



Curriculum Vitae

Graeme F. Woodworth, M.D., FAANS, FACS
Professor and Chair, Department of Neurosurgery
Director, Brain Tumor Treatment and Research Center
University of Maryland School of Medicine

Date April 4, 2020

Contact Information

Clinic: Department of Neurosurgery
22 South Greene Street, S-12-D
University of Maryland Medical Center
Baltimore, MD 21201
gwoodworth@som.umaryland.edu
(o) (410) 328-6148
(f) (410) 328-0756

Lab: Translational Therapeutics Research Group
655 West Baltimore Street
Bressler Research Building, Rm. 8-055
Baltimore, MD 21201
(o) (410) 706-3255
(l) (410) 706-3256

Education

1997 B.S., Chemistry, Tufts University
2005 M.D., Johns Hopkins University School of Medicine

Post Graduate Education and Training

2005-2006 *Intern*, Department of Surgery, Johns Hopkins Hospital, Baltimore, Maryland
2006-2011 *Resident*, Department of Neurosurgery, Johns Hopkins Hospital, Baltimore, Maryland
2009-2011 *Fellow*, Neuro-Oncology-NCI/Nanotechnology for Cancer Medicine Program, Johns Hopkins University School of Medicine, Baltimore, Maryland
2011 *Fellow*, Cranial Neuro-Endoscopy, Department of Neurological Surgery, Weil Cornell School of Medicine, New York, New York
2011-2012 *Assistant Chief of Service*, Department of Neurosurgery, Johns Hopkins Hospital, Baltimore, Maryland
2019-2020 *Surgical Leadership Program*, Harvard Medical School, Boston, MA

Professional Licensure and Board Certification

2009 Maryland (active)
2010 New York (inactive)
2015 *Diplomate*, American Board of Neurological Surgery

Other Certification

2010 Cyberknife Stereotactic Radiosurgery
2012-present *Basic Life Support*, American Red Cross
2015 *Fellow*, American Association of Neurological Surgeons
2016 *Fellow*, American College of Surgeons
2019 Gamma Knife Stereotactic Radiosurgery

Employment History

Academic Appointments

2012-2015 *Assistant Professor*, Department of Neurosurgery, University of Maryland School of Medicine
2012-present *Adjunct Faculty*, Department of Neurosurgery, Johns Hopkins University School of Medicine
2013-2015 *Assistant Professor* (secondary), Department of Anatomy and Neurobiology, University of Maryland School of Medicine
2013-present *Graduate Faculty*, University of Maryland, Baltimore Graduate School
2014-2015 *Assistant Professor* (secondary), Department of Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine
2015-2018 *Associate Professor*, Department of Neurosurgery, University of Maryland School of Medicine
2015-2018 *Associate Professor* (secondary), Department of Anatomy and Neurobiology, University of Maryland School of Medicine
2015-2018 *Associate Professor* (secondary), Department of Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine
2016-present *Director*, Brain Tumor Treatment and Research Center, Greenebaum Comprehensive Cancer Center, University of Maryland
2018-present *Professor*, Department of Neurosurgery, University of Maryland School of Medicine
2018-present *Professor* (secondary), Department of Anatomy and Neurobiology, University of Maryland School of Medicine
2018-present *Professor* (secondary), Department of Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine
2019-2020 *Interim Chair*, Department of Neurosurgery, University of Maryland School of Medicine
2020-present *Chair*, Department of Neurosurgery, University of Maryland School of Medicine

Other Employment & Appointments

1997-1999	<i>Assistant Scientist, Pfizer, Inc., Discovery Chemistry Division- Central Research, Groton, Connecticut</i>
2000-2001	<i>Research Associate, University of California San Francisco, Gladstone Institute of Virology and Immunology, San Francisco, California</i>
2009-2011	<i>Contract Physician, Surgical Intensive Care Unit, Department of Anesthesiology and Critical Care Medicine, Johns Hopkins Hospital, Baltimore, Maryland</i>
2009-2011	<i>Contract Physician, Department of Neurosurgery, Sinai Hospital, Baltimore, Maryland</i>
2012-present	<i>Attending Neurosurgeon, University of Maryland Hospital and Shock Trauma Center, Baltimore, Maryland</i>
2012-present	<i>Attending Neurosurgeon, Baltimore Veterans Affairs Medical Center, Baltimore, Maryland</i>
2013-present	<i>Unaffiliated Neurotrauma Consultant, National Football League</i>
2015-present	<i>Attending Neurosurgeon, University of Maryland St. Joseph's Medical Center</i>
2019-present	<i>President, University of Maryland Neurosurgical Associates</i>
2019-2020	<i>Interim Neurosurgeon-in-Chief, University of Maryland Medical Center</i>
2020-present	<i>Neurosurgeon-in-Chief, University of Maryland Medical Center</i>

Professional Society and Memberships

2005-present	American Association of Neurological Surgeons (AANS)
2005-2016	Congress of Neurological Surgeons (CNS)
2015-present	American College of Surgeons (ACS)
2013-present	AANS Section on Tumors
2010-2012	Cyberknife Society
2012-present	North American Skull Base Society
2012-present	Focused Ultrasound Foundation
2012-present	Society for Neuro-Oncology

Honors and Awards

1997	<i>Cum Laude, Department of Chemistry, Tufts University</i>
1997	<i>Robert M. Allan Sr. Award, Intercollegiate Sailing Association</i>
2001	<i>Above and Beyond Award, The Gladstone Institute/UCSF, San Francisco, California</i>
2004	<i>Clinical Research Award, Southern Society of Neurological Surgery</i>
2004	<i>Medical Student Research Award, Alpha Omega Alpha Honors Society</i>
2004	<i>B. Wood Research Award, Johns Hopkins School of Medicine</i>
2007	<i>Patient Safety Research Award, Johns Hopkins Department of Neurosurgery</i>
2009	<i>T32 Award, Nanotechnology in Cancer Medicine, Johns Hopkins University</i>
2009	<i>Top Ten Abstract, CNS Annual Meeting, New Orleans, Louisiana</i>
2010	<i>Chairman's Award for Patient Safety Research, Johns Hopkins Department of Neurosurgery</i>
2011	<i>Harvey Cushing Research Award, Johns Hopkins Department of Neurosurgery</i>
2012	<i>Neurosurgeon Research Career Development Program Award, Massachusetts General Hospital/NINDS</i>

Graeme F. Woodworth, M.D., FACS

- 2013 *Clinician-Scientist Award*, The Passano Foundation
- 2014 *Dean's Challenge Award*, University of Maryland School of Medicine
- 2014 *Pilot Research Award*, University of Maryland Greenebaum NCI Cancer Center
- 2015 *Innovation in Biotechnology Award*, (co-awardee) American Association of Pharmaceutical Scientists and Genentech
- 2015 *Jorge Heller Outstanding Paper Award*, (co-award) Controlled Release Society
- 2016 *Research Scholar Award*, American Cancer Society
- 2017 *Pilot Research Award*, University of Maryland Greenebaum Comprehensive Cancer Center
- 2018 *Accelerated Translational Project Award*, Institute for Clinical and Translational Research, University of Maryland School of Medicine
- 2018 *University of Maryland Research and Innovation Award – M-Power Program*
- 2019 *Andrew J. Lockhart Memorial Prize*, Focused Ultrasound Foundation
- 2019 *Top Docs*, Baltimore Magazine

Clinical Activities

The Neurosurgery Service provides 24/7/365 coverage for the University of Maryland Hospital (UMH), Shock Trauma Center (STC), and the Baltimore VA Medical Center (BVAMC).

Neurosurgery Residents rotate through a preset curriculum and schedule with this Service over a seven-year period. As a neurosurgery faculty member, the general coverage scheme includes: 5 days/week, 1 in 7 weekends/month, 1 in 7 week nights/week throughout each calendar year, with oversight and teaching of 1 chief resident (UMH), 1 senior resident (BVAMC/STC), and 2 junior residents (UMH/BVAMC/STC). Currently, there are 14 residents in the Neurosurgery Program.

- 2012-present *Attending Neurosurgeon*, Department of Neurosurgery, University of Maryland Medical Center
 - Inpatient service oversight and teaching: 1 chief resident (UMH), 1 senior resident (VA/STC), 2 junior residents (UMH/VA/STC)
 - Operative oversight and teaching: 6-10 hours/day, 2 days/week
 - Clinical service coverage: 1 in 7 weekends/month, 1 in 7 week nights/week throughout each year.
- 2016-present *Director*, Brain Tumor Treatment and Research Center, Greenebaum Comprehensive Cancer Center
 - Consultative and surgical services for brain and spinal tumor patients 5/7 days/week, 3/7 weekends/months (see also description below).
 - Program leadership in clinical trials development, faculty recruitment, and patient outreach and support.
- 7/1/19-present *Neurosurgeon-in-Chief*, University of Maryland Medical Center
 - Administrative and leadership services for the university and shock trauma hospitals
 - Integrating system hospitals to improve patient safety, quality of care, and transfer efficiency
 - Coordinating Quality Improvement program for perioperative and related patient care services

Neurosurgery trainees:

- 2012-2013 Chris Maulucci, M.D., *Resident*, UM Department of Neurosurgery

	<u>Current Position:</u> Vice Chair of Clinical Neurological Surgery, Director of the Neurosurgery Spine Program, Assistant Residency Program Director, Department of Neurosurgery, Tulane University
2012-2013	David Chessler, M.D., Ph.D., <i>Resident</i> , UM Department of Neurosurgery. <u>Current Position:</u> Assistant Professor, Department of Neurosurgery, Stony Brook University
2012-2014	Gary Schwartzbauer, <i>Resident</i> , UM Department of Neurosurgery, <u>Current Position:</u> Assistant Professor, Departments of Neurosurgery and Critical Care Medicine - Shock Trauma Center, Baltimore, MD
2012-2014	Adam Polifka, M.D., <i>Resident</i> , UM Department of Neurosurgery, <u>Current Position:</u> Assistant Professor, Department of Neurosurgery, University of Florida, Gainesville, FL
2012-2015	Justin Slavin, M.D. <i>Resident</i> , UM Department of Neurosurgery, <u>Current Position:</u> Assistant Professor, Department of Neurosurgery, University of Massachusetts Medical School, Worcester, MA
2012-2016	Kenneth Crandal, M.D., <i>Resident</i> , UM Department of Neurosurgery, <u>Current Position:</u> Assistant Professor, Department of Neurosurgery, University of Maryland, Baltimore, MD
2012-2016	Narlin Beatty, M.D., <i>Resident</i> , UM Department of Neurosurgery, <u>Current Position:</u> Neurosurgeon, Tallahassee Neurological Clinic, Tallahassee, FL
2012-2017	Akil Patel, M.D., <i>Resident</i> , UM Department of Neurosurgery, <u>Current Position:</u> Neurosurgeon, KPN Brain & Spine, Kettering, OH
2012-2017	Evan Lewis, M.D., <i>Resident</i> , UM Department of Neurosurgery, <u>Current Position:</u> Neurosurgeon, Andrews Institute, Pensacola, FL
2012-2018	Elizabeth Le, M.D., <i>Resident</i> , UM Department of Neurosurgery <u>Current Position:</u> <i>Assistant Professor</i> , University of Alabama, Birmingham, AL
2012-2018	David Hersh, M.D., <i>Resident</i> , UM Department of Neurosurgery <u>Current Position:</u> <i>Assistant Professor</i> , Division of Neurosurgery, University of Connecticut School of Medicine, Hartford, CT
2013-2019	Salazar Jones, M.D., <i>Resident</i> , UM Department of Neurosurgery <u>Current Position:</u> Assistant Professor, Department of Neurosurgery, Mount Sinai School of Medicine, New York, NY
2013-2019	Erik Hayman, M.D., <i>Resident</i> , UM Department of Neurosurgery <u>Current Position:</u> Spine Fellow, Swedish Neuroscience Institute, Seattle, WA
2014-present	Harry Mushlin, M.D., <i>Resident</i> , UM Department of Neurosurgery
2014-present	Matthew Kole, M.D., <i>Resident</i> , UM Department of Neurosurgery

Administrative Service

Institutional Service

2012-2018	<i>Chair</i> , Quality Assurance Committee, Department of Neurosurgery, University of Maryland School of Medicine
	- Quarterly planning and committee meetings (4-8 hours per quarter)
	- Developed multidisciplinary care rounds for inpatient Neurosurgery Service

