BARROW
Neurological Foundation

FISCAL YEAR 2019 STEWARDSHIP REPORT

Neuroscience Publications

This represents the Spine App (pedicle screw placement simulation) that neurosurgery resident Jake Godzik, MD, developed with us and presented to the Council of State Neurosurgical Societies to show virtual reality's educational potential to neurosurgeons nationwide. It is currently being rebuilt for the PlayStation Platform.

→ **THE VIDEO GAME** and movie industries pour millions into creating true-to-life imagery, through cutting-edge tools and technology. While games and movies are more realistic every year, medical media has not changed significantly in the past decade. At Barrow Neurological Institute, our Neuroscience Publications team is leveraging these new video and gaming technologies to revolutionize how we educate the next generation of neuroscience leaders.

Barrow President and CEO, Michael T. Lawton, MD, has challenged us to create his next textbook with 3D models and include interactivity that will allow the user to explore the differences between surgical choices and variations in anatomy. No one has models as good as those at Barrow, and yet we still need to raise the bar higher, so that when a resident cuts a specific craniotomy to reveal the brain, she would see exactly the same exposure in the virtual world as she would in a real-life operating room.

Illustrated
5
major journal covers

Completed
1,559
media projects

483
models in Virtual Neuroanatomy App

ABOUT BARROW NEUROLOGICAL INSTITUTE

#1 IN ARIZONA
#11 IN THE UNITED STATES
for neurology and neurosurgery

CLINICAL IMPACT

92,515
BNI Clinic visits

3,135
number of neurosurgeries

1,578
number of spine surgeries

$2.8 MILLION
amount of charity care

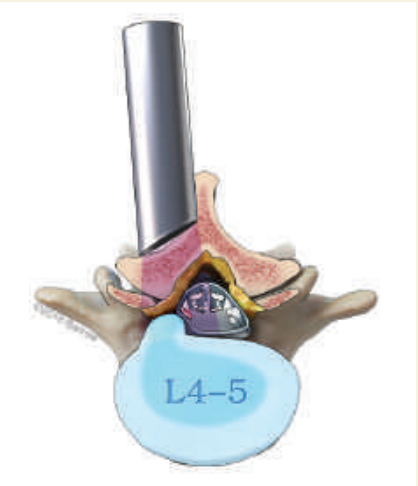
GLOBAL IMPACT

54
visiting scholars, research fellows and observers from Mexico, India, Egypt, Pakistan, UK, Russia, China, Chile, Spain, Brazil, Japan, France, Italy, Kingdom of Saudi Arabia, Indonesia, Turkey, Germany, Poland, Colombia, Philippines, Israel, Argentina and Thailand.

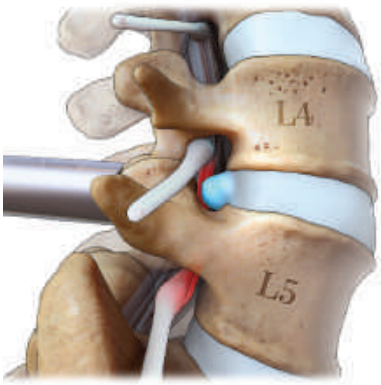
PROGRAM ACCOMPLISHMENTS

We are empowering neurosurgeons and residents to develop their ideas into virtual reality surgical simulations. We are currently developing a Spine Pedicle Screw App, a Deep Brain Nuclei Stimulation App, and a Virtual Neuroanatomy App. Residents can experience immersive 3D patient anatomy and surgical procedures before they're in the room with cadavers or patients, which may help them better prepare for educational and surgical experiences to save resources and improve patient outcomes. So far, the Virtual Neuroanatomy App includes 483 models, or parts of anatomy and instruments. 1,639 new lines of code enable users to cut craniotomies in the skull, add and grow aneurysms and tumors in specific locations, retract soft tissue and much more.

