment for cystic fibrosis as well. NYU Langone will now be studying whether it can also help alleviate Dravet syndrome and CDKL5 disorder, two conditions that cause seizures and developmental delays in children.

"It's the first time anyone has tried a genetic therapy for epilepsy," notes Orrin Devinsky, MD, professor of neurology, neurosurgery, and psychiatry, and director of the CEC. "People with these mutations typically have just 50 percent function in the affected protein. If we can get that to 65 or 70 percent, it could radically improve not just seizure control, but also the patient's entire brain function."

The pioneering study is one more example of NYU Langone's leading role in exploring new treatment options for seizure disorders. In this case, ongoing conversations with the drug's manufacturer paved the way for the trial of the new drug. "Ataluren can potentially be used for a thousand different disorders," says Dr. Devinsky. "We were fortunate to get the specific genes associated with these two disorders placed at the top of the list."



▲ Orrin Devinsky, MD

### Collaboration with NYU Langone's Neuroscience Institute

A paper published in the February 2015 issue of *Nature Neuroscience* reported on lab findings that affirmed the NeuroGrid's ability to detect the electrical activity of specific neurons in both humans and animal subjects

In 2015, Howard L. Weiner, MD, professor of neurosurgery and pediatrics, performed his

### 100th surgery

for tubular sclerosis

### INVESTIGATING THE BENEFITS OF CANNABIS EXTRACT

NYU Langone also recently launched the first large-scale trials of cannabidiol (CBD), a nonpsychoactive ingredient of marijuana, as a therapy for severe, treatment-resistant pediatric epilepsy. It is currently collaborating with University of California, San Francisco on a double-blind study of Epidiolex, a purified CBD extract administered daily in liquid form, in patients with various severe forms of epilepsy, including Dravet and Lennox-Gastaut syndromes. Results from an earlier open-label study, presented at the American Academy of Neurology's annual conference in April 2015, found that a 12-week course of Epidiolex reduced participants' seizures by 54 percent on average.

In September 2015, Dr. Devinsky and co-author Daniel Friedman, MD, assistant professor of neurology, published a review article on CBD in the *New England Journal of Medicine*. Their article noted that preliminary study data suggests CBD "may be effective in the treatment of some patients with epilepsy," but that such data remains too limited for any firm conclusions to be drawn. "Relaxation of the regulatory status of cannabis-derived drugs," they added, "especially those containing a high proportion of nonpsychoactive cannabinoids, for which the potential for abuse is low, could help to accelerate scientific study."

#### THE SEARCH FOR CAUSES IN EPILEPSY-RELATED SUDDEN DEATH

In 2015, the CEC also commenced its NIH-funded research on the neuropathology of sudden unexplained death in epilepsy (SUDEP) as a participant in the NIH's newly established Center for SUDEP Research. NYU Langone researchers are studying how the electrophysiology of seizures may relate to SUDEP risk, and are also looking at the brains and genetic profiles of people who died from SUDEP.

In addition, CEC is leading a new research effort on sudden unexplained death in children (SUDC)—a long-overlooked phenomenon affecting children over age one, for which a history of febrile seizures appears to be a risk factor. NYU Langone is home to a recently established international SUDC registry, and its investigators are studying the genes, brain tissue, and case histories of affected children. “We just completed genetic analysis of nine children who died from SUDC, and discovered the genes that caused the deaths in two of the cases,” notes Dr. Devinsky. “As we gain a better understanding of what causes SUDC, we can begin to develop preventive strategies.”

#### THE NEXT PHASE: GENETICALLY TAILORED THERAPIES

With researchers at NYU Langone and elsewhere compiling ever-more data on epilepsy's genetic risk factors. This includes the findings from the recently concluded Epilepsy Phenome/Genome project, a global consortium studying mutations linked to epilepsy, in which NYU Langone participated—Dr. Devinsky believes the next phase of epilepsy treatment will involve a tailored approach.

“The idea is that we might take a single patient with a single gene mutation, and then put that gene into a zebra fish or a mouse and study a variety of compounds to see which are effective,” he says. “We could then develop personalized medical treatment for that child.” While this approach still requires study, he adds, “we're involved in some active precision medicine collaborations right now. It could definitely become a reality within a few years.”

