The Project

A Publication of The Miami Project To Cure Paralysis & The Buoniconti Fund To Cure Paralysis

The Miami Project To Cure Paralysis

Research Review 2017

THE MIAMI PROJECT TO CURE PARALYSIS

UHealth UNIVERSITY OF MIAMI HEALTH SYSTEM

UNIVERSITY OF MIAMI MILLER SCHOOL of MEDICINE

This has been a very successful year for The Miami Project to Cure Paralysis. Our multidisciplinary scientific programs are dedicated to discovering new treatments for people living with the detrimental consequences of brain and spinal cord injury. During the past year, The Miami Project and the Department of Neurological Surgery completed our FDA approved Phase I safety trial that tested human Schwann cell transplantation into subacute spinal cord injured subjects. These published findings showed safety and a strong rationale for moving this exciting cell therapy to chronically injured subjects. After receiving permission from the FDA, our scientific team began the necessary steps to identify subjects that would undergo for the first time a new multimodal exercise and rehabilitation protocol that would be combined with the Schwann cell transplantation protocol. We have now successfully transplanted chronically injured thoracic subjects and are following their progress. Thus far no serious complications have been documented and several individuals are showing signs of improved sensation. These results are very encouraging and we are actively transplanting chronically injured subjects with complete and incomplete cervical spinal cord injury. Cellular transplantation approaches after spinal cord injury offer hope for people living with paralysis and other quality of life issues.

Drs. Barth A. Green, W. Dalton Dietrich and Allan D. Levi

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New discoveries in other areas of neuroscience are also helping to clarify novel approaches to help protect and repair the injured nervous system. Clinical studies in The Miami Project are testing the benefits of different types of neural stimulation including direct brain or peripheral stimulation on spinal circuit reorganization and function. In the future, these powerful approaches may be combined with cellular approaches and other reparative strategies to augment reparative processes and maximize functional recovery mechanisms. For example, deep brain stimulation is currently being used by Miami Project investigators to successfully treat neuropathic pain, which is a common consequence of SCI and important quality of life issue. These types of investigative studies are helping to bring new technologies into the field of spinal cord injury and establishing new approaches to treat abnormal motor and sensory function after SCI. The combination of biological treatments including cell therapies or growth promoting factors with state-of-the-art robotics and

neuromodulation is a critical area for future research and discovery. To promote this innovative research initiative, members of our Neural Engineering Institute are developing new collaborations with Miami Project researchers that will complement our current reparative strategies and help advance new discoveries in the future.

Our basic and translational research programs continue to provide the knowledge required for future clinical programs as new discoveries are being made to clarify cellular and molecular mechanisms of cell death and axonal regeneration. Powerful screening strategies are identifying compounds and novel molecular targets that can be tested in clinically relevant models to protect injured tissues from progressive damage and promote circuit recovery. New knowledge on what factors may enhance or impede repair mechanisms after injury are accelerating our progress toward discovery and new therapeutics. Also, through collaborations with industry, alliances are being developed that will increase our opportunities to bring new therapies to our subjects and patients. In addition to spinal cord injury, our discoveries are also being tested for possible benefits in other models of traumatic brain injury, concussion, stroke, and neurodegenerative diseases including Multiple Sclerosis, Alzheimer's disease, and Chronic Traumatic Encephalopathy. Together these studies are providing the necessary knowledge for understanding how best to utilize combination treatments to maximize protection and recovery mechanisms after injury.

Our Educational Outreach and Training Programs continue to significantly contribute to the mission of the Miami Project. We are reaching out to individuals throughout the United States and abroad providing clinical information, resources, and news regarding progress in research and care. Over 3500 individuals living with SCI have volunteered to be in our research registry and in 2017 alone over 500 individuals participated in our active studies. The new Christine Lynn Rehabilitation Center for The Miami Project at the University of Miami and Jackson Memorial Hospital is under construction and will allow our scientists and clinicians to evaluate and recruit individuals with acute, subacute, and chronic injuries into our active clinical studies and trials.

