

CURRICULUM VITAE

Richard J. McMurtrey, MD, MSc

Academics

MD – Doctor of Medicine and Surgery with Highest Honors (AOA) – University of Colorado School of Medicine
NIH research training grant in the area of neuropharmacology.

MSc – Master of Science in Biomedical Engineering with Distinction – University of Oxford
Thesis research in the area of neural tissue engineering.

BS – Bachelor of Science in Neuroscience with University Honors (top 1%) – Brigham Young University
Thesis research in the area of neuroacoustic processing.

Resident Physician (2008-2011) – University of Virginia
Primary neurosurgery resident for OR, ER, ICU, trauma, and general patients. Covered pediatric neurosurgery, neuro-trauma, neuro-oncology, and neuro-endocrine services. Also covered critical care units, including trauma surgery, neuro-ICU, surgical-ICU, cardiovascular-ICU, trauma-ICU, pediatric-ICU, and neonatal-ICU.

Passed the American Board of Neurological Surgery and the American Board of Surgery Written Examinations.
Licensed for Independent Practice of Medicine and Surgery.
Clinical Research, PHRP, and ICH/GCP Certifications.
Completed all U.S. Medical Licensing Examinations (95-97%ile)
MCAT (97%ile), GRE (99%ile), ACT (99%ile), AP English/Calculus (5/5)

Research Grants & Awards

Distinguished at the University of Oxford as one of the top innovators in the Oxbridge Biotech Roundtable.

Awarded the Oxford Skolkovo Innovation prize, supported by the University of Oxford Saïd Business School and the Skolkovo Foundation—first place amongst four finalists.

Qualified Therapeutic Discovery Program Grant from the Department of Health and Human Services for translating basic science research into clinical applications.

Hamilton Medical Research Award from the University of Colorado School of Medicine for outstanding research in the field of neurological disease.

Awarded the ARCS Research Scholarship twice as a medical student.

NIH T32 Research Training Fellowship studying CaMKII signaling mechanisms. Mentor: K. Ulrich Bayer.

Research grant from the Honors Department and Office of Research and Creative Arts (ORCA). Mentors: S.C. Steffensen & D.E. Fleming.

Research Engineering and Apprenticeship Program (REAP) Grant No. N00014-94-1-10096. Mentor: Dr. Carl E. Patton, Department of Physics – Magnetization Dynamics Group, Colorado State University.

Four year full-tuition academic scholarship to BYU.

Awarded the Rensselaer medal and scholarship for outstanding achievement in mathematics and science.

Publications & Presentations

McMurtrey RJ. “Elements of Organoid Design.” *Organoids and Mini-Organs*. Ed. Jamie Davies. London, United Kingdom: Elsevier, 2018.

McMurtrey RJ. “Roles of Diffusion Dynamics and Molecular Concentration Gradients in Cellular Differentiation

- and Three-Dimensional Tissue Development.” *Stem Cells and Development*. 2017; 26(18):1293-1303. PMID: 28707964 arXiv 1707.08543
- McMurtrey RJ. “Multi-Compartmental Biomaterial Scaffolds for Patterning Neural Tissue Organoids in Models of Neurodevelopment and Tissue Regeneration.” *J. Tissue Engineering*. 2016; 7:1-8. PMID: 27766141 arXiv:1610.02543
- McMurtrey RJ. “Analytic Models of Oxygen and Nutrient Diffusion, Metabolism Dynamics, and Architecture Optimization in Three-Dimensional Tissue Constructs with Applications and Insights in Cerebral Organoids.” *Tissue Engineering Part C*. 2016; 22(3):221-249. PMID: 26650970 arXiv1512.06475
- McMurtrey RJ. “Novel Advancements in Three-Dimensional Neural Tissue Engineering and Regenerative Medicine.” *Neural Regeneration Research*. 2015; 10(3):352-354. PMID: 25878573 arXiv1504.00698
- McMurtrey RJ. “Patterned and Functionalized Nanofiber Scaffolds in 3-Dimensional Hydrogel Constructs Enhance Neurite Outgrowth and Directional Control.” *J. Neural Engineering*. 11 (2014) 066009. PMID: 25358624 arXiv1501.01338
- McMurtrey RJ. “Novel 3-Dimensional Hydrogel Constructs with Patterned and Functionalized Nanofiber Scaffolding for Enhanced Neurite Outgrowth and Directional Control.” *World Stem Cell Summit*, San Diego, CA, Dec 2013.
- McMurtrey RJ. “The Effects of Patterned and Functionalized Nanofiber Scaffolds on Neurite Outgrowth and Guidance in 3-dimensional Hydrogels.” Thesis for the Degree of Master of Science in Biomedical Engineering with Distinction, Department of Engineering, University of Oxford.
- McMurtrey RJ. “A Novel Biomolecular Interface for Suppression of Astroglia with Neural Implants.” (*In Process, extension of McMurtrey, R.J. “Decorin and Gliosis and Related System and Method.” U.S. Patent App 12,701,603.*)
- McMurtrey RJ; Zuo Z. “Isoflurane Preconditioning and Postconditioning in Rat Hippocampal Neurons.” *Brain Research* 2010; 1358:184-90. PMID: 20709037
- McMurtrey RJ; Zuo Z. “Cell Signaling Pathways in Preconditioning and Postconditioning of Rat Hippocampal Neurons.” American Society for Anesthesiologists Annual Meeting 2010, San Diego, CA.
- McMurtrey RJ. “Microanatomy, Macroanatomy, and Embryology of the Hippocampus.” Department of Neurological Surgery Conference Presentation, 2009, Charlottesville, VA.
- McMurtrey RJ; Vest R; Bayer KU. “Modulation of Calcium/Calmodulin Protein Kinase II (CaMKII) Protects against Ischemic Neuronal Cell Death.” *Journal of Investigative Medicine*, Vol. 56 (1), 00-00, Jan 2008.
- McMurtrey RJ. “The Role of CaMKII in CNS Trauma and Excitotoxic Injury.” Presentations for the UCHSC and University of Virginia (UVA) Departments of Neurosurgery, 2008.
- McMurtrey RJ; Vest R; Bayer KU. “The Role of Calcium/Calmodulin Protein Kinase II (CaMKII) in Oxygen/Glucose Deprivation.” Western Student Medical Research Forum, 2008, Carmel, CA.
- McMurtrey RJ; Bayer KU. “Alternative Splicing of Calcium/Calmodulin Protein Kinase II (CaMKII) Affects Subcellular Localization and Dendritic Arborization.” *Journal of Investigative Medicine*, Vol. 54, (1) #177, Jan 2006.
- McMurtrey RJ; Bayer KU. “Alternative Splicing of Calcium/Calmodulin Protein Kinase II (CaMKII) Affects Subcellular Localization and Dendritic Arborization—with Sequence Analysis of Functional Regions.” Western Student Medical Research Forum 2006, Carmel, CA.
- O’leary H; Filbin ME; McMurtrey RJ; Lasda E; Davies K; Bayer KU. “Alternative Splicing Modulates Cytoskeletal Association of the Neuronal CaMKII β .” (Department of Pharmacology and Program in Neurosciences) Society for Neuroscience Annual Meeting 2006.