#### Mapping—and Manipulating—the Brain's Electrical Activity

In addition to its pursuit of new medications and genetic tools, NYU Langone's Epilepsy Center is also actively working with the brain's electrophysiology—using electrodes to study the brain's networks and learn more about their structure and function, including how and where seizures arise, and also utilizing electrical simulation therapeutically. For epilepsy patients who don't respond to medication and aren't candidates for surgical resection, using electrical current to disrupt seizure activity is emerging as an important new treatment option. In 2015, NYU Langone led the world in the number of procedures performed to implant the NeuroPace—a responsive neurostimulation (RNS) device that sends a prophylactic electric current into the brain when it detects early signs of a seizure.

NeuroPace reduced long-term seizure frequency by 60 percent or more in one large multi-site study. “RNS stops the seizure in its tracks by rebooting the affected brain area,” explains Werner K. Doyle, MD, associate professor of neurosurgery, who played a leading role in the device's clinical testing and was the first surgeon to implant a NeuroPace following its FDA approval in late 2013. NYU Langone has also been expanding the applications of RNS, using it to record activity in the cortex and stimulate the thalamus (rather than just stimulate the cortex), in order to treat seizures that have a more widespread focus.

“As we continue to learn more about the brain's functional and structural networks and understand which regions are triggering seizures, the efficacy of RNS is only going to improve,” says Dr. Doyle.



◀ Jacqueline A. French, MD, was named Chief Scientific Officer of the Epilepsy Foundation in 2015

## Skull Base Surgery: The Best Route In

### A LEADING SKULL BASE SURGEON EMPLOYS WIDELY DIVERGENT APPROACHES FOR TWO PATIENTS WITH DEEP-SEATED TUMORS

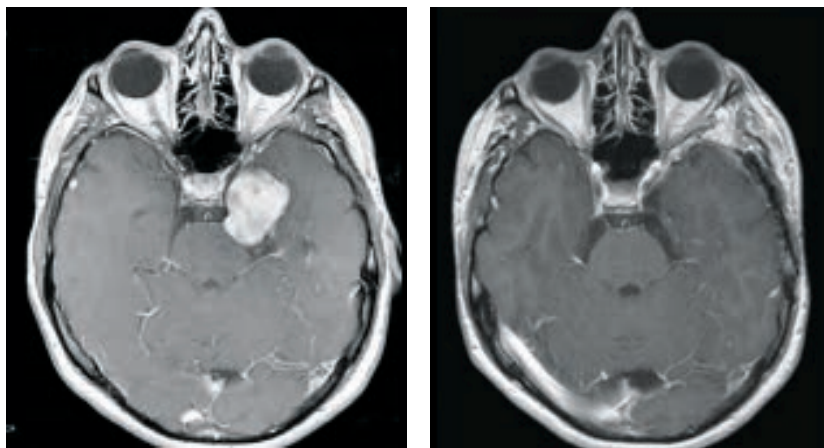
“Ten years ago, I would have used an open-skull procedure to take this tumor out,” says Chandranath Sen, MD, professor of neurosurgery and director of NYU Langone’s division of skull base surgery and cranial nerve disorders. He is studying the MRI image of a recent case: a 46-year-old woman who came to him with steadily failing vision in both eyes due to a large benign tumor at the bottom of her brain, directly behind the sinuses. Despite its sensitive location deep inside the skull, however, he was able to use a minimal access endoscopic approach to remove this particular tumor, entering through the nostrils.

“I could take that approach because the tumor was at the base of the brain, in the midline even with the nose, and also because minimally invasive instrumentation is continuing to improve significantly,” notes Dr. Sen. “The newer scopes offer better vision, and the surgical instruments are longer and more versatile.” As a result of these advances, Dr. Sen is now doing a greater percentage of endoscopic procedures every year.

“The patient was very distraught, of course,” continues Dr. Sen, returning to the case at hand. “The tumor was in a region that controls many important functions, including the pituitary gland, and was also pressing on her optic nerves. We knew she would likely suffer loss of pituitary function from the operation, and that there could be residual damage to her vision. Our goal was to stop her vision from getting any worse, by completely removing the tumor.”