- Assisted in establishing mid-level provider team for Neurosurgery Service
 - Working to improve Acute Care Neurosurgical floor layout and environment
 - Developed early mobilization and discharge planning system
 - Developed multi-modal pain management protocol for post-operative patients to reduce use of narcotics
- 2013-present *Director of Neurosurgical Oncology*, Department of Neurosurgery, University of Maryland School of Medicine
- Lead neurosurgical component of weekly multi-disciplinary brain tumor conference (1-2 hours per week)
 - Lead the monthly ‘Pituitary and Skull Base’ tumor multi-disciplinary conference (1-2 hour per month)
 - Developed ‘awake craniotomy’ brain surgery team including anesthesiology team and neurophysiological monitoring
 - Developed “fluorescence guided brain tumor surgery including fluorescein and 5-Ala based approaches at UMMC
 - Developed ‘laser interstitial thermotherapy (LITT) brain tumor surgery including setup and optimization of Monteris system at UMMC
- 2013-present *Co-director*, Translational Therapeutics Research Group, Greenebaum Cancer Center and Department of Neurosurgery, University of Maryland School of Medicine
- Developing targeted therapeutics for cancer therapy (brain, breast, lung) with a multi-disciplinary team of engineers, cancer biologists, and physician scientists
 - Developing genetically engineered glioma models
 - Investigating MR-guided focused ultrasound for brain cancer
 - Collaborating with leading scientists at MD Anderson Cancer Center, Fred Hutchinson Cancer Center, Johns Hopkins University, Mayo Clinic, Duke University, Translational Genomics Research Institute, University of North Carolina
- 2013-2017 Judge, Medical Student Summer Research Program (4 hours per summer session)
- 2013-2015 NeuroCritical Care Review Committee (1-2 hours per month)
- 2014-present *Co-director*, Center for Metabolic Imaging and Therapeutics (CMIT), University of Maryland School of Medicine
- Co-investigator, Focused Ultrasound Essential Tremor Phase III clinical trial
 - Developed pre-clinical MR-guided focused ultrasound for blood brain barrier disruption and interstitial brain effects
 - Principle Investigator, MRgFUS blood brain barrier disruption trials in glioblastoma patients
- 2014-present Nathan Schnaper Summer Intern Program in Cancer Research Selection Committee
- 2014-2015 Neurosurgery Mid-level Provider Search Committee (2 hours per week)
- 2014-present NIH T32 Cancer Biology Training Grant Selection Committee
- 2015-present Interviewer, University of Maryland School of Medicine Admissions Committee

Graeme F. Woodworth, M.D., FACS

- 2016-present Passano Foundation-University of Maryland Clinician-Scientist Award Selection Committee
- 2016-present *Director*, Brain Tumor Treatment and Research Center, Greenebaum Comprehensive Cancer Center
- Leading faculty searches, recruitments, and program development efforts with Cancer Center Director (KC) and Neurology Chair (PC) for medical neuro-oncologists and brain cancer scientists
 - Successful recruitment of Haroon Ahmad, M.D. – Neuro-oncology, University of Virginia
 - Leading search and recruitment efforts with Pathology Chair (SS) for Neuropathology scientists and clinician scientists
 - Successful recruitment of Cherry Ho, MD., PhD., Assistant Professor, Children’s National Medical Center
 - Successful recruitment of Heather Ames, M.D., Ph.D., Post-doctoral Fellow, Johns Hopkins Hospital
 - Successful recruitment of Eli Bar, Ph.D., Assistant Professor, Case Western Reserve University
 - Establishing clinical and research endowments (see Philanthropy section below)
 - Working to integrate clinical and research efforts across Neurosurgery (G. Woodworth, H. Eisenberg, F. Aldrich), Radiation Oncology (W.Regine, M.Mishra) Radiology (E. Melhem, P. Raghavan, R Gullapalli, V. Frenkel), Neurology (P.Crino), Cancer Center (E. Sausville, K. Cullen, J. Winkles), Pathology (C. Ho, H. Ames, S. Stass), Institute for Genome Sciences (S. Devine)
- 2017-present Center for Innovative Biomedical Resources (CIBR) Advisory Committee
- 2018-present UMMC Operating Room Committee – block review and redistribution, OR efficiency including start times, turn around times, surgical team establishment
- 2019 Search Committee, UMSOM General Surgery Department Chair
- 2019 Review Committee, UMSOM Otolaryngology Head and Neck Surgery Chair
- 2019 Search Committee, UMSOM Director of the Program in Transplantation
- 7/1/19-present *Chair*, Department of Neurosurgery, University of Maryland School of Medicine
- Restructuring Neuro-Interventional Program with Departments of Radiology (E. Melhem) and Neurology (P.Crino)
 - Re-negotiating new neurosurgery department contracts with University of Maryland Medical Center, Shock Trauma Center, Baltimore VA Medical Center
 - Budget management consisting of approximately \$10 million in net clinical and research operating revenues, including 4 NIH-funded research laboratories
 - Developing a University system-wide strategy for integrating the missions and expertise of 12 system medical centers and hospitals

Local Service

Graeme F. Woodworth, M.D., FACS

- 2002-2005 *Co-founder*, Johns Hopkins Student Outreach Resource Center (SOURCE: source.jhu.edu), received AOA Community Service Grant, 2004
- 2008-2012 Educational Committee, Johns Hopkins University Department of Neurosurgery
- 2008-2010 Information Technology Committee, Provider Order Entry/Eclipsys Platform Development, Johns Hopkins University Department of Neurosurgery
- 2013-2018 Scientific Advisory Committee, Nanotechnology in Cancer Medicine T32 program, Johns Hopkins University

National & International Service

- 2007-2011 Young Neurosurgeon's Committee, American Association of Neurological Surgeons
- 2010-2011 Member Benefits Development Committee, American Association of Neurological Surgeons
- 2012-present Ad Hoc Reviewer: *Clinical Cancer Research, Nature Nanotechnology, Journal of Neuro-Oncology, Neuro-oncology, Neurosurgery, Journal of Controlled Release, Journal of Biomedical Materials Research, International Journal of Nanomedicine, Oncotarget, PLOS ONE, Advanced Materials Research, Nanomedicine, Theragnostics, BMC Genomics, Scientific Reports, BMC Cancer*
- 2012-2014 Life-Long Learning Committee, Congress of Neurological Surgeons
- 2012-present Scientific Advisory Committee, Focused Ultrasound Foundation
- 2018-present DSMB, ABTC 1401
- 2018-present Neuro-Oncology Advisory Board (unpaid), InSightec Inc.
- 2019-present Society for Image-Guided Neuro-interventions (SIGN), Annual Meeting organizing committee

Grant and Program Review

- 2012-present Focused Ultrasound Foundation
- 2014-present Nathan Schnaper Summer Intern Program in Cancer Research
- 2014-present NIH T32 Cancer Biology Training Program, University of Maryland School of Medicine
- 2016-present Passano Foundation
- 2016-present American Cancer Society - Institutional Research Grant Program, University of Maryland
- 2017-present Cigarette Restitution Fund, State of Maryland and Greenebaum Cancer Center
- 2018-present Institute for Clinical and Translational Research, University of Maryland
- 2019 Westin Brain Institute, Toronto, Canada
- 2019 *Ad hoc member*, NIH/CSR, Imaging-guided Interventions and Surgery Study Section (IGIS)
- 2019 *Invited member*, Board of Scientific Counsellors, National Institute of Neurological Diseases and Stroke (NINDS)
- 2019 *Ad hoc member*, ZCA1 RPRB-N Study Section, NIH SPORE (P50) Review

Teaching Service

2010	Teaching Assistant, Medical Student Residency Preparation Course (“Triple”). Johns Hopkins University School of Medicine
2010-2011	Teaching Assistant, Neuroscience. Johns Hopkins University School of Medicine
2012-present	Resident Didactic and Surgical Anatomy Curriculum, Department of Neurosurgery, University of Maryland Medical Center <ul style="list-style-type: none">- Contributed to the establishment of neurosurgical anatomy lab and dissections program- Performed prosections with residents to detail skull base and microsurgical anatomy of neurosurgical approaches. (2 hours per session, 2-4 dissections/year)- Established biannual Neurosurgical Anatomy and Operative Skills Workshop for Hopkins, Medstar, and Maryland neurosurgery residents, held Fall and Spring each year.
2013-present	Graduate Faculty, University of Maryland Graduate School, Baltimore <ul style="list-style-type: none">- Mentoring graduate student(s) in the research laboratory: 1 student, 4-6 hours/week)- Molecular Medicine Professors Rounds (1 hour per semester)
2013-present	Neurosurgery Residency Program Liaison – Department of Neurosurgery, University of Maryland Medical Center <ul style="list-style-type: none">- Monitoring of resident case logs (1-2 hours/month)- Graduate Medical Education Committee meetings (2 hours/meeting, 1 meeting/ quarter)
2014-present	Discussion leader, Conflicts of Interest in Biomedical Research course, CIPP 907, University of Maryland Graduate School, Baltimore (2 hours/semester)
2014	Lecturer, Department of Radiation Oncology – Resident Conference (1 hour/semester)
2015	Lecturer, Department of Neurology – Resident Conference (1 hour/semester)
2016-present	Lecturer, Pathophysiology and Therapeutics, University of Maryland School of Medicine Core Curriculum. Lectures: Brain Tumors, Pituitary adenoma surgery, Hydrocephalus
2018-present	Lecturer, Advanced Cancer Biology Course, GPLIS 760, University of Maryland School of Medicine
2016-present	Course faculty, Selected Topics in Neuroplastic & Reconstructive Surgery: An International Symposium on Cranioplasty and Implantable Neurotechnology
2019-present	Course faculty, Clinical Experience for Biomedical Engineers, University of Maryland

Scientific Mentoring

Medical Students:

Graeme F. Woodworth, M.D., FACS

- 2006 Kaisorn Chaichana, B.S., Johns Hopkins School of Medicine- Outcomes following resection of brain and spinal tumors (PMID: 17621024, 17665203, 18425015, 18447686, 19589201, 22595358).
- 2009-2010 Alfred See, B.S., Johns Hopkins School of Medicine Analysis of outcomes in endoscopic third ventriculostomy and vestibular schwannoma surgery (PMID: 22120264, 25599212).
- 2010 Chris Jackson, B.S., Johns Hopkins School of Medicine- Outcomes following resection of vestibular schwannoma (PMID: 25599212).
- 2010-2012 Thomas Link, B.S., M.S., Johns Hopkins School of Medicine- Functional outcomes following surgery for malignant glioma (PMID: 22595358).
- 2016-2018 Aymen Alqazzaz, B.S., University of Maryland School of Medicine (PMID: 30132163)
- 2018 Neila Kline B.S., UMSOM, Fn14 and nuclear envelop rupture-mediated DNA damage in glioblastoma. UMSOM Prism Awardee
- 2018 Lucy Wang B.S., UMSOM, Targeted therapeutics for metastatic brain cancer. UMSOM Prism Awardee
- 2019 Adarsha Malla, B.S., UMSOM MSTP program, Confined migration in neural precursor cells. MSTP grant awardee
- 2019 Yamini Vyas, B.S., UMSOM, Ultrasound-enabled liquid biopsy of brain tumors. Kuckein AOA Research Fellowship

Surgical Residents:

- 2014 Akil Patel, M.D., Department of Neurosurgery, University of Maryland Medical Center, Diagnosis and management of post-operative pseudoaneurysms. (PMID: 24818055)
- 2013-2017 David Hersh, M.D., Department of Neurosurgery, University of Maryland Medical Center. Fn14 gene expression in glioma molecular subtypes, Focused ultrasound applications in brain disease. (PMID: 26481053, 26685681, 26954763, 27369449, 29415084, 29453678). Young Investigator Award, Focused Ultrasound Foundation 2016.
- 2018-present Abdul Ahmed, M.D., Department of Neurosurgery, University of Maryland Medical Center. Ultrasound-enhanced liquid biopsy of brain tumors.