We greatly appreciate the critical support from our friends and colleagues that are helping to move these investigations forward. The Miami Project to Cure Paralysis was established in 1985 to develop new therapies to improve function in paralyzed individuals. We are enthusiastic about our current accomplishments and multi-disciplinary research programs and excited about the future as we continue to move new treatments forward to treat paralysis.

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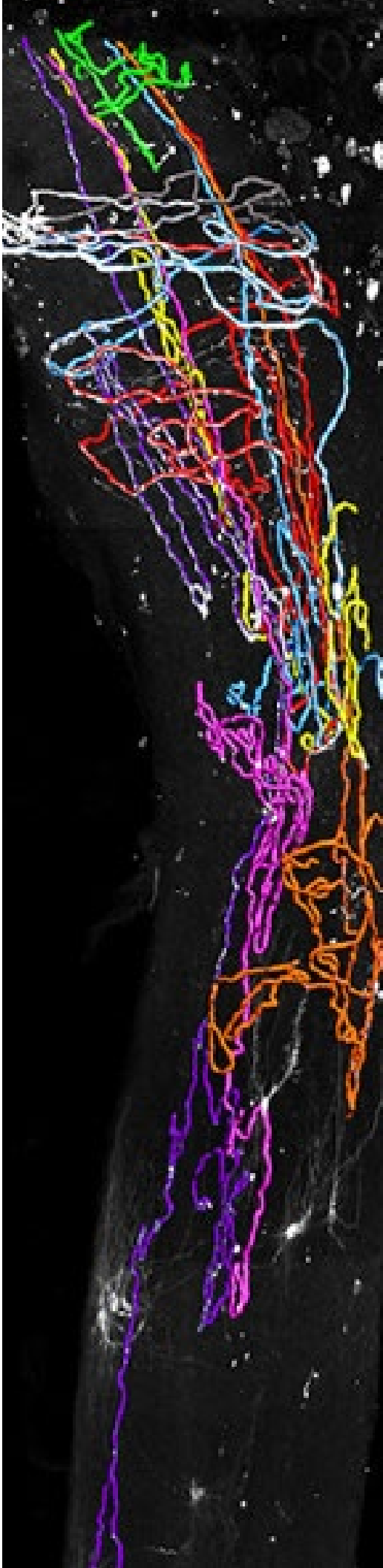

The Miami Project scientific team is grateful for the dedication and hard work of the fundraising, administrative, and scientific support staff. This incredible group of people spend countless hours providing direct clerical and administrative support to the research staff, and raising the precious private funds to support Miami Project research endeavors.

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In Memoriam – Christine K. Thomas, Ph.D.

Christine Thomas, Ph.D., Professor, Department of Neurological Surgery and The Miami Project, who has been researching neuromuscular weakness, fatigue, spasms, and regeneration for more than 30 years, passed away on December 1, 2017 after a long battle with cancer. She was recruited to the University of Miami in 1990 to conduct basic and clinical research targeting spinal cord injury (SCI) and to interface with a growing Miami Project research team and was promoted to Professor of Neurological Surgery in 2003. "Dr. Thomas will be greatly missed as she was a dedicated colleague, mentor to many, and outstanding medical researcher. I will always remember her sitting with SCI subjects surrounded by electrophysiological equipment as she accumulated data on signal motor unit recordings," said Dr. W. Dalton Dietrich, Scientific Director of The Miami Project. Colleagues gathered on December 22, 2017 at The Miami Project to remember her work and her friendship.

In addition to her studies clarifying mechanisms of spasticity and muscle weakness and fatigue, Chris also conducted preclinical studies to investigate muscle denervation and rescue of such muscles by motoneuron replacement strategies. All of these studies were supported by federal and other funding agencies indicating the very high quality of her work and acknowledgement from her peers. Chris was a very serious investigator who carefully analyzed her data and published in the best neurophysiological and neuroscience journals. She was also a wonderful team player and collaborated with many colleagues inside The Miami Project as well as around the world. Based on her many research contributions, Chris received many awards and was invited in 2016 to give the commencement lecture at her alma mater, The University of Otago in New Zealand. At that time she told graduates that "with new technology we have lots of data, new ways to process it, but these are just tools, and tools do not solve the problem. The difficult task is to understand what you see and to turn that information to some use." She will be remembered for obtaining and critically reviewing enormous amounts of data during her clinical investigations and coming up with new hypotheses that challenged the field. Dr. Thomas will be greatly missed, but has left us all with valuable collections of data and instructive observations on which the SCI field can continue to grow.