At the start of her procedure, Dr. Sen teamed with Richard A. Lebowitz, MD, associate professor of otolaryngology, to thread an endoscope through the sinuses to the anterior wall of the skull base. There, using stereotactic guidance to navigate between the optic nerves, he drilled into the base of the skull itself. The dura was opened to bring the tumor into clear view. The tumor was gradually fragmented and separated from the optic nerves and the fine blood vessels at the skull’s base to remove it completely, and the opening at the base was then carefully closed to prevent leakage of spinal fluid into the nose and infection from going up into the brain.

By the end of the six-hour procedure, Dr. Sen had successfully removed all of the tumor except some grayish remnants along the walls of the third ventricle. Today, the patient is receiving hormone therapy from an endocrinologist to compensate for her damaged pituitary function, but is otherwise living a normal, active life.



▲ LEFT: Preoperative MRI. RIGHT: Postoperative MRI.



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**WHY MINIMAL ISN'T ALWAYS OPTIMAL:  
THE IMPORTANCE OF OPTIONS IN SKULL BASE SURGERY**

While Dr. Sen acknowledges the appeal of endoscopic procedures, which can result in faster and easier post-surgical recovery compared to craniotomy, he cautions that minimally invasive surgery's popularity can be misleading—particularly with deep-lying tumors at the base of the brain.

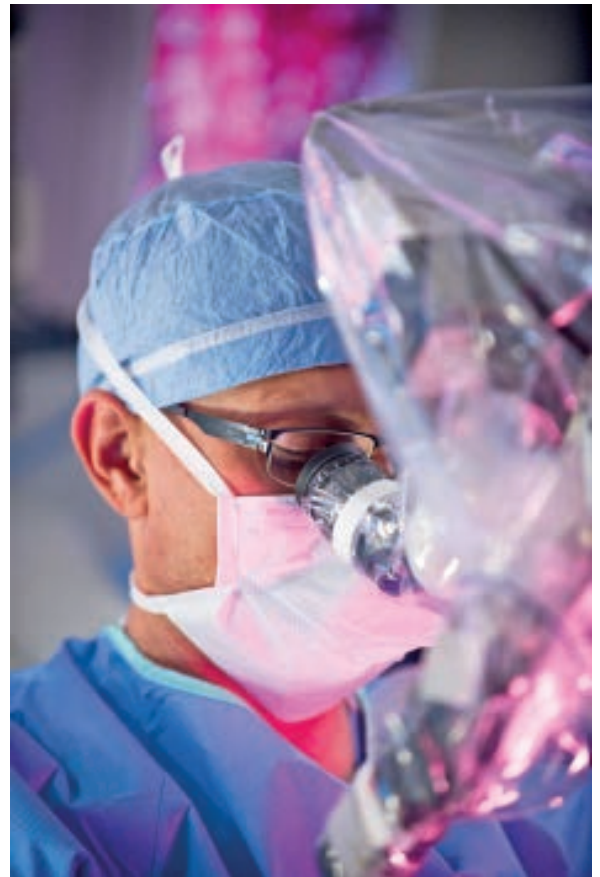
“A very important factor in any skull base surgery program,” he says, “is that you have a surgeon with the skills and judgment, based on extensive experience, to know which approach will work best for a particular individual and a particular tumor, and then execute it.” Although patients intuitively think going through the nose is better than opening the skull, Dr. Sen notes, there are many occasions when craniotomy is the better method, due to the tumor's location and its relation to other important structures in the vicinity. “Opening the skull is not the scary part,” he adds. “As I tell every patient, the real risk involves where the tumor is located, not how I get to it.”

To illustrate his point, he describes another recent case involving a man in his early thirties. “The patient had almost no symptoms,” he recalls, “just a little tingling and numbness in his face.” Yet imaging revealed a large dumbbell-shaped tumor on the left side of his brain, which had likely been growing for four or five years. “It was a benign tumor arising out of the trigeminal nerve, deep under the brain adjacent to the brain stem,” says Dr. Sen. “For this reason, some centers might have chosen to treat it with external radiation or partial removal, because they deemed the risks of surgery to be too high.”