Summer & rotation students:

- 2014 Haelee Pettingill, St. Mary's College, St. Mary's City, MD
- 2015 Adip Bhargav, M-Scholars Intern Program, University of Maryland School of Medicine and College Park
- 2015 Arjun Adapa, M-Scholars Intern Program, University of Maryland School of Medicine and College Park
- 2015 Philip Smith, B.S., MD/PhD MSTP, University of Maryland School of Medicine
- 2016 Jay Swayambunathan, M-Scholars Intern Program, University of Maryland School of Medicine and College Park
- Nathalie Chen, Schnaper Intern Program, University of Maryland School of Medicine, Carnegie Mellon University, Pittsburgh, PA

Graeme F. Woodworth, M.D., FACS

- 2017 Sara Barlow, Schnaper Intern Program, University of Maryland School of Medicine, Grand Valley State University, Allendale, MI
- 2017 Pranjali Kanvinde, Molecular Medicine program, University of Maryland School of Medicine
- 2018 Nicole Gould, Molecular Medicine program, University of Maryland School of Medicine
- 2018 Ravina Pandita, B.S., Molecular Medicine program, University of Maryland, Baltimore
- 2018 Jacqueline Wang, Schnaper Intern Program, University of Maryland School of Medicine. (PMID: 30132163)
- 2019 Jennifer Mariano, B.S. Molecular Medicine program, University of Maryland, Baltimore
- 2019 Sarah Talamantez-Lyburn, Molecular Medicine program, University of Maryland, Baltimore
- 2019 Mitasha Palha, Molecular Medicine program, University of Maryland, Baltimore
- 2019 Blair Landon, Schnaper Intern Program, University of Maryland School of Medicine
- 2019 Bruck Negash, M-Scholars Intern Program, University of Maryland School of Medicine and College Park

Masters students:

- 2011-2012 Ting-Yu Shih, B.S., *M.S. Candidate*, Johns Hopkins Department of Chemical and Biomolecular Engineering - Drug-loaded brain penetrating nanoparticle therapy for glioblastoma. (PMID: 24979210)

Graduate students:

- 2011-2012 Clark Zhang, B.S., Johns Hopkins Department of Chemical and Biomolecular Engineering, Nanoparticle-mediated drug delivery for brain tumors. (PMID: 25761435, 25542792)
- 2014-2018 Jimena Perez, B.S., University of Maryland School of Medicine, GPILS Molecular Medicine Program. Fn14 signaling and therapeutic targeting in glioblastoma. (PMID: 25542792, 26415854, 26300004, 29453678) [T32 Cancer Biology Grant 2016](#). Current Position: FDA Research Analyst
- 2015-2018 Nathan Roberts, B.S., Medical Scientist Training Program, University of Maryland School of Medicine, Immunomodulation of the GBM microenvironment (PMID: 26685681, 28887134). [NIH F30 Grant Award, First-percentile score, 2017](#). Current Position: MS3 Medical Student
- 2018 Oleg Makarevich, B.S., Medical Scientist Training Program - Thesis Committee - ‘Functional cooperation between Sp1 and p53 to activate neuronal apoptotic pathways’, Genome Biology track, Molecular Medicine Graduate Program, University of Maryland School of Medicine
- 2018 Pranjali Kanvinde, B.S., GPLIS Molecular Medicine program, University of Maryland School of Medicine. ‘Impact and therapeutic implications of Fn14 in the glioblastoma microenvironment’
- 2018 Christine Carney, B.S., GPLIS Microbiology and Immunology program, University of Maryland School of Medicine. Impact and therapeutic implications of Fn14 in the breast cancer microenvironment

2019 Babar Khan, M.D., Doctoral Research Program, The Elmezzi Graduate School of Molecular Medicine, NY. 'Targeting glioblastoma heterogeneity with miRNA nanoparticles'

Post-doctoral research fellows:

2009-2010 Thomas Garzon-Muvdi, M.D., Department of Neurosurgery, Johns Hopkins School of Medicine- Pseudoprogression following treatment of malignant glioma (PMID: 25599212, 23666202). *Current Position:* Fellow, Endoscopic Neurosurgery, Jefferson University

2013-2014 Craig Schneider, University of Maryland School of Medicine, Preclinical models of glioblastoma and targeted therapeutics for invasive brain cancer (PMID: 25542792, 26300004, 26415854). *Current Position:* Resident, Radiation Oncology, University of Alabama

2014-present Nina Connolly, Ph.D., University of Maryland School of Medicine, Preclinical models of glioblastoma and targeted therapeutics for invasive brain cancer (PMID: 26300004, 26685681, 28358926, 29352201). T32 Cancer Biology Grant 2015

2015-2019 Aniket Wadajkar, Ph.D., University of Maryland School of Medicine, Immunomodulatory nanotherapeutics and enhanced local delivery for invasive brain cancer (PMID: 26415854, 26685681, 27813323, 28887134). ACS-IRG Grant and T32 Cancer Biology Grant 2017. *Current Position:* Associate Director, Nanoparticle Platforms, Nextimmune, Gaithersburg, MD

2017-present Pavlos Anastasiadis, Ph.D., University of Maryland School of Medicine, Acoustic activation of the glioma-brain microenvironment. (PMCID: 5418115, 5802894) T32 Cancer Biology Grant 2017, Bracco Suisse SA Young Investigator Award 2018, Focused Ultrasound Foundation

2019-present Nikhil Pandey, Ph.D., University of Maryland School of Medicine, Immunomodulatory nanotherapeutics and enhanced local delivery for invasive brain cancer

2019-present Anshika Kapur, Ph.D., University of Maryland School of Medicine, Nanotherapeutics trafficking and optimization for primary and metastatic brain cancers

Junior faculty:

2013 Gary Schwartzbauer, M.D., Ph.D., Assistant Professor - Department of Neurosurgery, University of Maryland School of Medicine. Cerebral edema and cerebral malaria, K08 Grant proposal development

2014 Shahid Nimjee, M.D., Ph.D., Assistant Professor - Department of Neurosurgery, Ohio State University Medical Center, K12 grant proposal development. K12 Awardee

2017 David Benavides, M.D., Ph.D., Assistant Professor – Department of Neurology, University of Maryland School of Medicine, Neurobiology of antibody-mediated injury in neurological disease, K08 grant proposal development. K08 Awardee (first submission)

2018 Heather Ames, M.D., Ph.D., Assistant Professor – Department of Pathology, University of Maryland School of Medicine, Dissecting to role

2019 of Fn14 in glioblastoma invasion, K08 proposal development. Passano Foundation Clinician-Scientist awardee
Winson Ho, M.D., Ph.D., Assistant Professor - Department of Neurosurgery, University of Texas-Austin, Pediatric brain tumor immunotherapy- K12/K08 proposal development, NINDS K12 Awardee.

Grants and Contracts

ACTIVE

07/01/16-06/30/20 (PI, Woodworth, 15%)
“Fn14-targeted biodegradable BCNU-loaded nanoparticles for invasive brain cancer”
American Cancer Society RSG-16-012-01-CDD
Annual Direct Costs: \$157,157
Total Direct Costs: \$628,628

07/01/16-06/30/20 (PI, Mayer; co-I, Woodworth)
“Exploiting altered porphyrin synthesis for metabolic imaging of glioblastoma”
NIH/NCI R21 CA202694
Annual Direct Costs: \$130,500
Total Direct Costs: \$275,000

07/01/17-06/30/20 (PI – Anastasiadis; mentor, Woodworth)
“Acoustic activation of the invasive glioblastoma microenvironment”
NIH/NCI T32 CA15427
Annual Direct Costs: \$70,000
Total Direct Costs: \$210,000
This is a mentored post-doctoral student award to Pavlos Anastasiadis, Ph.D

01/01/19-12/30/21 (mPI: Huang, Chen, Woodworth)
“Image-guided photodynamic priming to prevent brain tumor recurrence”
UMB-UMCP Research and Innovation MPower Grant
University System of Maryland
Annual Direct Costs: \$75,000
Total Direct Costs: \$150,000

04/01/19-03/31/24 (PI, Woodworth 20%)
“Nanotherapeutic treatment of the invasive glioblastoma microenvironment”
NIH/NINDS R01 NS107813
Annual Direct Costs: \$267,817
Total Direct Costs: \$1,360,000

07/15/19-06/14/21 (mPI, Bettegowda, Woodworth)
“MRgFUS-enabled non-invasive interrogation of malignant glioma via circulating tumor DNA”

Graeme F. Woodworth, M.D., FACS

NIH/NINDS R21NS113016

Annual Direct Costs: \$349,937

Total Direct Costs: \$600,000

- 08/01/19-07/31/20 (mPI, Kim, Winkles, Woodworth)
“Development of the DART therapeutic nanoparticle platform for Fn14-positive cancers”
Maryland Innovation Initiative Technology Assessment Program
Annual Direct Costs: \$115,000
Total Direct Costs: \$115,000
- 04/01/20-03/31/22 (PI, Woodworth)
“Acoustic activation of the GBM-brain microenvironment for improved immunotherapy”
Focused Ultrasound Foundation
Annual Direct Costs: \$100,000
Total Direct Costs: \$200,000
- 07/01/20-06/30/22 (PI, Pearl; co-I, Woodworth)
"Enhanced intra-arterial drug delivery to the brain after blood brain barrier opening: comparison between osmotic and MRI-guided focused ultrasound opening techniques"
NIH/NINDS R21 NS118232
Annual Direct Costs: \$100,000
Total Direct Costs: \$200,000

PENDING

- 07/01/20-07/01/22 (PI, Woodworth)
“MRgFUS-enabled detection and measurement of ctDNA in brain tumor patients”
Focused Ultrasound Foundation
Annual Direct Costs: \$125,000
Total Direct Costs: \$250,000
- 10/01/20-09/30/25 (mPI: Lammerding, Dunn, Woodworth)
“Immunotherapeutic targeting of migration-induced neoantigens in brain tumors”
NIH R01 OD029943
Annual Direct Costs: \$1,000,000
Total Direct Costs: \$5,000,000
- 10/01/20-09/30/25 (PI, Huang; co-I, Woodworth)
“Mechanism-informed, image-guided photodynamic combination priming for glioblastoma”
NIH/NCI R01 CA238577
Annual Direct Costs (sub-contract): \$120,000
Total Direct Costs: \$600,000

Graeme F. Woodworth, M.D., FACS

- 09/01/20-08/31/25 (mPI, Kim (contact), Winkles, Woodworth)
“Novel tumor cell- and macrophage-targeted nanotherapeutics for breast cancer brain metastases”
NIH/NCI R01 CA255744
Annual Direct Costs: \$250,000
Total Direct Costs: \$1,250,000
- 09/01/20-08/31/25 (mPI, Kim, Winkles, Woodworth (contact))
“Ultrasound-enhanced targeted nanoparticle treatment of breast cancer brain metastases”
NIH/NCI R21 CA255918
Annual Direct Costs: \$250,000
Total Direct Costs: \$500,000

COMPLETED (Last 5 years)

- 01/01/18-01/01/20 (PI, N. Roberts; mentor, Woodworth)
“Improving CNS delivery of chemotherapeutics to invasive brain cancer”
NIH/NCI F30 CA216970
Annual Direct Costs: \$40,000
Total Direct Costs: \$120,000
This is a mentored graduate student award to Nathan Roberts, MSTP M.D., Ph.D. student
- 09/15/14-08/31/19 (PI, Woodworth, 50%)
“Brain-penetrating nanoparticle therapeutics for invasive brain cancer”
NIH/NINDS K08 NS090430
Annual Direct Costs: \$150,000
Total Direct Costs: \$750,000
- 07/01/18 – 6/30/19 (mPI: Winkles, Woodworth, Devine, Kim)
“Identification of TWEAK/Fn14 signaling nodes of vulnerability for improved treatment of glioblastoma”
CRF Pilot Grant
University of Maryland Comprehensive Cancer Center
Annual Direct Costs: \$150,000
Total Direct Costs: \$150,000
- 07/01/18-06/30/19 (mPI: Mayer, Woodworth, Raghavan, Ho)
“Hyperpolarized [1-13C] pyruvate metabolic imaging for noninvasive diagnosis and monitoring of glioblastoma”
ICTR Pilot Grant
University of Maryland School of Medicine
Annual Direct Costs: \$35,000
Total Direct Costs: \$35,000
- 02/01/17-02/01/18 (PI, Woodworth)