Left: Dr. Thomas performing an electrophysiology experiment in her copper shielded laboratory. Right: Dr. Thomas, right standing, with the Miami Project clinical faculty in 2013.

"an astonishing ensemble of contributions from all corners of present knowledge regarding the relationships between brain and mind."

Miami Project Scientist Ioan Opris, Ph.D.

Ioan Opris, Ph.D., an Associate Scientist at The Miami Project to Cure Paralysis, has recently co-edited and published a book titled *The Physics of the Mind and Brain Disorders*, along with Dr. Manuel Casanova from the University of South Carolina School of Medicine. Miami Project Research Associate Professor, Brian Noga, Ph.D., is also a contributing author.

The book offers a new look at how the fundamental principles of physics affect scientists' understanding of the structure and function of the brain. The brain is an incredibly complex system, consisting of hundreds of billions of interconnected cells (neurons). A highly sophisticated structure is necessary to organize all of the electrical and chemical signaling that occurs, which allows humans to carry out all of the tasks required throughout a day. These tasks range from low-level functions, such as touch, taste, smell, vision, hearing, and movement, to high-level cognitive functions, like perception, awareness, memory, decision-making, reasoning, and language.

Joaquín M. Fuster, M.D., Ph.D., distinguished professor of cognitive neuroscience at UCLA Medical School, said that *The Physics of the Mind and Brain Disorders* is "an astonishing ensemble of contributions from all corners of present knowledge regarding the relationships between brain and mind. Despite the enormous variety of subjects and methodologies it covers, from basic anatomy to spirituality, the book is eclectic in the true sense, in that it manages to reconcile them with an unprecedented integrative effort. I am full of admiration."

In the book, Dr. Opris and colleagues also discuss how dysfunction in the brain can lead to debilitating disorders, such as schizophrenia, dementia, autism, aging, or addictions, which carry a high economic and sociologic burden. New diagnostics and therapeutics to address these disorders are now in development, which may produce strategies for mapping and repairing the brain.

Prominent neuroscience researchers agree that "this is a most remarkable book plowing new ground on the perennial puzzle of physics and mind. The new insights will cast a very long lasting influence in the years to come, with the bar set at a height difficult to surpass," noted Apostolos P. Georgopoulos, M.D., Ph.D., Regents Professor of Neuroscience, University of Minnesota. Congratulations Dr. Opris and Dr. Noga, and thank you for contributing to our understanding of the complexities of the brain.

Hassan Al-Ali, Ph.D.

"Mix in more energy than you find in a colada (strong and sweet Cuban espresso) and you will start to build a mental image of Hassan."

Hassan Al-Ali, Ph.D., Research Assistant Professor at The Miami Project, is not your typical scientist. His previous mentor and current business partner, Dr. Vance Lemmon, describes him like this: "Hassan is unlike anyone I have met. He is a fusion of a computational scientist, an entrepreneur, a biochemist, a hyper efficient bench scientist, and an artist. Mix in more energy than you find in a colada (strong and sweet Cuban espresso) and you will start to build a mental image of Hassan."

While still a Master's student at the American University of Beirut (AUB), Hassan attended a lecture by a visiting professor, Dr. Sawsan Khuri. In her talk, she described the use of informatics in biological research, which at the time was a relatively new concept. Dr. Khuri explained how she could use genetic information from plants to computationally predict structure and function relationships of proteins. Although Hassan wasn't particularly interested in plant biology, he says that his "mind was blown" by seeing the effect that information technology could have in biological science. He developed an instant interest in computational science and proceeded

to incorporate informatics into his wet lab work. Hassan then helped establish the Computational Science and Bioinformatics Core at AUB, which he managed for two years.