In this case, the optimal approach was a craniotomy. Dr. Sen first took down the patient's left cheekbone, then opened the skull in front of the ear. Navigating past various cranial nerves to the eye, he gained access to the tumor, sitting under the brain.

“Working in this manner,” he wrote in his postsurgical notes, “the posterior fossa part and the middle cranial fossa part of the tumor were completely removed.” At the same time, most of the trigeminal nerve was preserved, with just a small portion removed along with the tumor. Since his procedure in late winter 2015, the patient is back working full-time, his only after-effect a small amount of residual facial numbness that is improving.

“The fact that these two patients' symptoms—both caused by deep-seated tumors at the base of the brain—differed so greatly and required such divergent procedures,” concludes Dr. Sen, “is evidence of the challenges inherent in the skull base field.”



▲ Chandranath Sen, MD

## Multiple Sclerosis Center Adds a World-Class Pediatric Component

### NEW DIVISION CHIEF IS A PIONEER IN DIAGNOSING AND TREATING CHILDREN WITH MS

Ten years ago, when Lauren B. Krupp, MD, professor of neurology, established the United States' first center for pediatric multiple sclerosis, at Stony Brook University Hospital, the idea that children and adolescents could develop MS was still novel. "The teaching in medical schools used to be that kids couldn't get multiple sclerosis," she says. "When children were actually diagnosed with the condition, families faced a lot of skepticism from their health care providers."

Today, physicians around the world utilize pediatric MS medical definitions and treatment guidelines that Dr. Krupp helped develop, and research on the condition is expanding rapidly. In the U.S., Dr. Krupp teamed with the National Multiple Sclerosis Society to promote pediatric MS research, which led to a cooperative network of pediatric MS centers.

NYU Langone Medical Center joined that network when Dr. Krupp, who specializes in adult and pediatric MS, was appointed head of NYU Langone's Multiple Sclerosis Comprehensive Care Center and established the Pediatric MS Center in 2015. Together with long-time colleagues she brought on board, Dr. Krupp has built a world-class pediatric MS program in New York City virtually overnight. Her team—including a pediatric neurologist, a neuropsychologist, a social worker, and a pediatric nurse—works closely with patients and their families to address physical, psychological, and social issues related to pediatric MS. The program also connects young MS patients through activities such as Teen Adventure Camp, a national, philanthropy-supported summer camp for adolescents with MS.

### LEADING THE SEARCH FOR NOVEL MS THERAPIES

NYU Langone is also deeply involved in developing new treatments for adult multiple sclerosis, running over 40 clinical trials—including research on medications, genomics, radiological imaging, and rehabilitation to improve specific symptoms and overall quality of life.

Some of the most cutting-edge research was presented at the 2015 annual meetings of the American Academy of Neurology and the European Committee

for Treatment and Research in MS (ECTRIMS). One presentation showed that natalizumab, currently one of the most effective MS medications, produced good outcomes when taken every eight weeks instead of four, with zero incidence of progressive multifocal leukoencephalopathy (PML)—a potentially deadly side effect that can occur with the shorter dosing interval.

In addition, NYU Langone researchers published studies last year showing that an experimental cancer drug, GANT61, protects brain myelin and reverses MS-like symptoms in chemically damaged mice. NYU Langone also has extensive clinical experience with ocrelizumab, a potential breakthrough drug that reported positive phase III trial results at last year's ECTRIMS conference for both relapse-remitting and primary progressive MS. "We'll be at the forefront of using the drug when it becomes available," says Dr. Krupp.

### NON-PHARMACEUTICAL APPROACHES ENHANCE QUALITY OF LIFE

While most MS centers concentrate primarily on drug research, NYU Langone is equally focused on studying non-pharmaceutical treatments for MS. "We're leading the way in defining state-of-the-art care for the daily problems people with MS face, like fatigue, cognitive difficulties, pain, and mood disruption," says Dr. Krupp.