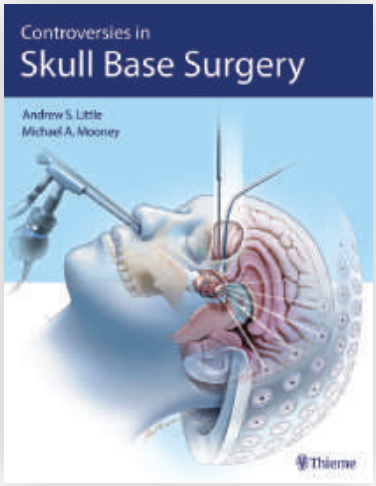
In March, we were invited to present our desktop and virtual reality (VR) neuroanatomy applications to Sony PlayStation. Impressed with our experience developing 3D interactive simulations as well as our understanding of the difficulty of programming interactive content, Sony PlayStation donated a development kit (PlayStation 4 and VR headset with interactive hand controllers). They also gave us access to their PlayStation Developer Network to help us navigate the complexity of programming for medical subject matter. We are currently working on a prototype of a spine surgery VR simulation using the Unity game engine that will run on the PlayStation VR platform.



The artwork for Minimally Invasive Spine Surgery *with over 330 illustrations was created entirely from the virtual models. This book is going to print in December 2020.*



Building for multiple platforms, including the Oculus Rift and PlayStation VR, allows us to take advantage of the strengths of different virtual reality technologies.



Barrow illustrator Peter Lawrence received the Award of Excellence in the Editorial Category at the 2019 Salon of the Association of Medical Illustrators for his Controversies in Skull Base Surgery *cover.*

Foundation funds were used to purchase a high-end graphics computer for the Eller Telepresence with the processing speed to display our 3D Interactive Apps in real time during Rounds, so that the neurosurgeons could explain difficult concepts and anatomy while reviewing actual cases with residents. Additionally, donations were used to purchase a 3D modeling workstation, VR headsets and a holographic display.

Barrow is consistently among the Top 5-10 neurosurgery centers in academic publications and the only non-university neurosurgery center in the top 100. This year, Neuroscience Publications edited 300 journal articles, 62 book chapters and 131 surgical videos. We completed five textbooks this year, one of which, *Minimally Invasive Spine Surgery,* was illustrated entirely with 3D models. In addition, Barrow illustrator Peter Lawrence received the Award of Excellence in the Editorial Category at the 2019 Salon of the Association of Medical Illustrators for his *Controversies in Skull Base Surgery* cover.

ON THE HORIZON

Neuroscience Publications will be hiring an additional medical modeler to help create the most accurate and realistic virtual head anatomy, empowering doctors and residents to demonstrate 100 neurosurgical approaches. We will be working with PlayStation to get the Spine application fully functional so that we can test its effectiveness with neurosurgery residents. For publications, almost all journals and textbooks are requesting videos and animations to accompany written text, thus we will increase our output to meet those needs. We are also devising ways to add overlay annotations on displays so neurosurgeons can better communicate with residents, not unlike television football commentators outlining plays on screen. Finally, Dr. Lawton wants to hire a video producer for his Neurosurgery Case Documentary Video project, which will provide richer storytelling and narration to educate residents, surgeons and even the general public about our work.

BY THE NUMBERS

RESEARCH

320
active research studies

839
patients enrolled in clinical trials

$9 MILLION
in federal research grant support

DONOR IMPACT

$3.98 MILLION
for basic and translational research

$3.65 MILLION
for strategic initiatives including Barrow Aneurysm & AVM Research Center, Barrow Artificial Intelligence Center, neuroimaging and stroke

$1.26 MILLION
for education and fellowship programs

$2.52 MILLION
for community outreach programs

THANK YOU FOR HELPING TRAIN THE NEXT GENERATION!

Thank you for giving us the means to develop advanced educational media for Barrow neurosurgeons and residents. Your support has allowed us to use 3D modeling and gaming technology to create tools for our doctors to communicate and learn the detailed relationships of neuroanatomy and surgical approaches. It allows us to convert 2D diagnostic scan series into 3D models to visualize, understand and strategize treatments of complex patient pathologies.

Mark Schornak
MANAGER
NEUROSCIENCE PUBLICATIONS

↑ *The illustration on the monitor above shows a patient's vascular lesion in the middle of the critical nuclei and nerves of the brainstem.*

Barrow Neurological Foundation raises awareness and funding for patient care, medical education, community outreach and research offered at Barrow Neurological Institute. Barrow is an internationally-recognized leader in neurology, neurosurgery and neuroscience research, treating patients with a wide range of conditions, including brain and spinal tumors, concussion and brain and spinal traumas, neuromuscular diseases, stroke, cleft and craniofacial disorders, and cerebrovascular disorders. It is home to several centers of excellence, including the Ivy Brain Tumor Center, Muhammad Ali Parkinson Center and Gregory W. Fulton ALS and Neuromuscular Disease Center. **www.SupportBarrow.org**

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