- “Investigation and development of materials with acoustic transparency for cranioplasty applications”
UM-Ventures Fund
Annual Direct Costs: \$20,000
Total Direct Costs: \$20,000
- 10/01/16-10/01/17 (PI, Woodworth)
“Focused-ultrasound mediated blood brain barrier disruption for improved therapeutic delivery to invasive brain cancer”
UM-GCCC Pilot Research Grant
Annual Direct Costs: \$50,000
Total Direct Costs: \$50,000
- 09/01/16-07/01/17 (PI, Woodworth)
“Focused ultrasound immunomodulation in a mouse GL261 intracranial glioma model”
Focused Ultrasound Foundation
Annual Direct Costs: \$59,000
Total Direct Costs: \$59,000
- 05/01/16 – 04/30/17 (M-PI, Frenkel, Woodworth, Kim)
“Effect of pulsed focused ultrasound on microstructures in the brain”
NSF/CBET EAGER 1557922
Annual Direct Costs: \$154,000
Total Direct Costs: \$154,000
- 06/01/14-06/01/16 (M-PI, Mayer, Woodworth, Frenkel)
“Leveraging altered porphyrin synthesis for metabolic imaging and sonodynamic therapy for glioblastoma”
Dean’s Challenge Award
Annual Direct Costs: \$40,000
Total Direct Costs: \$80,000
- 01/01/15-01/01/16 (Co-I, Woodworth; PI, Kim)
“Fn14-targeted nanotherapeutics for glioblastoma: distribution, pharmacokinetics, and efficacy studies”
American Cancer Society Institutional Research Grant
Annual Direct Costs: \$100,000
Total Direct Costs: \$100,000
- 01/01/13-12/31/15 (PI, Woodworth)
“Targeted brain-penetrating nanoparticle gene delivery for glioblastoma”
Passano Foundation Clinician-Scientist Award
Annual Direct Costs: \$45,000
Total Direct Costs: \$90,000
- 01/01/13-12/31/15 (PI, Woodworth)
“Targeted brain-penetrating nanoparticle gene delivery for glioblastoma”

CLINICAL TRIALS (Investigator Initiated)

- 07/01/18-06/30/20 (PI, Woodworth)
“ExAblate Blood Brain Barrier Disruption (BBBD) for Planned Surgery in Glioblastoma”
InSightec, BT004, NCT03322813
- 09/01/18-08/31/20 (PI, Woodworth)
“Assessment of Safety and Feasibility of ExAblate Blood-Brain Barrier Disruption for the Treatment of High-Grade Glioma in Patients Undergoing Standard Chemotherapy”
InSightec, BT008, NCT03551249
- 07/25/19-07/24/21 (PI, Woodworth, Mishra)
“Laser Interstitial Thermal Therapy (LITT) followed by Hypofractionated Radiation Therapy for Recurrent High-Grade Gliomas”
Keep Punching Foundation, NCT pending

CLINICAL TRIALS (other)

- 05/01/16-02/01/19 (site PI, Woodworth)
“Vaccine Therapy with Bevacizumab Versus Bevacizumab Alone in Treating Patients with Recurrent Glioblastoma Multiforme That Can Be Removed by Surgery”
NCT01814813

Philanthropy

- 2016-present Maryland Brain Tumor Research Fund
Total: \$50,000
- 2018-present Hillman Brain Tumor Research Fund
Total: \$100,000
- 2019 Establishment of the *Howard M. Eisenberg Distinguished Professorship* in Neurosurgery, University of Maryland School of Medicine.
Total: \$2.5 million
- 2019 Establishment of *Hevy-Thompson Professorship* in Neurosurgery, University of Maryland School of Medicine
Total: \$1.5 million

Patents

“Engineering Synthetic Brain Penetrating Gene Vectors”. Hanes J, Suk JS, Mastorakos P, Zhang C, **Woodworth GF**. US9937270B2 Priority 2014-05-12, Filing 2015-05-12, Publication 2018-04-10, Grant 2018-04-10. **WO 2015/175539 A1** (exp. 2035)

“Interlaminar, interspinous stabilization devices for the cervical spine” **Woodworth GF**. US20160135851A1, Priority 2014-11-13, Filing 2015-11-12, Publication 2016-05-19, Grant 2019-05-07. **US 10,278,745 B2** (exp. 2035)

“Large Nanoparticles that Penetrate Tissue”. **Woodworth GF**, Nance EA, Hanes J. US and International Patent Pending: US 20,130,183244A1, Priority 2010-09-10, Filing 2011-09-12, Publication 2013-07-18

“Targeted Structure-Specific Particulate Delivery Systems” **Woodworth GF**, Hanes J, Winkles JA, Kim AJ, Schneider CS. US Patent Pending: US20180185511A1, Priority 2014-11-21, Filing 2015-11-20, Publication 2018-07-05

“Decreased Adhesivity Receptor-Targeted Nanoparticles for Fn14-Positive Tumors”. **Woodworth GF**, Kim, AJ, Wadajkar A, Winkles JA. US 16/289,424, Filing 2019-28-02

Publications

Peer-Reviewed Journal Articles

1. Sarracino DA, Steinberg JA, Vergo MT, **Woodworth GF**, Tetzlaff CN, Richert C. 5'-Peptidyl substituents allow a tuning of the affinity of oligodeoxyribonucleotides for RNA. *Bioorganic and Medicinal Chemistry Letters*, 1998, 8: 2511-2516. PMID: 9873571
2. Brooks PR, Wirtz MC, Vetelino MG, **Woodworth GF**, Morgan BP, Coe JW. Boron Trichloride/Tetra-n-Butylammonium Iodide: A mild, selective combination reagent for the cleavage of primary alkyl esters and aryl ethers. *Journal of Organic Chemistry*, 1999, 64: 9719-9721.
3. Morgan BP, Trilles RV, **Woodworth GF**. New, scalable route for the synthesis of a trans-fused hexahydro-1H-phenathre-2-one from a conjugated tetrahydro-3H-phenathre-2-one. *Synthetic Communications*, 2003, 33: 915-920.
4. McGirt MJ, **Woodworth GF**, Lynch JR, Laskowitz DT. Statins for the treatment of neurological injury: A role beyond cholesterol lowering. *Clinical Neurosurgery*, 2003, 51: 320-328. PMID: 15571161
5. Morgan BP, Liu KK, Dalvie DK, Swick AG, Hargrove DM, Wilson TC, LaFlamme JA, Moynihan MS, Rushing MA, **Woodworth GF**, Li, J, Trilles RV, Yang X, Harper KW, Carroll RS, Martin KA, Nardone NA, O'Donnell JP, Faletto MB, Vage C, Soliman V. Discovery of potent, non-Steroidal, and highly selective glucocorticoid receptor antagonists with anti-obesity activity. *Letters in Drug Discovery and Design*, 2004, 1: 1-5.
6. McGirt MJ, **Woodworth GF**, Thomas G, Miller N, Williams M, Rigamonti D. Cerebrospinal fluid shunting for pseudotumor cerebri associated intractable headache: Predictors of treatment response and analysis of long-term outcomes. *J Neurosurgery*, 2004, 101: 627-632. PMID: 15481717
7. **Woodworth GF**, McGirt MJ, Rigamonti D. Use of ventriculoperitoneal shunts in patients with uncontrollable intracranial hypertension secondary to HIV-associated cryptococcal meningitis. *Surg Neurol.*, 2005, 63: 529-31. PMID: 15936373
8. McGirt MJ, **Woodworth GF**, Pradilla, G, Warner D, Tamargo R, Clatterbuck RC, Lynch DR, Laskowitz DT. Simvastatin attenuates experimental cerebral vasospasm and ameliorates serum markers of neuronal and endothelial injury in patients after subarachnoid hemorrhage: A dose-

- response effect dependent on endothelial nitric oxide synthase. *Clin Neurosurgery*, 2005, 52: 371-8. PMID: 16626096
9. McGirt MJ, **Woodworth GF**, Frazier JM, Coon AL, Olivi A, Weingart JD. Independent predictors of morbidity after image-guided stereotactic brain biopsy: A risk assessment of 270 cases. *Journal of Neurosurgery*, 2005, 102: 897-901. PMID: 15926716
 10. **Woodworth GF**, McGirt MJ, Samdani A, Garonzik I, Olivi A, Weingart JD. Accuracy of frameless and frame-based MRI-guided stereotactic brain biopsy in the diagnosis of glioma: Comparison of biopsy and open resection specimen. *Neurological Research*, 2005 27: 358-62. PMID: 15949232
 11. **Woodworth GF**, McGirt MJ, Rigamonti D. Frameless stereotactic ventricular shunt placement for pseudotumor cerebri. *Stereotactic and Functional Neurosurgery*, 2005, 83: 12-16. PMID: 15724109
 12. Sciubba D, Stuart RM, McGirt MJ, **Woodworth GF**, Jallo GI, Carson B. Effect of antibiotic-impregnated shunt catheters in decreasing the incidence of shunt infection in the treatment of hydrocephalus. *J Neurosurgery*, 2005, 103: 131-6. PMID: 16370278
 13. **Woodworth GF**, McGirt MJ, Gailloud P, Clatterbuck RC. Evaluation of a distal, non-mycotic pericallosal artery aneurysm visualized with 3-dimensional digital subtraction angiography: case report and treatment implications. *Surgical Neurology*, 2005, 64: 321-4. PMID: 16229089
 14. Cowan JA, McGirt MJ, **Woodworth GF**, Rigamonti DR, Williams MA. The syndrome of hydrocephalus in young and middle-aged adults (SHYMA). *Neurological Research*, 2005, 27: 540-7. PMID: 15978182
 15. McGirt MJ, **Woodworth GF**, Coon AC, Thomas G, Williams M, Rigamonti D. Diagnosis, treatment, and analysis of long-term outcomes in idiopathic normal pressure hydrocephalus. *Neurosurgery*, 2005, 57: 699-705. PMID: 16239882
 16. McGirt MJ, **Woodworth GF**, Coon A, Brooke B, Jain S, Buck D, Tamargo R, Perler B. 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitors reduce the risk of perioperative stroke and mortality after carotid endarterectomy. *J Vasc. Surg.*, 2005, 42: 829-36. PMID: 16275430
 17. Thomas G, McGirt MJ, **Woodworth GF**, Williams M, Hillis A, Rigamonti D. Baseline neuropsychological profile can predict cognitive response to CSF shunting for idiopathic normal pressure hydrocephalus. *Dement Geriatr Cogn Disord*, 2005, 20: 163-8. PMID: 16020945
 18. **Woodworth GF**, McGirt MJ, Samdani A, Garonzik I, Olivi A, Weingart JD. Frameless Image-Guided Stereotactic Brain Biopsy: Diagnostic Yield, Operative Morbidity, and Comparison with the Frame-based Technique. *J Neurosurgery*, 2006, 104: 233-7. PMID: 16509497
 19. McGirt MJ, **Woodworth GF**, Coon A, Brooke B, Jain S, Buck D, Tamargo RJ, Perler B. Hyperglycemia independently increases the risk of perioperative stroke, myocardial infarction, and death after carotid endarterectomy. *Neurosurgery*, 2006, 58: 1066-73. PMID: 16723885
 20. Sciubba DM, Mavinkurve GG, Gailloud P, Garonzik IM, Recinos PF, McGirt MJ, **Woodworth GF**, Witham T, Khavkin Y, Gokaslan ZL, Wolinsky JP. Preoperative imaging of cervical spine hemangioblastomas using three-dimensional fusion digital subtraction angiography. Report of two cases. *J Neurosurg Spine*, 2006, 5: 96-100. PMID: 16850967
 21. McGirt MJ, Blessing R, Alexander MJ, Nimjee SM, **Woodworth GF**, Friedman AH, Graffagnino C, Laskowitz DT, Lynch JR.. Risk of cerebral vasospasm after subarachnoid hemorrhage reduced by statin therapy: A multivariate analysis of an institutional experience. *J Neurosurgery*, 2006, 105: 671-4. PMID: 17121126
 22. McGirt MJ, Buck D, **Woodworth GF**, Sciubba D, Carson B, Jallo GI. Adjustable versus set-pressure valves decrease the risk of shunt failure in the treatment of pediatric hydrocephalus. *Childs Nerv Syst.*, 2007, 23: 289-95. PMID: 17106749