Dr. Krupp's team recently submitted an abstract showing that mindfulness, demonstrated in well-designed studies to decrease fatigue and pain, improves concentration and attention for MS patients. The center is also doing groundbreaking research on how MS affects social cognition in children, and has submitted a paper on its use of sensitive measures to track overall cognitive function in children with MS. Yet another pending abstract reports on the effectiveness of a cognitive therapy in adults with MS that is administered to patients at home via computer.

"As we gain confidence in this telemedicine approach, it will immediately be transferable to pediatrics—which is extremely important, since these children can live hundreds of miles from the nearest available treatment center," explains Dr. Krupp.



## MS Center Highlights

- **31 total posters and presentations** delivered by MS Center faculty atECTRIMS, American Academy of Neurology, and Consortium of Multiple Sclerosis Centers in 2015
- One of the largest MS centers in the U.S., with **2,000 patients** under its care in 2015
- A **major clinical trials site** for novel MS drugs and innovative uses of approved MS medications
- Center's clinical research team recently developed **new, highly accurate tools for assessing MS severity**
- Maintains a large **patient biotissue repository** used to study the influence of genetics, the gut microbiome, and other factors impacting MS incidence and progression.

# Tracking Concussions Through Eye Scans, Phone Apps, and Sideline Screening Tests

## NYU LANGONE'S CONCUSSION CENTER BREAKS NEW GROUND IN DIAGNOSING AND UNDERSTANDING MILD TRAUMATIC BRAIN INJURY

What does reciting strings of numbers or pictures from a card or computer screen have to do with diagnosing and understanding concussions? Quite a bit when the watcher is being tested on the sideline of an athletic event, and even more when he or she is simultaneously being monitored by neuro-ophthalmologists and physiatrists using eye-tracking technology called EyeLink. By using this apparatus to record and analyze eye movements too rapid to be seen by an ordinary observer, scientists can study the subtle effects of concussion on patients' visual systems.

Neurologic researchers with NYU Langone's Concussion Center are now collaborating with Rusk Rehabilitation's Visuomotor Integration Lab to study the correlations between such eye movements and performance on a rapid number naming test called the King-Devick test, in which the subject is asked to read a series of irregularly spaced numbers in rapid succession. "The hope is that by comparing injured patients' results with healthy controls using these techniques, we can start to develop markers for concussion and other brain conditions," says Laura J. Balcer, MD, MSCE, vice chair and professor of neurology, ophthalmology, and population health, and a co-director of the Concussion Center.

With no objective tools currently available to diagnose concussions, such biomarkers would represent a major step forward in identifying and treating this widespread condition. The EyeLink research is already producing intriguing results. "We know King-Devick reading times become prolonged by a few seconds if there's a concussion, but we don't know why that happens," says Janet C. Rucker, MD, the Bernard A. and Charlotte Marden Associate Professor of Neurology and director of the Division of Neuro-ophthalmology. "Do eye movements become slower or taking longer to initiate, or is it that they become inaccurate and aren't landing on the number?"

In fact, what the lab of Dr. Rucker and John-Ross (J.R.) Rizzo, MD, assistant professor of rehabilitation medicine, is investigating is whether concussion increases the interval between saccades—the ultrafast, movements that the eyes make as they scan a person's surroundings. "This interval incorporates fixation, duration, and saccade latency," explains Dr. Rucker.

### \$1.2 Million NY State Grant

from the Empire Clinical Research Investigator Program (ECRIP) to study the use of diagnostic vision-based performance measures, neuroimaging techniques, and blood tests to identify and validate structural, functional, and biological markers and sequelae of sports-related concussion relative to long-term exposure to contact sports

Her team has submitted abstracts on their findings and has begun drafting articles for publication. They also have another paper now under review, describing their research methodology.

Other researchers at the Concussion Center are investigating the effects of concussion on the optic nerves, using ocular coherence tomography (OCT), which measures changes in the gray and white nerve matter at the back of the eye. In addition, the center is teaming with NYU Langone's neuro-radiologists to study the impact of concussion on brain metabolism and structure, using PET and MRI scans.