McMurtrey RJ. "Psychiatric Sequelae of Traumatic Brain Injury." UCHSC Psychiatry Conference 2006.

McMurtrey RJ. "A Novel Role of Alternative Splicing in Neuronal Plasticity." UCHSC University Research Conference Poster Presentation, 2006.

Escobar GA; McMurtrey RJ; Hedges J; Moore JB. "Large Spontaneous Unilateral Adrenal Hemorrhage in Pre-eclampsia: Case Report and Clinical Image." Institution: Denver Health Medical Center/University of Colorado Health Sciences Center.

McMurtrey RJ. NIH T32 Research Training Fellowship Report and Summary, 2005 (NIHMS Manuscript 64900).

McMurtrey RJ; Fleming DE. "Effects of Harmony and Dissonance with Two-tone Narrow and Wide Range Frequencies on Auditory Evoked Potentials," *Journal of Undergraduate Research and Creative Activities (JUG)* 2002.

McMurtrey RJ. The Effects of Harmony and Dissonance with Two-tone Narrow- and Wide- Range Frequencies on Auditory Evoked Potentials—with Proposed Neural Mechanisms of Tone Perception. University Honors Thesis AS 36 .B752 M34646 2004. (66 pp.)

Srivastava AK; Hurben MJ; Wittenauer MA; Kabos P; Patton CE; Ramesh R; Dorsey PC; Chrisey DB. "Angle Dependence of the Ferromagnetic Resonance Linewidth and Two Magnon Losses in Pulsed Laser Deposited Films of Yttrium Iron Garnet, MnZn Ferrite, and NiZn Ferrite," *Journal of Applied Physics*, Vol. 85.11, June 1999. (U.S. Army Research Engineering and Apprenticeship Program.)

Intellectual Property

McMurtrey RJ. "Biochemically Functionalized Tissue Constructs with Patterned Three-Dimensional Architecture." U.S. Patent App 62,077,207.

McMurtrey RJ. "Artificial Composite Neural Tissue Construct." U.S. Patent App 29,499,603, D789538.

McMurtrey RJ. "Patterned and Functionalized Composite Constructs for Neural Tissue Engineering." U.S. Patent App 14,461,325.

McMurtrey RJ. "Composition and Method for Achieving Rehydration and Improved Performance in Endurance Exercise." U.S. Patent App 13,103,105.

McMurtrey RJ. "Decorin and Gliosis and Related System and Method." U.S. Patent App 12,701,603.

Reviewer for Academic Journals

Scientific Reports (Nature Publishing Group)

Tissue Engineering (Tissue Engineering and Regenerative Medicine International Society - Mary Ann Liebert Pub.)

Neural Regeneration Research (Neural Regeneration Research Publishing House)

Journal of Biomedical Materials Research (Society for Biomaterials - John Wiley & Sons Pub.)