Realizing he missed laboratory work, he contacted Dr. Khuri, who at that time was a professor at the University of Miami, for advice. She invited him to explore research opportunities in Miami, where they could collaborate on projects. There, he met Dr. TK Harris, Professor of Biochemistry and Molecular Biology, who was using novel techniques to study the structure and function of genes important in cancer biology. Hassan joined his lab as a Ph.D. student and started working on combining two different technologies, x-ray crystallography and nuclear magnetic resonance spectroscopy, to understand the structural properties of complex proteins.

After completing his Ph.D., Dr. Al-Ali decided that he wanted to work in a lab that was more translational – a place where he could use his computational and biochemical knowledge in a complex disease model. So, he again went back to his now long-time mentor, Dr. Khuri, for guidance. She introduced him to Dr. Vance Lemmon and Dr. John Bixby at The Miami Project to Cure Paralysis. Dr. Al-Ali felt an instant chemistry with them and soon joined their lab as a post-doctoral fellow.

With their support and the freedom to explore his own ideas, Dr. Al-Ali was able to be creative and try different things, some of which failed. But Drs. Bixby and Lemmon continued to encourage him to push forward. Most importantly, says Hassan, "They made me feel like it was ok to challenge the status quo, which had a profound impact on my ability and desire to innovate". He started to combine basic biochemical information with cell-based assays and phenotypic screening, trying to merge all these methods to identify targets that can be modulated to make nerve fibers (axons) grow. Dr. Al-Ali knew that advances in machine learning technology would hold the key, and he turned to his long-time friend, Dr. Houssam Nassif, a machine learning scientist at Amazon, for help. The two had successfully collaborated on several projects back at AUB, where they were introduced to each other by Dr. Khuri during her fateful visit. He says of her now, "she was probably my biggest champion". He then adds, "I have been extremely lucky with my mentors over the years, and I owe much of my success to the support and guidance I have received from them."

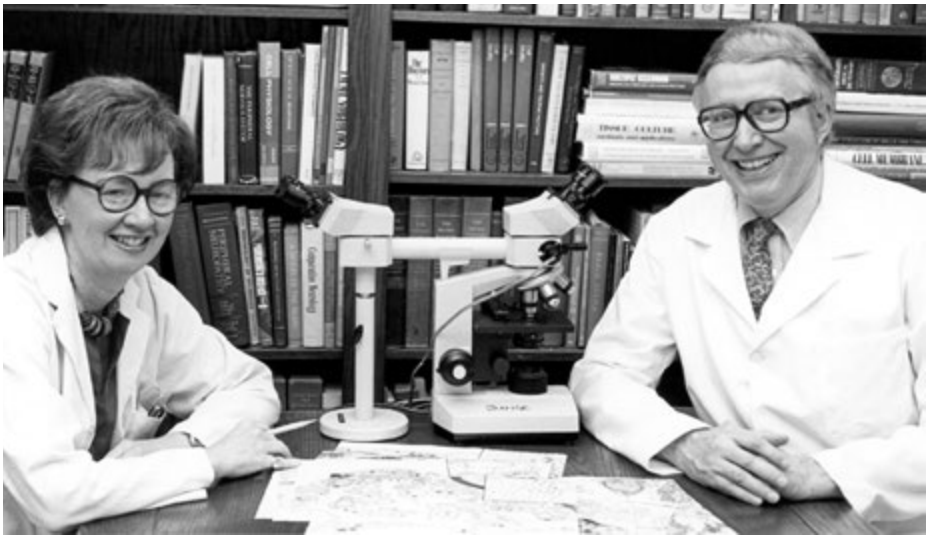
Finally, Hassan's platform began to take form and appeared to outperform existing technologies for identifying effective drug targets. Using this new tool, Dr. Al-Ali was able to identify a compound that engages multiple targets to robustly promote axon growth after injury in the central nervous system (CNS). When that compound was tested in an animal model, there was significant regrowth of axons after injury, something that doesn't usually happen.