These approaches are also being employed in NYU Langone's arm of a recently launched NIH-funded study of retired NFL players. Medical Center researchers will utilize eye-tracking, OCT, PET and MRI scans, and behavioral markers to look for biomarkers of traumatic brain encephalopathy—a condition now diagnosable only through autopsy after death. Early study results are expected within a year.

### A NEW SMARTPHONE APP HELPS MONITOR PATIENTS' RECOVERY

The center has also teamed with NYU Langone's IT Department to develop an app for the Apple iPhone and Apple Watch that allows newly diagnosed concussion patients and their doctors to monitor symptoms, cognitive function, and activity levels. The NYU Langone Concussion Tracker app, built using Apple's Research Kit software platform, is being utilized in a Concussion Center research project launched in late 2015, in which patients use their smart phones to complete three daily tasks—a five-question survey of symptoms, a six-minute walk, and a concentration test in which they input a set of digits in reverse order—plus a weekly 22-question assessment. Results are then integrated into the



Medical Center's electronic medical records system, Epic, using MyChart, the patient mobile portal. The app includes a dashboard that presents cumulative results in graphical form, as well as an educational component.

"Normally, people get these tests done every week or two," notes Paul A. Testa, MD, assistant professor of emergency medicine and NYU Langone's chief medical information officer. "By tracking these measurements of concussion patients on a daily basis, this app and the related research project will let us assess current treatment protocols in ways not before possible."

A free version of the app will also be available to members of the general public who have suffered a concussion and wish to participate in the NYU Langone study. The use of Apple's Research Kit allows individuals from anywhere in the United States to choose to join the study.

#### **DEMONSTRATING THE EFFECTIVENESS OF SIDELINE CONCUSSION SCREENS**

At the same time, NYU Langone is advancing the use of rapid number naming and other simple, low-tech screens in the clinic and in the community: Its investigators recently published their work with local youth and college athletic teams, showing that a combination of three simple sideline tests—the King-Devick test of rapid number naming; the timed tandem gait screen; and the Standardized Assessment of Concussion test, which measures memory and concentration—will detect virtually any concussion that has occurred, when compared to preseason baseline results. They also conducted a recent meta-analysis, published early last year, confirming that sideline administration of the King-Devick test can be employed productively across a wide range of age groups and geographic areas.

In addition to investigating sideline screening tests, the center is taking an active role in disseminating information about them to athletic leagues and other community groups. "We're proving that these tests are effective for detecting concussion at athletic events of all levels," notes Dr. Balcer. "Since they can be quickly administered by parents or other adults without medical training, they provide a clear protocol for addressing traumatic collisions as soon as they happen, and for ensuring that a concussed athlete is removed from play and gets prompt treatment."



Has treated 2,000 adults and children since opening, including

**1,187 patients  
in 2015**

Recently opened a

**new hub facility**

in NYU Langone's Ambulatory Care Center,  
custom-designed for concussion patients  
with a softly lit, TV-free waiting area

# TRAINING THE NEXT GENERATION



Education programs in neurology and neurosurgery at NYU Langone are growing and offering exciting new opportunities for tomorrow's leaders.

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## Expanding Residencies and Fellowships to Optimize Training Opportunities

Given their highly skilled faculty and comprehensive educational programs, NYU Langone's Departments of Neurology and Neurosurgery are uniquely qualified to train physicians in respective specialties—a fact reflected by the increasingly strong nationwide demand in recent years for resident slots within the two departments. With a growing volume of patients and resident applicants, both departments increased the size of their residency programs in 2015. The Department of Neurology added three residency positions for a total of 33, while the Department of Neurosurgery expanded from 14 to 18 residents. Plans call for moving to three neurosurgery residents per year in the near future to reach a departmental total of 21, which will make it the largest program of its kind in New York City.

Thanks to the support of the Morris and Alma Schapiro Fund, the Medical Center also launched a new vascular neurology fellowship last year, with the first fellow starting in July 2015, and added a second multiple sclerosis fellowship position. In addition, the Department of Neurology recently instituted a policy in which all junior faculty members, regardless of tenure status, are assigned a mentoring committee to provide guidance and advice on career development to residents.