Journal of the Royal Society Interface (The Royal Society Publishing)

Computer Skills

Expertise in MATLAB programming (including ODEs, PDEs, Modeling, & Analysis—successfully completed rigorous Matlab Programming Course at Oxford), Sigmapstat and several other statistics programs (completed advanced statistics and epidemiology courses), and all Microsoft Office Suite software.

University Adjunct Professor Teaching Experience and Consulting Experience

Neurobiology & Neurodevelopment
Neurohistology & Neuroanatomy
Tissue Engineering & Biomaterials
Stem Cell Biology
Regenerative Medicine
Neural Modeling
Neural Interfaces

Molecular Biology
Biophysics
Imaging (MRI, PET, CT)
Quantitative Physiology
Device Instrumentation
Neurosurgery
Trauma and Critical Care

Languages

Latin (1st place in the Yengich Latin I translation competition amongst several universities)
Hebrew (intermediate level)
Greek (intermediate level)
Russian (basic level)
Spanish (advanced level)

Medical Experience

Neurosurgery/Critical Care Resident: Provided hospital call for all neurosurgery services, including OR, ER, ICU, trauma, and general patients. Also served as primary resident for pediatric neurosurgery, neurotrauma, neurooncology, and neuroendocrine services, with primary operative experience in numerous surgical interventions and techniques. Primary on-call resident for neuro-ICU, trauma-ICU, surgical-ICU, cardiovascular-ICU, cardiac surgery, trauma surgery, pediatric surgery, and neurosurgery services. Covered hospital emergency code pager, critical care team, and all aspects of ICU care and management. Medical school fourth year sub-internships at Denver General County Medical Center, University Hospital, and Denver Children's Hospital in general surgery, trauma surgery, intensive care, neurosurgery, pediatric neurosurgery, neurology, and neuroradiology.

Extracurricular Activities and Accomplishments

I enjoy exploring the outdoors and have extensive experience in rock and ice climbing, including climbing the Diamond of Longs Peak (D7), completing the entire Cirque of the Towers traverse, summiting the Grand Teton via the Direct Petzoldt and Exum ridges, climbing one of the longest sport routes (Squawstruck), climbing classic routes like Rainbow Wall's Original Route and Levitation 29 at Red Rock Canyon, completing several alpine ice and mixed climbs (e.g., Mixed Master in Canada), and many other alpine and expedition medicine experiences. I love trail running through the mountains and currently hold the 35+ age division record in the Utah Valley 10K (39:28), and I also played rugby at the intercollegiate and professional club levels (flanker and wing positions). I am always intrigued by the physiologic mechanics that enable extraordinary athletic performance, with many interesting questions still remaining to be explored. When I was younger I also played concert piano, including some of my favorite works by Rachmaninov and Beethoven, and I hope to return to playing and composing more someday when I have the time, especially because the interactions of artistic brilliance, acoustical physics, and auditory neural processing still fascinate me. I am also a somewhat obsessive collector of books, especially of historical works in science, literature, and mountaineering, as well as scientific photography, and one of my own microscopy photographs of neurons was displayed at the "Art in Science" exhibit at the Denver Museum of Nature and Science.

Research Statement

With the current limitations in therapies for neurological diseases and conditions—including those of stroke, traumatic brain injury, spinal cord injury, and neurodegenerative diseases—there is a greater need than ever to engineer new approaches and find more effective therapies. Innovative advancements are most likely to come from those who think outside the box and who have a range of skills and perspectives across disciplines, and I hope to be at the forefront of that discovery, advancing novel solutions to the vast array of unresolved problems in medicine. With my creativity, devotion, and talents, I hope to make many meaningful contributions and advancements in the areas of neural tissue engineering, neural interfaces, and stem cell research.

Neural tissue engineering holds incredible potential to restore functional capabilities to damaged neural tissue. My current research focuses on methods of understanding and reconstructing functional neural tissue. This work incorporates several fascinating fields, from neuroscience, molecular biology, and biochemistry to physics, engineering, and mathematics. The mechanisms of synaptogenesis, neural differentiation, and neurotransmission are complex, and regenerative approaches to neural injury and disease will require a synthesis of many innovative ideas in order to guide functional restoration of neural tissue. My approaches include 1) construction of 3-dimensional neuronal tissue with nanopatterned scaffolding for guidance of cell differentiation and replication of neuroanatomical structures and pathways, which can be used to study mechanisms of development, disease, and regeneration of tissue, 2) refining the implantation, differentiation, and integration of neural stem cells, 3) imaging structure and activity in 3-dimensional artificial neural networks, 4) researching mechanisms of neuron death and neuroprotective therapeutic interventions for stroke, traumatic brain injury, and spinal cord injury, 5) development of novel neural interfaces, including new biomolecular approaches that may improve the biocompatibility, function, and duration of neural implant constructs and devices, and 6) modeling of neural networks and diffusion modeling

of neural tissue morphogenic gradients involved in neural development. These will all be essential components in the advancement of therapeutic interventions that will usher in significant improvement in functional neural recovery over the next decade.