23. **Woodworth GF**, McGirt MJ, Thomas G, Williams M, Rigamonti D. Prior CSF Shunting Increases the Risk of Treatment Failure Following Endoscopic Third Ventriculostomy for Adults with Obstructive Hydrocephalus. *Neurological Research*, 2007, 29: 27-31. PMID: 17427271
24. Brooke BS, McGirt MJ, **Woodworth GF**, Chang DC, Roseborough GS, Freischlag JA, Perler BA. Preoperative statin and diuretic use influence the presentation of patients undergoing carotid endarterectomy: Results of a large single-institution case-control study. *J Vasc Surg.*, 2007 45: 298-303. PMID: 17264007
25. Sciubba DM, Gallia GL, McGirt MJ, **Woodworth GF**, Garonzik IM, Witham T, Gokaslan ZL, Wolinsky JP. Thoracic kyphotic deformity reduction with a distractible titanium cage via an entirely posterior approach. *Neurosurgery*. 2007 Apr;60(4 Suppl 2):223-30. PMID: 17415157
26. Sciubba DM, McGirt MJ, **Woodworth GF**, Carson B, Jallo GI. Prolonged exposure to antibiotic-impregnated shunt catheters does not increase incidence of late shunt infections. *Childs Nerv Syst.*, 2007 Aug;23(8):867-71. PMID: 17387486
27. Sciubba DM, Lin LM, **Woodworth GF**, McGirt MJ, Carson B, Jallo GI. Factors contributing to medically incurred costs for CSF shunt infection treatment are greater in pediatric patients with standard shunt components versus those with antibiotic-impregnated components. *Neurosurg Focus*. 2007, 22:9. PMID: 18447686
28. **Woodworth GF**, Chaichana K, McGirt MJ, Sciubba D, Gokaslan Z. Predictors of ambulatory status following resection of intramedullary spinal cords tumors. *Neurosurgery*, 2007 61: 99-105. PMID: 17621024
29. **Woodworth GF**, McGirt MJ, Huang J, Perler B, Clatterbuck RC, Tamargo RJ. Selective versus Routine Intraoperative Shunting during Carotid Endarterectomy: A Multivariate outcome analysis. *Neurosurgery*, 2007, 61: 1170-6.
30. McGirt MJ, **Woodworth GF**, Ali H, Tamargo RJ, Clatterbuck RC. Perioperative hyperglycemia is an independent predictor of poor outcome after aneurysmal subarachnoid hemorrhage. *Neurosurgery*, 2007, 107: 1080-5. PMID: 18077943
31. McGirt MJ, Chaichana KL, Atiba A, Attenello F, **Woodworth GF**, Jallo GI. Neurological outcome after resection of intramedullary spinal cord tumors in children. *Childs Nerv Syst*. 2008, 24: 93-7. PMID: 17665203
32. Chaichana K, **Woodworth GF**, McGirt MJ, Sciubba D, Gokaslan Z. Predictors of ambulatory status following resection of metastatic spinal cords tumors. *Neurosurgery* 2008, 62: 683-92. PMID: 18425015
33. Murphy K, Wyse G, Gailloud P, **Woodworth GF**, Sciubba DM, Oka M, Sasson AD, Long D. Two-needle technique for the treatment of symptomatic tarlov cysts. *J Vasc Interv Radiol.*, 2008, 19: 771-3. PMID: 18440468
34. Sciubba D, Chaichana K, **Woodworth GF**, McGirt MJ, Gokaslan Z., Jallo GI. Factors associated with cervical instability requiring fusion after cervical laminectomy for intradural tumor resection. *J Neurosurg Spine*, 2008, 8: 413-9. PMID: 18447686
35. Sheth SA, McGirt M, **Woodworth GF**, Wang P, Rigamonti D., Ultrasound guidance for distal insertion of ventriculo-atrial shunt catheters: technical note. *Neurol Res.*, 2009, 31: 280-2. PMID: 19040795
36. **Woodworth GF**, McGirt MJ, Williams MA, Rigamonti D. Cerebral spinal fluid drainage and dynamics in the diagnosis of normal pressure hydrocephalus. *Neurosurgery*, 2009; 64: 919-25; discussion 925-6. *Editor's Choice*. PMID: 19404152
37. **Woodworth GF**, Baird CJ, Garcia-Ambrossi G, Tonascia J, Tamargo RJ. Inaccuracy of the administrative database: comparative analysis of two databases for the diagnosis and treatment of intracranial aneurysms. *Neurosurgery*, 2009, 65: 251-6; discussion 256-7. PMID: 19625902

38. Chaichana KL, McGirt MJ, **Woodworth GF**, Dattoo G, Tamargo RJ, Weingart J, Olivi A, Brem H, Quinones-Hinojosa A. Persistent outpatient hyperglycemia is independently associated with survival, recurrence and malignant degeneration following surgery for hemispheric low grade gliomas. *Neurol Res.*, 2010, 32: 442-8. PMID: 19589201
39. **Woodworth GF**, See A, Bettegowda C, Jallo G, Rigamonti D. Predictors of surgery-free outcome in adult endoscopic third ventriculostomy. *World Neurosurg*, 2012, 78: 312-7. PMID: 22120264
40. Raithatha R, McCoul ED, **Woodworth GF**, Schwartz TH, Anand VK. Endoscopic endonasal approaches to the cavernous sinus. *Int Forum Allergy Rhinol.*, 2012, 2: 9-15. PMID: 22311835
41. Link T, **Woodworth GF**, Chaichana KL, Mayer SA, Grossman RS, Quinones-Hinojosa A. Hyperglycemia is independently associated with post-operative function loss in primary glioblastoma. *J Clin Neurosci.*, 2012, 19: 996-1000. PMID: 22595358
42. Nance EA*, **Woodworth GF***, Sailor K, Tamargo RJ, Eberhart CE, Hanes J. A dense poly(ethylene glycol) coating improves penetration of large polymeric nanoparticles within brain tissue. *Sci Transl Med.*, 2012, 4: 149ra119. [* co-first authors] PMID: 22932224
43. Schuster B, Suk JS, Kim A, **Woodworth GF**, Hanes J. Nanoparticle diffusion in respiratory mucus from humans without lung disease. *Biomaterials*, 2013, 34: 3439-46. PMID: 23384790
44. **Woodworth GF**, Garzon-Muvdi T, Blakeley JO, Yu X, Weingart J & Burger PC, Histo-pathological correlates with survival in re-operated glioblastoma. *J Neurooncol.*, 2013, 113: 485-93. PMID: 23384790
45. Timbie K, Burke C, Nance EA, **Woodworth GF**, Miller GW, Hanes J, Price RJ. Ultrasound-targeted delivery of systemically administered therapeutic nanoparticles. *J Acous. Soc.*, 2013, 134 (5), 4047-4047
46. Banu MA, Kim JH, Shin BJ, **Woodworth GF**, Anand VK, Schwartz TH. Low-dose intrathecal fluorescein and etiology-based graft choice in endoscopic endonasal closure of CSF leaks. *Clin Neurol Neurosurg.*, 2014, 116: 28-34. PMID: 24315752
47. **Woodworth GF**, Kunal PS, Shin B, Burkhardt JK, Touris AJ, McCoul ED, Anand VK, Schwartz TS. Surgical outcomes using a medial-to-lateral, endonasal endoscopic approach to pituitary adenomas invading the cavernous sinus. *J. Neurosurgery*, 2014, 120: 1086-94. PMID: 24527820
48. Kim AJ, **Woodworth GF***, Boylan NJ, Suk JS, Hanes J*. Highly compacted pH-responsive DNA nanoparticles mediate transgene silencing in experimental glioma. *J. Mat. Chem. B*, 2014, June; 2(146):8165-173. (* corresponding author) PMID: 25485114
49. **Woodworth GF**, Dunn GP, Nance EA, Hanes J, Brem H. Emerging insights into barriers to effective brain tumor therapeutics. *Front. Oncology*, 2014, Jul 21;4:1-14. PMID: 25101239
50. Nance EA, Timble K, Miller, W, Song J, Louttit C, Klibanov A, Shih T, Swaminathan G, Tamargo RJ, **Woodworth GF**, Hanes J, Price RJ. Noninvasive delivery of stealth, brain-penetrating nanoparticles across the blood-brain barrier using MRI-guided focused ultrasound. *J Cont. Release*, 2014, Sept 10;189:123-32. PMID: 24979210
51. Garzon-Muvdi T, Jackson C, See AP, **Woodworth GF**, Tamargo RJ. Preservation of the greater occipital nerve during suboccipital craniectomy results in a paradoxical increase in postoperative headaches. *Neurosurgery*. 2015, Apr;76(4):435-40. PMID: 25599212
52. Schneider CS, Perez-Bermudez J, Cheng E, Smith P, Winkles JA, **Woodworth GF***, Kim AJ*. Minimizing the non-specific binding of nanoparticles to the brain enables active targeting of Fn14-positive glioblastoma cells. *Biomaterials*, 2015 Feb;42:42-51 *Co-corresponding authors. PMID: 25542792

53. Mastorakos P1, Zhang C, Berry S, Oh Y, Lee S, Eberhart CG, **Woodworth GF**, Suk JS, Hanes J. Highly PEGylated DNA Nanoparticles Provide Uniform and Widespread Gene Transfer in the Brain. *Adv Healthc Mater.* 2015 Mar 11. PMID: 25761435
54. Perez J, Tran N, Rosenblum M, Schneider C, Connolly N, Kim AJ, **Woodworth GF**, Winkles JA. The TWEAK Receptor Fn14 is a Potential Cell Surface Portal for Targeted Delivery of Glioblastoma Therapeutics. *Oncogene* 2015 Aug 24. doi: 10.1038/onc.2015.310. PMID: 26300004
55. Schneider CS, Bhargav AG, Perez-Bermudez J, Wadajkar A, Winkles JA, **Woodworth GF***, Kim AJ*. Surface plasmon resonance as a high throughput method to evaluate specific and non-specific binding of nanotherapeutics. *J Control Release.* 2015 Sep 25. pii: S0168-3659(15)30148-6. (*Co-corresponding authors) PMID: 26415854
56. Hersh DS, Firempong AO, Chesler D, Castellani RJ, **Woodworth GF**. Chondromyxoid fibroma invasion of the transverse-sigmoid sinus junction causing posterior fossa hemorrhage. *J Clin Neurosci.* 2015 Oct 5. PMID: 26481053
57. Hersh DS, Wadajkar AS, Roberts NB, Perez JG, Connolly NP, Frenkel V, Winkles JA, **Woodworth GF**, Kim AJ. Evolving drug delivery strategies to overcome the blood brain barrier. *Curr Pharm Des.* 2015 Dec 21. PMID: 26685681
58. Cotter DJ, **Woodworth GF**, Gupta SV, Manadhar P, Schwartz TH. Infrared thermal imaging during ultrasonic aspiration of bone. *Phys. Proc.*, 2015, 63, 2015, 167-176
59. Hersh DS, Nguyen BA, Dancy JG, Adapa AR, Winkles JA, **Woodworth GF**, Kim AJ, Frenkel V. Pulsed ultrasound expands the extracellular and perivascular spaces of the brain. *Brain Res.* 2016 Jun 28. pii: S0006-8993(16)30464-4. PMID: 27369449
60. Dancy JG, Wadajkar AS, Schneider CS, Mauban JR, Goloubeva OG, **Woodworth GF**, Winkles JA, Kim AJ. Non-specific binding and steric hindrance thresholds for penetration of particulate drug carriers within tumor tissue. *J Control Release.* 2016 Jul 25;238:139-148. PMID: 27460683
61. Hersh DS, Kim AJ, Winkles JA, Eisenberg HM, **Woodworth GF**, Frenkel V. Emerging Applications of Therapeutic Ultrasound in neuro-oncology: moving beyond tumor ablation. *Neurosurgery.* 2016 Nov, 79(5):643-654. PMID: 27552589
62. Roberts NB, Wadajkar AS, Winkles JA, Davila E, Kim AJ, **Woodworth GF**. Repurposing platinum-based chemotherapies for multi-modal treatment of glioblastoma. *Oncoimmunology* 2016 Aug 19;5(9). PMID: 27757301
63. Connolly NP, Stokum JA, Schneider CS, Ozawa T, Xu S, Galisteo R, Castellani RJ, Kim AJ, Simard JM, Winkles JA, Holland EC, **Woodworth GF**. Genetically engineered rat gliomas: PDGF-driven tumor initiation and progression in *tv-a* transgenic rats recreate key features of human brain cancer. *PLoS ONE.* 2017 Mar 30;12(3):e0174557. PMID: 28358926
64. Wadajkar AS, Dancy JG, Hersh DS, Anastasiadis P, Tran NL, **Woodworth GF**, Winkles JA, Kim AJ. Tumor-targeted nanotherapeutics: overcoming treatment barriers for glioblastoma. *Wiley Interdiscip Rev Nanomed Nanobiotechnol.* 2017 Jul;9(4). PMID: 27813323
65. Wadajkar AS, Dancy JG, Roberts NB, Connolly NP, Strickland DK, Winkles JA, **Woodworth GF**, Kim AJ. Decreased non-specific adhesivity Receptor Targeted (DART) nanoparticles improve dispersion, cellular uptake, and tumor retention in invasive gliomas. *J Control Release.* 2017 Sep 5. pii: S0168-3659(17)30829-5. PMID: 28887134
66. Connolly NP, Shetty AC, Stokum JA, Hoeschele I, Siegel MB, Miller CR, Kim AJ, Ho C, Davila E, Simard JM, Devine SE, Rossmeisl JH, Holland EC, Winkles JA, **Woodworth GF**. Cross-species transcriptional analysis reveals conserved and host-specific neoplastic processes in mammalian glioma. *Sci Rep.* 2018 Jan 19;8(1):1180. PMID: 29352201
67. Hersh DS, Anastasiadis P, Mohammadabadi A, Nguyen BA, Guo S, Winkles JA, Kim AJ, Gullapalli R, Keller A, Frenkel V, **Woodworth GF**. MR-guided transcranial focused