After the study was published, other investigators that wanted to perform a similar analysis in different disease models began sending Hassan their screening data. It soon became obvious that the platform was readily portable to other applications and can enable drug discovery in many other diseases, not only in CNS injury. Dr. Al-Ali and Dr. Lemmon co-founded a startup company, Truvitech, LLC, with the goal of commercializing their technology and extending its application to oncology and kidney disease, amongst others. To better prepare for the challenge of launching a startup company, Dr. Al-Ali decided to go to business school and he recently completed a Master's degree in business management at the University of Miami.

Dr. Al-Ali and his company recently received notification that their recent NIH small business technology transfer (STTR) grant application was selected for funding. This will allow them to harden their drug discovery technology. They will then use it to develop a lead compound for diffuse large B-cell (DLBCL) lymphoma, as a first step in extending their work towards cancer applications.

Irrespective of Truvitech's success, Dr. Al-Ali doesn't plan on leaving academia any time soon. "For me, academia is my intellectual refuge, and I don't want to give that up", he says. "If you go back to my timeline, everything I've achieved was made possible by a gift of knowledge or information or data or guidance that I received freely as an academic from my mentors or collaborators." Last year, Hassan met Dr. Alessia Fornoni, Director of the Katz Drug Discovery Center and Chief of Nephrology at UM. "I was greatly impressed by her combination of strong translational science and entrepreneurship." After several discussions with Dr. Fornoni, Hassan joined her Center to launch a new drug discovery program for kidney disease. "This is the kind of magic that only happens in academia." Hassan is also a member of the Sylvester Comprehensive Cancer Center, where he collaborates with several groups on oncological drug discovery projects.

Dr. Richard Bunge and Dr. Mary Bartlett Bunge devoted their careers to understanding and repairing the central nervous system.



Drs. Bunge to Receive Lifetime Achievement Award

from The American Spinal Injury Association

The American Spinal Injury Association (ASIA) is awarding the 2018 Lifetime Achievement Award to Dr. Richard P Bunge and Dr. Mary Bartlett Bunge. The award is presented to individuals who made a significant contribution to the world of spinal cord injury care.

Dr. Richard Bunge and Dr. Mary Bartlett Bunge devoted their careers to understanding and repairing the central nervous system. Their research of Schwann cells allowed The Miami Project to gain approval from the FDA to initiate clinical trials of Schwann cell transplantation in people with spinal cord injury. In addition to their own scientific contributions, they trained countless scientists who will continue their work for many years to come.

Dr. Anderson Heading North

We would like to congratulate Dr. Kim Anderson, Professor of Neurological Surgery and Director of Education at The Miami Project, who has accepted a faculty position as Professor of Physical Medicine and Rehabilitation at Case Western Reserve University, MetroHealth System, in Cleveland, Ohio. She will be working with the Institute for Functional Restoration, which is focused on moving implanted neuroprosthetic technologies for people with spinal cord injury (SCI) out of the research realm and in to the community.

Dr. W. Dalton Dietrich, Scientific Director of The Miami Project, said of her departure, “Kim has been a critical member of the Miami Project and will be greatly missed. Her sincere dedication to the Project and the SCI community has and will continue to be greatly appreciated. Kim’s many contributions have greatly contributed to our success over the years and helped the Miami Project evolve into the very special program it is today. Even in Cleveland, Kim will remain an important member of our Miami Project Family.” Dr. Katie Gant has taken over as Director of Education and Outreach. The Education Department can be reached at 305-243-7108 or mpinfo@med.miami.edu.

Miami Project Sponsors Working 2 Walk Meeting

The Miami Project was very happy to be the title sponsor of the 12th Annual Working 2 Walk Science and Advocacy Symposium. The symposium is organized by Unite 2 Fight Paralysis and provides a unique opportunity for people living with paralysis, and their family and friends, to interact with scientists, advocates, and clinicians in a dynamic setting that promotes the exchange of ideas and strategies to find advanced treatments for paralysis.