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## Education and Training on an International Scale

The Department of Neurology recently established a global health division to coordinate its overseas efforts and to implement a global health elective as part of its residency program. In 2015, its first full year of activity, the division sponsored its first global health elective course for residents. Alexandra Lloyd-Smith, MD, a third-year resident, spent her three-week elective on the neurology ward at Mulago Hospital in Kampala, Uganda, where she was joined by global health program director Jaydeep Bhatt, MD, clinical assistant professor of neurology. There, they experienced a wide array of neurological infectious and non-communicable disease (NCD) burden and resource-limited treatment paradigms.

## Fellowship in Stereotactic Gamma Knife Radiosurgery

announced in late 2015

Both neurology and neurosurgery faculty have engaged in numerous other global initiatives in recent years, bringing their expertise to regions with limited access to specialized medical care. In the past year, these global efforts included the following:

- Ruben Kuzniecky, MD, professor of neurology and co-director of NYU Langone's Comprehensive Epilepsy Center, led a team that included Howard Weiner, MD, professor of neurosurgery and pediatrics, a neurosurgery resident, and an EEG technician on their third trip to Panama to perform implant surgery in epilepsy cases in Hospital del Niño of Panama. This year, the team performed the most complex epilepsy surgery ever seen in Panama, an invasive EEG study to record seizures for brain mapping. Their hope is to make this a replicable program for other Central American countries.
- Another NYU Langone epileptologist, Anuradha Singh, MD, clinical associate professor of neurology, traveled to Raipur, India, last year to deliver neurological care to patients with seizure disorders in rural areas with limited access to health systems. She participated in the Lifeline Express, a mobile, multispecialty medical train known for its novel approach to epilepsy care and awareness.
- In addition, Jori Fleisher, MD, assistant professor of neurology, published a review article on the global burden of neurological disease and opportunities in clinical service and education.

### THIRD ANNUAL PATRICK J. KELLY LECTURE

In September 2015, the Department of Neurosurgery hosted its third annual Patrick J. Kelly Lecture, an annual event that brings the top minds in the field to NYU Langone. The speaker for this year's lecture was Jon H. Robertson, MD, emeritus professor at the University of Tennessee, Memphis. His lecture was titled, "A Neurosurgeon's Legacy."



# Academic Activities

## NEUROLOGY

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Blanca Vazquez  
Akila Venkataraman



# Leadership

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## NEUROSURGERY

### **John G. Golfinos, MD**

Associate Professor of Neurosurgery  
and Otolaryngology  
Chair of the Department of Neurosurgery

### **Mitchell Chesler, MD, PhD**

Professor of Neurosurgery  
Vice Chair of Research  
Associate Director, Medical Science  
Training Program

### **Douglas S. Kondziolka, MD, MSc**

Professor of Neurosurgery  
Vice Chair of Clinical Research  
Director, Center for Advanced Radiosurgery

### **Howard A. Riina, MD**

Professor of Neurosurgery  
Vice Chair of the Department of Neurosurgery  
Director, Endovascular Surgery  
Director, Neurosurgery Residency  
Training Program

### **Anthony K. Frempong-Boadu, MD**

Associate Professor of Neurosurgery  
Director, Division of Spinal Neurosurgery

### **Jafar J. Jafar, MD**

Professor of Neurosurgery  
Director, Division of Cerebrovascular Surgery

### **Alon Mogilner, MD, PhD**

Associate Professor of Anesthesiology  
and Neurosurgery  
Director, Center for Neuromodulation

### **Noel I. Perin, MD**

Associate Professor of Neurosurgery  
Director, Minimally Invasive Spinal Surgery

### **Chandranath Sen, MD**

Professor of Neurosurgery  
Vice Chair for Education  
Director, Skull Base

### **Jeffrey H. Wisoff, MD**

Professor of Neurosurgery and Pediatrics  
Director, Division of Pediatric Neurosurgery

## NEUROLOGY

### **Steven L. Galetta, MD**

Philip K. Moskowitz, MD Professor  
Chair of the Department of Neurology

### **Salman Azhar, MD**

Clinical Professor of Neurology  
Vice Chair of Neurology,  
NYU Lutheran Medical Center