- ultrasound safely enhances interstitial dispersion of large polymeric nanoparticles in the living brain. *PLoS ONE* 2018 13(2): e0192240. PMID: 29415084
68. Hersh DS, Peng S, Dancy JD, Galisteo R, Eschbacher JM, Castellani RJ, Heath JE, Legesse T, Kim AJ, **Woodworth GF**, Tran NL, Winkles JA. Differential Expression of the TWEAK Receptor Fn14 in IDH1 Wild-Type and Mutant Gliomas. *J. Neurooncol.* 2018 Feb 16. PMID: 29453678
 69. Hersh DS, Harder BG, Roos A, Peng S, Heath JE, Legesse T, Kim AJ, **Woodworth GF**, Tran NL, Winkles JA. The TNF receptor family member Fn14 is highly expressed in recurrent glioblastoma (GBM) and in GBM patient-derived xenografts with acquired temozolomide resistance. *Neuro Oncol.* 2018 Apr 20. PMID: 29897522
 70. Roberts NB, Alqazzaz A, Qi X, Keegan AD, Kim AJ, Winkles JA, **Woodworth GF**. Oxaliplatin disrupts pathological features of glioma cells and associated macrophages independent of apoptosis induction. *J Neurooncol.* 2018 Aug 21. 10.1007/s11060-018-2979. PMID: 30132163
 71. Rice S, Kwok Y, Feigenberg S, Bentzen S, **Woodworth GF**, Mehta MM. Prognostic models for patients with brain metastasis after stereotactic radiosurgery with or without whole brain radiotherapy: a validation study. *J Neurooncol.* 2018 Aug 21. 10.1007/s11060-018-2958. PMID: 30132164
 72. Harder BG, Blomquist, MR, Wang J, Kim AJ, **Woodworth GF**, Winkles JA, Loftus JC, Tran NL. Developments in blood-brain barrier penetrance and drug repurposing for improved treatment of glioblastoma. *Front Oncol.* 2018 Oct 23;8: 462. PMID: 30406029
 73. Wadajkar A, Dancy JP, Carney C, Hampton B, Winkles JA, **Woodworth GF**, Kim AJ. Leveraging Surface Plasmon Resonance to Dissect the Interfacial Properties of Nanoparticles: Implications for tissue binding and tumor penetration. *Nanomedicine* 2019 Jun 5:102024 PMID: 31176045
 74. Schneider CS, **Woodworth GF**, Vujaskovic Z, Regine W, Mishra M. Radio-sensitization of high-grade gliomas through induced hyperthermia: Review of clinical experience and the potential role of MRI-guided focused ultrasound. *Radiother Oncol.* 2019 Aug 17. pii: S0167-8140(19)33010-5. doi: 10.1016/j.radonc.2019.07.017. PMID: 31431370
 75. Inglut C, Connolly N, Baglo Y, Liang B, Cheema Y, Stabile J, **Woodworth GF**, Huang HC. Systematic evaluation of light-activatable biohybrids for anti-glioma photodynamic therapy *J Clin Med.* 2019 Aug 21;8(9). pii: E1269. doi: 10.3390. PMID: 31438568
 76. Inglut C, Baglo Y, Liang B, Cheema Y, Stabile J, **Woodworth GF**, Huang HC. Predictors and limitations of the penetration depth of photodynamic effects in the rodent brain. *Photochem Photobiol.* 2019 Aug 23. doi: 10.1111/php.13155. PMID: 31441057
 77. Dancy JG, Wadajkar AS, Connolly NP, Galisteo R, Ames HM, Peng S, Tran NL, Goloubeva OG, **Woodworth GF**, Winkles JA, Kim AJ. Decreased nonspecific adhesivity receptor targeted therapeutic nanoparticles for primary and metastatic breast cancer. *Sci Adv.*, 2020, Jan 15;6(3):eaax3931. doi: 10.1126. PMID: 31998833
 78. Spina R, Voss DM, Yang X, Sohn JW, Vinkler R, Schraner J, Sloan A, Welford SM, Avril N, Ames HM, **Woodworth GF**, Bar EE. MCT4 regulates de novo pyrimidine biosynthesis in GBM in a lactate independent manner. *Neurooncol Adv.*, 2020 Jan-Dec;2(1):vdz062. doi: 10.1093/noajnl/vdz062. PMID: 32002519
 79. Remick JS, Kowalski E, Khairnar R, Sun K, Morse E, Cherng HR, Poirier Y, Lamichhane N, Becker SJ, Chen S, Patel A, Kwok Y, Nichols E, Mohindra P, **Woodworth GF**, Regine WF, Mishra MV. A multi-center analysis of single-fraction versus hypofractionated stereotactic radiosurgery in the treatment of brain metastasis. *Radiation Oncology*, In press.

Case Reports:

1. **Woodworth GF**, McGirt MJ, Gailloud P, Clatterbuck RC. Evaluation of a distal, non-mycotic pericallosal artery aneurysm visualized with 3-dimensional digital subtraction angiography: case report and treatment implications. *Surgical Neurology*, 2005, 64: 321-4. PMID: 16229089
2. Dunn IF, **Woodworth GF**, Siddiqui A, Smith ER, Vates GE, Day AL, Goumnerova L. Traumatic pericallosal artery aneurysm—a rare complication of the transcallosal surgical approach. *J Neurosurgery: Pediatrics*, 2007, 106(2): 153-7. PMID: 17330545
3. Patel AP, Gandhi D, Taylor RJ, **Woodworth GF**. Use of Dyna CT in the evaluation and treatment of pseudoaneurysm secondary to craniofacial tumor resection: Case report and diagnostic implications. *Surg Neurol Int.*, 2014, 11:48. PMID: 24818055
4. Lamos, EM, **Woodworth GF**, Munir KM. Carotid artery aneurysm resulting in myxedema coma. *Interdisc. Neurosurgery*, June 2015, 2:2, 120-22.
5. Hersh DS, Houbova P, Castellani RJ, Rodriguez FJ, Mehta MP, **Woodworth GF**. Pathologic deposition of non-amyloid immunoglobulin in the brain leading to mass effect and neurological deficits. *J Clin Neurosci*. 2016 Mar 4. PMID: 26954763

Book Chapters

1. Subtemporal Extradural Approach – Core techniques in Operative Neurosurgery. Edited by: Rahul Jandial, MD, PhD; Paul C. McCormick, MD, MPH, FACS; Peter M. Black, MD, PhD.
2. Intracystic Therapies for Craniopharygioma - Controversies in Brain Tumor Surgery. Edited by Alfredo Quinones-Hinojosa, M.D.
3. Novel Delivery Strategies - Malignant Brain Tumors: State-of-the-Art Treatment, Edited by Joseph M Piepmeyer, MD; Jennifer Moliterno Gunel, MD; and Joachim M. Baehring, MD, DSc.
4. Surface-modified Nano-drug Carriers for Brain Cancer Treatment. Topics in Drug Delivery. Aniket S. Wadajkar, Nina P. Connolly, Christine P. Carney, Pranjali P. Kanvinde, Jeffrey A. Winkles, Graeme F. Woodworth, Anthony J. Kim
5. Focused Ultrasound-mediated Blood-Brain Barrier Disruption for Enhanced Drug Delivery to Brain Tumors. Pavlos Anastasiadis, Jeffrey A. Winkles, Anthony J. Kim, Graeme F. Woodworth. Springer Nature, Neuromethods.
6. Case studies: Gliomas and other intrinsic tumors. Intrinsic and Skull Base Tumors, first edition. Editors: Kaisorn Chaichana, M.D., Alfredo Quinones, M.D.

Invited Reviews and Commentaries

1. **Woodworth GF**, Schwartz TH. Anatomic lines and extent of exposure in expanded endoscopic approaches to the cranio-vertebral junction. *World Neurosurgery*, 2011, 76: 76-8.
2. **Woodworth GF**, McCoul E, Anand V, Schwartz TH. Endoscopic management of anterior cranial fossa meningiomas. *Operative Techniques in Otolaryngology – Head and Neck Surgery*, 2011, 22, 254-262.
3. Hersh DS, Mehta RI, **Woodworth GF**, Castellani RJ. The Molecular Pathology of Primary Brain Tumors. *Path Case Rev*. 2013, 18 (5), 210-220.
4. **Woodworth GF**, Simard JM. Letter by Woodworth and Simard Regarding Article, "Outcome Following Decompressive Hemicraniectomy for Malignant Cerebral Infarction: Ethical Considerations. *Stroke*. 2015 Nov;46(11):e245. PMID: 26443827
5. Ahmed AK, Anastasiadis P, Alikacem N, Zadicario E, Gandhi D, Eisenberg HM, **Woodworth GF**. MRgFUS-enabled blood-brain barrier disruption in infiltrating gliomas: clinical implementation and future applications. *Operative Neurosurgery 2019, in review*

News and Media

1. Associated Press, News Service: “*Ultrasound jiggles open brain barrier, a step to better care*”, July 2018
2. Maryland Public Television, *Direct Connection*: “*Glioblastoma and John McCain*”, September 2018
3. *Cure – ‘Cancer Updates, Research & Education*, October 2018
4. Hematology Today, “*Using ultrasound to access the brain*”, November 2018
5. Psychology today, “*Bypassing the Blood-Brain Barrier*”, January 2019
6. Healthline, “*Keytruda May Be Effective in Helping Treat Brain Cancer*”, February 2019

Major Invited Speeches

Local

1. “*Recurrent Glioblastoma and Brain Penetrating Nanoparticles*”, Johns Hopkins Sydney Kimmel Comprehensive Cancer Center, Neuro-Oncology Research Conference, April 2011, Baltimore, MD.
2. “*Novel Approaches to Drug Delivery for Brain Tumors*”, Johns Hopkins Department of Neurosurgery, Grand Rounds, May 2011, Baltimore, MD.
3. “*Nano-particle-mediated Brain Tumor Therapy*”, Johns Hopkins Department of Neurosurgery, Grand Rounds, May 2012, Baltimore, MD.
4. “*Treatment Considerations and Surgical Management of Pituitary Adenomas*”, University of Maryland School of Medicine, Endocrinology Grand Rounds, April 2013, Baltimore, MD.
5. “*Neuro-Oncology Applications of MR-Guided Focused Ultrasound*” Society of Brain Mapping and Therapeutics, Annual Meeting May 2013, Baltimore, MD.
6. “*Advances in Therapeutic Delivery to the Brain*” University of Maryland, Department of Otolaryngology –Head and Neck Surgery, Grand Rounds October 2013, Baltimore, MD.
7. *CIMIT: The Center for Integrated Metabolic Imaging and Therapeutics*. University of Maryland School of Medicine Council Meeting. September 2013, Baltimore, MD.
8. *CIMIT: The Center for Integrated Metabolic Imaging and Therapeutics*. University of Maryland School of Medicine Board of Visitors Meeting. April 2014, Baltimore, MD.
9. *CIMIT: The Center for Integrated Metabolic Imaging and Therapeutics*. University of Maryland Medical System Board Meeting. September 2014, Baltimore, MD.
10. *Clinical and Translational Applications of MR-guided Focused Ultrasound*. Annual Retreat of the Brain Science Research Consortium, University of Maryland School of Medicine, October 2014, Baltimore, MD.
11. *Advances in Brain Cancer Research at the NCI-Greenebaum Cancer Center*. Greenebaum Cancer Center Board Meeting, October 2014, Baltimore, MD.
12. *Launching a career as a surgeon-scientist*. Passano Clinician-Scientist Career Development Symposium, University of Maryland School of Medicine, March 2015, Baltimore, MD.
13. *Awake Craniotomy: Anesthetic & Surgical Considerations*. Department of Anesthesiology Grand Rounds, University of Maryland Medical Center, November 2015, Baltimore, MD.
14. *Clinical and Translational Applications of MR-guided Focused Ultrasound*. Festival of Science, University of Maryland School of Medicine. December 2015, Baltimore, MD.
15. *Developing a Career as a Clinician-Scientist*. University of Maryland - Summer Research Forum, July 2016, Baltimore, MD.