The meeting was held October 13-14, 2017 at the Miami Airport Hilton. Dr. Dalton Dietrich kicked off the symposium with a talk about "Current Progress on Neuroprotection and Repair Following Spinal Cord Injury: The Miami Project Experience." Later that day Dr. Allan Levi spoke about "The Future Direction of Neuroregenerative Therapy in Traumatic Spinal Cord Injury" and was part of a stem cell panel discussion with Drs. Paul Lu, Paul Reier, Murray Blackmore, and Edward Wirth. Other topics discussed by various speakers during the meeting include improving arm and hand function with external stimulation, internal stimulation, or nerve transfers; gene therapy; advocacy examples and networks; activity-based therapy strategies; big-data analytics; and overcoming the glial scar. Videos of many of the presentations can be viewed at https://vimeo.com/album/4851806.

On the second day of the meeting, several Miami Project faculty and staff held breakout sessions with the attendees. The first was on "Clinical Research Participation," led by Drs. Katie Gant and Kim Anderson; the second was on "Therapeutic Potential of Brain Stimulation", led by Drs. Brian Noga and Monica Perez; and the third was on "Healthy Aging after Spinal Cord Injury", led by Drs. Eva Widerstrom-Noga, Rachel Cowan, and Gregory Bigford. To read a blog about more of the meeting activities, please access https://working2walk2017.wordpress.com.

From top: Scientific Director, W. Dalton Dietrich addressing the crowd.

Drs. Eva Widerstrom-Noga and Gregory Bigford participating in discussion.

Drs. Katie Gant and Kim Anderson leading a breakout session.

Dr. Mary Bartlett Bunge's Retirement Celebration

After more than 60 years of research, Dr. Mary Bartlett Bunge finally decided to retire – kind of.

She is still Professor Emeritus at the University of Miami (UM). However, she is slowly closing down her lab, cleaning out her office, and preparing for her next adventure in New York. On November 17, 2017 The Miami Project hosted a day of celebration of her career. Several of her colleagues and past trainees were invited to speak about her contributions and influence in science. These included James Salzer, Xiao-Ming Xu, Reggie Edgerton, Giles Plant, Scott Whittemore, James Guest, Pat Wood, Mary Blair Clark, Cristina Fernandez-Valle, Caitlin Hill, Martin Oudega, and Damien Pearse. Several former trainees mentioned how she had affected their lives (in a good way) and how much they treasured the family atmosphere in the lab.

Dr. Xiao-Ming Xu, Dr. Mary Bunge and Dr. Dalton Dietrich

Dr. Bunge retires as the Christine E. Lynn Distinguished Professor in Neuroscience and Professor of Cell Biology, Neurological Surgery, and Neurology. The research focus of most of her career has been the Schwann cell, which she and her husband Richard determined to be a key to helping repair damaged spinal cords. Their work with Schwann cells has led to numerous discoveries, and was central to The Miami Project's FDA-approved clinical trial program transplanting autologous Schwann cells in spinal cord injury. Drs. Mary and Richard Bunge's research is considered so valuable that the National Institutes of Health (NIH) has renewed their individual research grant for 45 years — an almost unmatched record of achievement. In 2018, they will both receive the Lifetime Achievement Award from the American Spinal Injury Association.

An internationally recognized authority on central nervous system (CNS) regeneration, Dr. Bunge has received many prestigious honors during her career, including the 1996 Wakeman Award for her seminal contributions to the understanding of spinal cord injury repair and the Javits Neuroscience Investigator Award from 1998-2005 from the NIH's National Institute of Neurological Disorders and Stroke (NINDS). In addition to serving on the NINDS council, she served on the Institute of Medicine's Committee on Spinal Cord Injury from 2003-2005, and received an honorary doctoral degree in Humane Science from her undergraduate alma mater, Simmons College, in 2006. She received a Distinguished Faculty Scholar Award and was inducted into Iron Arrow, the highest honor at UM. The greatest honor of her career came in 2013, when she was elected to the National Academy of National Academy of Medicines' Institute of Medicine.

Below are two narratives that Dr. Bunge would like to share with all of our readers and supporters. First, her biography of events that shaped her life and, second, her "Schwann song" farewell.