### **Laura J. Balcer, MD**

Professor of Ophthalmology and Neurology  
Vice Chair of the Department of Neurology

### **William B. Barr, PhD**

Associate Professor of Neurology  
and Psychiatry  
Director, Neuropsychology Service

### **Aleksandar Beric, MD**

Professor of Rehabilitation Medicine,  
Neurology, Neurosurgery,  
and Orthopaedic Surgery  
Director, Clinical Neurophysiology,  
Hospital for Joint Diseases

### **Jaydeep Mukesh Bhatt, MD**

Clinical Assistant Professor of Neurology  
Director, Division of Global Health

### **Orrin Devinsky, MD**

Professor of Neurology, Neurosurgery,  
and Psychiatry  
Director, Division of Epilepsy  
Director, NYU Langone's Comprehensive  
Epilepsy Center

### **Alessandro Di Rocco, MD**

Founders Professor of Neurology  
Director, Division of Movement Disorders  
Executive Director, The Marlene and  
Paolo Fresco Institute for Parkinson's  
and Movement Disorders

### **Albert S. Favate, MD**

Assistant Professor of Neurology  
Director, Division of Vascular Neurology

### **Richard Hanson, MD**

Chief of Service,  
New York Harbor Veterans Affairs  
Medical Center

### **Horacio Kaufmann, MD**

Felicia B. Axelrod Professor of  
Dysautonomia Research  
Director, Division of Autonomic Disorders  
Director, Dysautonomia Center

### **Sanjeev Kothare, MD**

Associate Professor of Neurology  
Director, Pediatric Sleep Disorders Program

### **Lauren B. Krupp, MD**

Professor of Neurology  
Director, Division of Multiple Sclerosis

### **Aaron S. Lord, MD**

Assistant Professor of Neurology  
Director, Division of Neurocritical Care

### **Janet C. Rucker, MD**

Bernard A. and Charlotte Marden  
Associate Professor of Neurology  
Director, Neuro-Ophthalmology

### **Howard W. Sander, MD**

Professor of Neurology  
Director, Division of  
Neuromuscular Medicine  
Associate Chair, Education

### **Anuradha Singh, MD**

Clinical Associate Professor of Neurology  
Director, Neurology Service,  
Bellevue Hospital Center

### **Harold J. Weinberg, MD, PhD**

Professor of Neurology  
Director, Division of General Neurology  
Chief, Neurology Service at Tisch Hospital

### **John T. Wells, MD**

Associate Professor of Neurology  
Director, Division of Child Neurology

### **Thomas M. Wisniewski, MD**

Lulu P. and David J. Levidow  
Professor of Neurology  
Professor of Neurology,  
Pathology, and Psychiatry  
Director, Center for Cognitive Neurology  
Director, Division of Cognitive Neurology  
Associate Chair, Research

# Leadership

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Senior Vice President and Vice Dean  
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### Nancy Sanchez

Senior Vice President and Vice Dean  
for Human Resources and Organizational  
Development and Learning

## By the Numbers\*

### NYU LANGONE MEDICAL CENTER

**1,069**

Total Number of Beds

**77**

Operating Rooms

**38,554**

Patient Discharges

**1,216,428**

Hospital-Based Outpatient Visits

**5,766**

Births

**2,900,000**

Faculty Group Practice  
Office Visits

**1,469**

Full-Time Faculty

**1,392**

Part-Time Faculty

**2,627**

Voluntary Faculty

**128**

Endowed Professorships

**2,740**

Physicians

**3,465**

Registered and Advanced  
Practice Nurses

**730**

Allied Health Professionals

**3,800**

Publications

**550,000**

Square Feet of Research Space

**\$178M**

NIH Funding

**\$295M**

Total Grant Funding

**611**

MD Candidates

**79**

MD/PhD Candidates

**272**

PhD Candidates

**400**

Postdoctoral Fellows

**1,063**

Residents and Fellows

\*Numbers represent FY15 (Sept 2014–Aug 2015)





**NYU LANGONE MEDICAL CENTER**  
550 FIRST AVENUE, NEW YORK, NY 10016  
**NYULANGONE.ORG**