Graeme F. Woodworth, M.D., FACS

16. *Awake, Fluorescent-guided Surgery for Maximal Resection of Intrinsic Brain Tumors*, Department of Surgery Grand Rounds, University of Maryland School of Maryland, January 2017, Baltimore, MD.
17. *Focused Ultrasound-mediated Immunomodulation in Brain Tumors*, Tumor Immunology and Immunotherapy Program Retreat, University of Maryland Greenebaum Cancer Center, August 2017, Baltimore, MD
18. *Emerging Therapeutic Delivery Approaches in Neuro-oncology*, Johns Hopkins Department of Neurosurgery, Grand Rounds, August 2017, Baltimore, MD
19. *New Therapeutic Delivery Approaches in Neuro-Oncology*, Experimental Therapeutics Program Retreat, University of Maryland Greenebaum Cancer Center, September 2017, Baltimore, MD
20. *Ultrasound enhanced drug delivery in Neuro-oncology*, Experimental Therapeutics Program Retreat, University of Maryland Greenebaum Cancer Center, October 2018, Baltimore, MD
21. *Developing a Career as a Clinician-Scientist*, Key note address, University of Maryland Medical Student Research Day, November 2018

National/International

22. “*Challenges in Neuro-Oncology*”, Yale-New Haven Hospital, Neuro-Oncology Center, January 2011, New Haven, CT.
23. “*New Approaches to Drug Delivery for Intrinsic Brain Tumors*”, University of Virginia Department of Neurosurgery, Grand Rounds, February 2012, Charlottesville, VA.
24. “*Advances in Brain Tumor Therapies*”, Dartmouth-Hitchcock Medical Center, Neurosurgery and Neurology Grand Rounds, March 2012, Lebanon, NH.
25. *Advances in Neuro-Oncology Seminar*, Annual Meeting of the American Association of Neurological Surgeons, April 2013, New Orleans, LA.
26. *Brain Tumors: State of the Art Seminar*, Annual Meeting of the American Association of Neurological Surgeons, April 2014, San Francisco, CA.
27. *Developing a career as a neurosurgeon-scientist*. Temple University Department of Neurosurgery, March 2015, Philadelphia, PA.
28. *Brain Tumors: State of the Art Seminar*, Annual Meeting of the American Association of Neurological Surgeons, May 2015, Washington, D.C.
29. *Getting a K Award*. NIH-NINDS R25 Grant Workshop, June 2015, Bethesda, MD.
30. *Exciting Developments in Translational Neuroscience*, Great-Grand Conference, AAMC, September 2015, Baltimore, MD.
31. *Building a Career as a Neurosurgeon-Scientist*, Brown University Medical School, April 2016, Providence, RI.
32. *Brain Tumors: State of the Art Seminar*, Annual Meeting of the American Association of Neurological Surgeons, May 2016, Chicago, IL.
33. *New Therapeutic Delivery Approaches in Neuro-oncology*, International Conference on Cancer Research and Targeted Therapy, October 2016, Baltimore, MD.
34. *Update on the clinical application of MRgFUS for drug delivery to brain tumors*. Adult Brain Tumor Consortium, Spring Meeting, April 2017, Baltimore, MD.
35. *Brain Tumors: State of the Art Seminar*, Annual Meeting of the American Association of Neurological Surgeons, April 2017, Los Angeles, CA.
36. *Neuro-Oncology Applications of Therapeutic Ultrasound*. Brain Tumor Biotech Summit, Northwell-Hofstra Medicine, Lennox Hill Hospital, June 2017, New York, NY.
37. *Emerging Therapeutic Delivery Approaches in Neuro-oncology*, Tisch-Duke Brain Tumor Center, March 2018, Durham, NC

38. *Brain Tumors: State of the Art Seminar*, Annual Meeting of the American Association of Neurological Surgeons, April 2018, New Orleans, LA.
39. *MRgFUS: Towards the next phase of development for neuro-applications*, InSightec Annual Board Meeting, May 2019, Miami, FL.
40. *Sound Power: Using focused ultrasound to unlock barriers to drug delivery in the brain*. Society for Image-Guided Neuro-interventions (SIGN) Annual Meeting 2019, Baltimore, MD.
41. *What clinical disease targets are ideal for FUS + immunotherapy combinations in GBM?* FUS Foundation-Cancer Research Institute Annual Meeting, July 2019, Arlington, VA
42. *Activating an immune response in glioblastoma: pulsed FUS*. FUS Foundation-Cancer Research Institute Annual Meeting, July 2019, Arlington, VA

National & International Meetings

1. McGirt MJ, Thomas G, Woodworth GF, Williams M, Rigamonti D. Diagnosis, treatment and analysis of long-term outcomes in idiopathic normal pressure hydrocephalus. *Twelfth International Symposium on Intracranial Pressure and Brain Monitoring. August, 2004, Hong Kong.*
2. McGirt MJ, Woodworth GF, Thomas G, Miller N, Williams M, Rigamonti D. Frameless stereotactic ventriculoperitoneal shunting for pseudotumor cerebri: An outcomes comparison versus lumboperitoneal shunting. *Annual Meeting of the Congress of Neurological Surgeons, October 2004, San Francisco, CA.*
3. McGirt MJ, Woodworth GF, Coon A, Thomas G, Williams M, Rigamonti D. Ventriculoperitoneal shunting for idiopathic normal pressure hydrocephalus: Predictors of treatment response and analysis of long-term outcomes. *Annual Meeting of the Congress of Neurological Surgeons, October 2004, San Francisco, CA.*
4. McGirt MJ, Woodworth GF, Samdani A, Garonzik I, Alex Olivi, Weingart J. Frameless versus frame-based image-guided stereotactic brain biopsy in the diagnosis of glioma: Comparison of biopsy and open resection specimen. *Annual Meeting of the Congress of Neurological Surgeons, October 2004, San Francisco, CA.*
5. McGirt MJ, Woodworth GF, Frazier J, Coon A, Olivi A, Weingart J. Independent Predictors of morbidity after image-guided stereotactic brain biopsy: A risk assessment of 270 cases. *Annual Meeting of the Congress of Neurological Surgeons, October 2004, San Francisco, CA.*
6. Woodworth GF, McGirt MJ, Thomas G, Miller N, Williams M, Rigamonti D. Prior shunt failure or concurrent ventriculoperitoneal shunting increases the risk of endoscopic third ventriculostomy failure for the treatment of obstructive hydrocephalus in adults. *Annual Meeting of the Congress of Neurological Surgeons, October 2004, San Francisco, CA.*
7. Sciubba DM, Stuart RM, McGirt MJ, Woodworth GF, Samdani AF, Carson B, Jallo GI. Antibiotic-impregnated shunt catheters decrease the incidence of shunt infection in the treatment of hydrocephalus. *AANS/CNS Section on Pediatric Neurological Surgery, December 2004, San Francisco, CA.*
8. McGirt MJ, Perler BA, Brooke B, Jain S, Woodworth GF, Buck DW, Roseborough GS, Tamargo RJ, Coon A, Heller J, Freischlag JA, Williams GM. Statin use reduces the incidence of complications following carotid endarterectomy: A novel potential neuroprotective effect. *Annual Meeting of the Society of Vascular Surgery, 2005, Chicago, IL*
9. Coon AL, McGirt MJ, Woodworth GF, Mundinger GS, Foran MP, Colby GP, Huang J. Phenytoin therapy predicts improved functional outcome after acute subdural hematoma

- evacuation. *Annual Meeting of the American Association of Neurological Surgeons, April 2005, New Orleans, LA.*
10. McGirt MJ, Coon A, Woodworth GF, Buck D, Jain S, Perler B, Tamargo RJ. A Decade experience with carotid endarterectomy at the Johns Hopkins Hospital: An assessment of current surgical risks. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 11. McGirt MJ, Coon A, Woodworth GF, Buck D, Jain S, Perler B, Tamargo RJ. Statins, HMG CoA-reductase inhibitors, reduce the risk of perioperative stroke after carotid endarterectomy: A novel role for a potential neuroprotectant. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 12. McGirt MJ, Coon A, Woodworth GF, Buck D, Jain S, Perler B, Tamargo RJ. Selective versus routine intraluminal carotid artery shunting guided by intraoperative electroencephalography (EEG) and somatosensory evoked potential (SSEP) monitoring reduces the risk of perioperative stroke after carotid endarterectomy. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 13. McGirt MJ, Coon A, Woodworth GF, Buck D, Jain S, Perler B, Tamargo RJ. Surgeon frequency, not cumulative volume is associated with perioperative morbidity after carotid endarterectomy. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 14. McGirt MJ, Buck D, Woodworth GF, Sciubba D, Weingart J, Jallo G. Adjustable versus set-pressure valves decrease the risk of shunt failure in the treatment of pediatric hydrocephalus. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 15. Coon AL; McGirt MJ; Woodworth GF; Vogel T; Colby GP; Jallo GI. Outcomes following craniotomy for acute subdural hematoma evacuation in children: A pediatric trauma center experience. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 16. Coon AL; McGirt MJ; Woodworth GF; Munding GS; Foran M; Colby GP, Huang J. Independent predictors of outcome following acute subdural hematoma evacuation: A novel grading scale for outcome prediction. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 17. Coon AL; McGirt MJ; Woodworth GF, Colby GP; Munding GS, Foran M, Huang J. Chronic anticoagulation with warfarin is associated with decreased functional outcome and increased length of stay following craniotomy for acute subdural hematoma *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 18. Woodworth GF, McGirt MJ, Thomas G, Williams M, Hillis A, Rigamonti D. Neuropsychological profile can predict cognitive response to CSF shunting for idiopathic normal pressure hydrocephalus. *Annual Meeting of the Congress of Neurological Surgeons, October 2005, Boston, MA.*
 19. McGirt MJ, Woodworth GF, Sciubba D, Wolinski JP, Jallo GI, Gokaslan ZL. Predictors of cervical instability requiring fusion after cervical laminectomy for intradural tumor resection. *AANS/CNS Section on Disorders of the Spine and Peripheral Nerves Annual Meeting, February 2006, Orlando, FL.*
 20. Coon A, McGirt MJ, Woodworth GF, Buck D, Jain S, Perler B, Tamargo RJ. Accuracy of carotid ultrasonography in the evaluation of carotid stenosis: a comparison to digital subtraction angiography in 631 consecutive cases. *Annual Meeting of the Cerebrovascular Section: Congress of Neurological Surgeons, February 2006, Kissimmee, FL.*
 21. McGirt MJ, Coon A, Brooke B, Woodworth GF, Buck D, Jain S, Tamargo R, Perler B. Hyperglycemia independently increases the risk of perioperative stroke and death after

- carotid endarterectomy: Analysis of 1566 cases. *Annual Meeting of the Congress of Neurological Surgeons, October 2006, Chicago, IL.*
22. Scuibba DS, McGirt MJ, Woodworth GF, Jallo GI. Antibiotic-impregnated shunt catheters do not increase the incidence of late shunt infection in the treatment of hydrocephalus. *Annual Meeting of the Congress of Neurological Surgeons, October 2006, Chicago, IL.*
 23. McGirt MJ, Woodworth GF, Chaichana KL, Attenello F, Carson BS, Jallo GI. Ventricular dilation is not a reliable measure of acute shunt failure in children having undergone multiple shunt revisions. *Annual Meeting of the Congress of Neurological Surgeons, October 2007, San Diego, CA.*
 24. Woodworth GF, McGirt MJ, Gokaslan Z, Witham T, Jallo GI, Wolinski JP. Predictors of ambulatory function following surgical resection of intramedullary spinal cord tumors. *Annual Meeting of the Congress of Neurological Surgeons, October 2007, San Diego, CA.*
 25. Than KD, Woodworth GF, Bettegowda C, McGirt MJ, Jallo GI, Rigamonti D. Adolescent age is an independent predictor of improved outcome following endoscopic third ventriculostomy for the treatment of hydrocephalus. *Annual Meeting of the Congress of Neurological Surgeons, October 2007, San Diego, CA.*
 26. Woodworth GF, Baird CJ, Garcia-Ambrossi G, Tonascia J, Tamargo RJ. Inaccuracy of the administrative database: comparative analysis of two databases for the diagnosis and treatment of intracranial aneurysms. Top Ten Abstract, *Annual Meeting of the Congress of Neurological Surgeons, October 2009, New Orleans, LA.*
 27. Woodworth GF, See A, Bettegowda C, Jallo G, Rigamonti D. Predictors of outcome following adult endoscopic third ventriculostomy. *Annual Meeting of the American Association of Neurological Surgeons, May 2010, Philadelphia, PA.*
 28. See A, Woodworth GF, Bettegowda C, Jallo G, Rigamonti D. Predictors of outcome following pediatric endoscopic third ventriculostomy. *Annual Meeting of the American Association of Neurological Surgeons, May 2010, Philadelphia, PA.*
 29. See A, Jackson C, Garzon-Muvdi T, Woodworth GF, Tamargo RJ. Facial nerve function following vestibular Schwannoma resection: Correlation with final nerve stimulation voltage. *Congress of Neurological Surgeons Annual Meeting, October 2010.*
 30. See A, Jackson C, Garzon-Muvdi T, Woodworth GF, Tamargo RJ. Facial nerve function following vestibular Schwannoma resection: Correlation with tumor dimensions. *Congress of Neurological Surgeons Annual Meeting, October 2010, San Francisco, CA.*
 31. Woodworth GF, Garzon-Muvdi T, Blakeley J, Burger P, Weingart JD. Degree of treatment effect is independently associated with survival in recurrent glioblastoma. *Congress of Neurological Surgeons Annual Meeting, October 2010, San Francisco, CA.*
 32. Link T, Woodworth GF, Chaichana KL, Mayer SA, Grossman RS, Quinones-Hinojosa A. Hyperglycemia is independently associated with post-operative function loss in primary glioblastoma. *Annual Meeting of the American Association of Neurological Surgeons, April 2011, Denver, CO.*
 33. Link T, Woodworth GF, Chaichana KL, Mayre SA, Grossman RS, Quinones-Hinojosa A. Immediate post-operative deficits delay treatment initiation and decrease overall survival in primary glioblastoma. *Annual Meeting of the American Association of Neurological Surgeons, April 2011, Denver, CO.*
 34. Hersh D, Schneider C, Kim AJ, Tran N, Winkles JA, Woodworth GF. Fibroblast-inducible factor 14 correlates with isocitrate dehydrogenase mutation status in patient glioma specimens. *Annual Meeting of the American Association of Neurological Surgeons, April 2014, San Francisco, CA.*

35. Hersh D, Schneider C, Kim AJ, Tran N, Winkles JA, Woodworth GF. Fibroblast-inducible factor 14 correlates with molecular subclasses in patient glioma specimens. *Annual Meeting of the American Association of Neurological Surgeons, April 2014, San Francisco, CA.*
36. Aniket S. Wadajkar, Jimena G. Dancy, Nina P. Connolly, Jeffrey A. Winkles, Graeme F. Woodworth, Anthony J. Kim (2017) Targeting Nanotherapeutics to the Invasive Glioblastoma Margin via the Cell Surface Receptor Fn14, *American Association of Cancer Research (AACR) Annual Meeting 2017*, Washington, D.C., USA
37. Jimena G. Dancy, Aniket S. Wadajkar, Graeme F. Woodworth, Jeffrey A. Winkles, Anthony J. Kim (2017) Optimizing Nanoparticle Surface Properties Using SPR for Improved Therapeutic Efficacy Against Triple-negative Breast Cancer Tumors, *American Association of Cancer Research (AACR) Annual Meeting 2017*, Washington, D.C., USA
38. Connolly NP, Schneider CS, Shetty A, Xu S, Ozawa T, Kim AJ, Winkles JA, Holland EC, Woodworth GF (2017) PDGF-A overexpression and p53 depletion in rat neural precursor cells induces large brain tumors that resemble human glioblastoma, *American Association of Cancer Research (AACR) Annual Meeting 2017*, Washington, D.C., USA
39. Hersh DS, Harder BG, Roos A, Peng S, Heath JE, Legesse T, Kim AJ, Woodworth GF, Tran NL, Winkles JA. The TNF receptor family member Fn14 is highly expressed in recurrent glioblastoma (GBM) and in GBM patient-derived xenografts with acquired temozolomide resistance. *Congress of Neurological Surgeons Annual Meeting, October 2018.*
40. Anastasiadis P, Connolly NP, Frank JA, Woodworth GF, Frenkel V. (2019) MR-guided focused ultrasound for the safe disruption of the blood-brain barrier in brain tumors. *Blood-Brain Barrier annual meeting, Cold Spring Harbor Laboratory.* Cold Spring Harbor, NY.
41. Anastasiadis P, Connolly N, Mohammadabadi A, Frank JA, Woodworth GF, Frenkel V. (2018) Towards a model of FUS-mediated blood-brain barrier disruption in non-enhancing, glioma-invaded brain regions for testing improvements in therapeutic delivery. *6th International Symposium on Focused Ultrasound.* Reston, VA
42. Anastasiadis P, Younger K, Roberts NB, Frank JA, Frenkel V, Davila E, Woodworth GF. (2018) Acoustic activation of the glioma-brain microenvironment. American Association of Cancer Research (AACR) Annual Meeting, Chicago, IL
43. Anastasiadis P, Younger K, Roberts NB, Frenkel V, Davila E, and Woodworth GF. (2017) Acoustic activation of the glioma-brain microenvironment for improved T-cell immunotherapy. Cancer Biology Training Consortium meeting; Stevenson, WA
44. Frenkel V, Hersh DS, Anastasiadis P, Mohammadabadi A, Guo S, Winkles JA, Kim AJ, Gullapalli R, Keller A, Woodworth GF. (2017) Pulsed focused ultrasound effects on the extracellular spaces in the brain. IEEE International Ultrasonics Symposium; Washington D.C. (oral).
45. Mohammadabadi A, Hersh DS, Anastasiadis P, Smith PC, Woodworth GF, Kim AJ, Frenkel V. (2017) Focused ultrasound for augmenting convection-enhanced delivery of nanoparticles in the brain. Acoustical Society of America (ASA) Meeting, Boston, MA

Regional Meetings

1. Woodworth GF, McGirt MJ, Thomas G, Williams M, Rigamonti D. Prior shunt failure or concurrent ventriculoperitoneal shunting increases the risk of endoscopic third ventriculostomy failure in the treatment of obstructive hydrocephalus. *Annual Meeting of the Southern Society of Neurological Surgeons, March 2004, Amelia Island, FL.*
2. McGirt MJ, Woodworth GF, Miller N, Williams M, Rigamonti D. Cerebrospinal fluid shunting for pseudotumor cerebri: Predictors of treatment response and analysis of long-term outcomes.

Annual Meeting of the Southern Society of Neurological Surgeons, March 2004, Amelia Island, FL.

3. McGirt MJ, Woodworth GF, Thomas G, Williams M, Rigamonti D. Independent predictors of endoscopic third ventriculostomy failure in the treatment of hydrocephalus. *Annual Meeting of the Southern Society of Neurological Surgeons, March 2004, Amelia Island, FL.*
4. Brooke BS, Heller JA, Chang DC, Matsen SL, McGirt MJ, Coon A, Jain S, Woodworth GF, Roseborough GS, Freischlag JA, Perler BA. Presentation and postoperative outcomes of carotid endarterectomy in African Americans at a high-volume hospital. *Annual Meeting of the Eastern Vascular Society, May 2005, Pittsburgh, PA.*
5. Sciubba DS, McGirt MJ, Woodworth GF, Jallo GI. Antibiotic-impregnated shunt catheters do not increase the incidence of late shunt infection in the treatment of hydrocephalus. *Annual Meeting of the Southern Society of Neurological Surgeons, March 2007, Sea Island, GA.*
6. McGirt MJ, Buck D, Woodworth GF, Sciubba D, Weingart J, Jallo G. Adjustable versus set-pressure valves decrease the risk of shunt failure in the treatment of pediatric hydrocephalus. *Annual Meeting of the Southern Society of Neurological Surgeons March 2007, Sea Island, GA.*
7. McGirt MJ, Woodworth GF, Chaichana K, Gokaslan Z, Jallo GI. Predictors of neurological outcome and progressive spinal deformity after resection of intramedullary spinal cord tumors in 80 consecutive patients. *Annual Meeting of the Southern Society of Neurological Surgeons March 2007, Sea Island, GA.*
8. Anastasiadis P, Connolly NP, Frank JA, Woodworth GF, Frenkel V. (2019) MRI-guided focused ultrasound-mediated blood-brain barrier in glioblastoma for the targeted delivery of diagnostic and therapeutic formulations. Maryland Neuroimaging Retreat: Functional Neuroimaging of Brain Development, Disorders & Disease. Baltimore, MD (poster).
9. Anastasiadis P, Connolly N, Mohammadabadi A, Hersh DS, Winkles JA, Kim AJ, Woodworth GF, Frenkel V. (2018) Targeted delivery of therapeutics through the blood-brain barrier enabled by transcranial pulsed focused ultrasound. Annual Cancer Research Day, Baltimore, MD
10. Anastasiadis P, Mohammadabadi A, Shen WB, Smith JA, Hersh DS, Winkles JA, Yarowsky PJ, Kim AJ, Woodworth GF, Fishman PS, Frenkel V. (2018) Non-invasive targeted delivery of therapeutics in the brain by MRI-guided focused ultrasound. Maryland Neuroimaging Retreat: molecular and physiological basis of brain signals, Baltimore, MD
11. Anastasiadis P, Connolly N, Frank JA, Woodworth GF, Davila E, Frenkel V. (2018) MR-guided focused ultrasound: a non-invasive therapeutic modality for glioblastoma. 9th Cancer Biology Research Retreat, Baltimore, MD

Courses, Workshops, & Seminars Attended

1. Neurosurgeon Research Career Development Program Retreat 2012, 2013, 2014
2. *Brain Tumors: State of the Art Seminar*, Annual Meeting of the American Association of Neurological Surgeons, 2013, 2014, 2015, 2016, 2017, 2018
3. “*Conflicts of Interest in Biomedical Research Seminar*”, CIPP 907, UMSOM, 2014, 2015, 2016, 2017, 2018
4. “*Transitioning from K to R Grants: Lessons learned*”. Faculty Career Development Program, University of Maryland School of Medicine, January 2015
5. Goodman Oral Board Review course, Houston, TX, May 2015.
6. “*NIH-NINDS R25 Grant Workshop*”, Bethesda, MD, June 2015

Graeme F. Woodworth, M.D., FACS

7. “*Writing an NIH Biosketch*”, Faculty Career Development Program, University of Maryland School of Medicine, January 2016
8. “*Ultrasound Immunomodulation for Brain Cancer*” Focused Ultrasound Foundation Workshop, February 2016, Charlottesville, VA
9. “*K-club*”, Faculty Career Development Program, University of Maryland School of Medicine, June 2016
10. “*Introduction to Clinical and Translational Research*”, University of Maryland, Baltimore, August 2016
11. *Tumor Satellite Symposium - panelist*, Congress of Neurological Surgeons Annual Meeting, September 2016, San Diego, CA.
12. *Research Summit: Building a Sustainable Neurosurgeon Research Environment*, Congress of Neurological Surgeons Annual Meeting, September 2016, San Diego, CA.
13. “*Ultrasound-based Immunomodulation for Brain Cancer*” Focused Ultrasound Foundation Workshop, October 2016 Alexandria, VA
14. “*How to write an NIH grant*”, Faculty Career Development Program, University of Maryland School of Medicine, October 2016
15. “*Writing an NIH grant: Things I wish I knew as a junior faculty member*”, Faculty Career Development Program, University of Maryland School of Medicine, January 2017
16. “*Are you ready to write a R01?*”. Faculty Career Development Program, University of Maryland School of Medicine, May 2017
17. “*Cancer Biology Retreat*”, University of Maryland Greenebaum Comprehensive Cancer Center, June 2017
18. “*Maintaining Morale and Succeeding in Research During Challenging Times*” Faculty Career Development Program, University of Maryland School of Medicine, July 2017
19. *Comparative Oncology Consortium Symposium*, NIH, Bethesda, MD September 2017
20. *Focused ultrasound blood brain barrier disruption for glioblastoma*, Focused Ultrasound Foundation, Washington, D.C. November 2017
21. *NCI – Innovative Molecular Analysis Technologies investigators meeting*, NCI Shady Grove, Rockville, MD, December 2017
22. *Gamma Knife Radiosurgery Training Program*, University of Pittsburgh Medical Center, 2019