Events that Shaped My Life

by Mary Bartlett Bunge, November 17, 2017

It has been a great and rewarding journey! Except for time out for education and giving birth to two sons, I have worked 70 years, 57 years since obtaining my PhD! I think it is interesting to learn how unexpected and unscheduled events shape a life. Let me tell you about some of the earlier events that shaped mine.

I was an only child raised by very creative and artistic parents. My father was a violinist and later a creator of beautiful homes; my mother, an interior decorator. I grew up in a very beautiful and historic small town, Essex, situated at the mouth of the Connecticut River. At the back of our home were woodlands to be explored and, in front, a stream with tiny frogs and tad poles that sparked an early interest in biology.

My four girlhood heroines were Olympic gold medalist, Sonja Henie, who brought ballet to figure skating, Anna Pavlova, one of the most famous ballerinas of all time and best known for her Swan dance. Also, Marie Curie who was awarded not one but two Nobel prizes and Eleanor Roosevelt. As a girl scout I was chosen to escort Eleanor to the stage of a local high school before her speech. (I do not remember one word she said!) A mix of art and science and women who made a difference.

My first summer job at age 16 was Supervisor of the Diet Kitchen at the Middlesex Hospital in Middletown, CT. I wore my hair up in a bun on top of my head to look older. I learned a lot about people that summer as most of my employees were from the local mental hospital. The next two summers I filled in for the secretary of the Pathology Laboratories at the hospital and coordinated all the requests for the patients' lab work and prepared the resulting reports.

Two years at a private high school, Northfield School for Girls, provided a far better pre-college education than the Essex public schools. It was so enjoyable to be with "sisters" who valued learning. I chose Simmons College in Boston because they offered a course in Medical Technology, and that was the type of job I was aiming for. Interest in biology had finally surpassed interests in careers in child psychology and fashion design. But a life-changing event occurred in the summer between my junior and senior college years.

I was accepted into the renowned summer program at Jackson Laboratories in Bar Harbor, Maine and became part of a community of 18 highly motivated science and pre-med students from all over the country. So exciting! The first time I viewed beating rabbit heart muscle in a culture dish that summer, I was smitten. Why not an MS degree?

I was accepted into the Medical Physiology Department at the University of Wisconsin Medical School. A telegram (This was the old days!) from a clinician-scientist to work in his lab with a Wisconsin Alumni Research Foundation stipend led me to Dr. Robert F. Schilling. He had achieved notoriety for devising the diagnostic test for pernicious anemia, caused by the lack of a factor in gastric juice needed for the absorption of vitamin B12. I was to work on binding of vitamin B12 analogs in gastric juice. Two highly regarded publications and an MS degree resulted. Dr. Schilling was an outstanding clinician-scientist and mentor. He viewed data very critically and taught me how to write a scientific paper. I am forever grateful for my time in his lab.

During this time I took a cytology course with Dr. Hans Ris, a foremost cell biologist in the Zoology Department at the UW. In one of the laboratory exercises he showed us images of tissue in the electron microscope (EM). I believe it was the second one in this country, purchased by the Biochemistry Department for a famous scientist studying mitochondrial fractions. I found these images enthralling and was intrigued to see the possibility of combining acquisition of scientific data with artistic expression. Now I was <u>really</u> smitten!

Dr. Schilling's lab had offered another life-changing possibility. He took on medical students every summer and, the first summer I was in his lab, one of them was Richard Bunge. Dick earned all the money needed to pay for his

Drs. Mary and Richard Bunge

undergraduate and medical school education at the UW. So that summer he not only worked in the lab (actually in the cold room all day) but at 5:00 he disappeared into the hospital cafeteria to wash dishes. <u>This guy needed fresh air</u>!

Despite growing up in one of the most favored yachting centers on the New England coast, I learned to sail on Lake Mendota in Madison. Why not take Dick sailing? Fortunately, he said yes! We were often becalmed in the middle of the lake giving us time to establish a friendship that evolved into a romance. I quickly recognized a gem. He personified "mid-western values." Now, I was <u>really, really</u> smitten!

Again, to earn money he initially attended medical school half-time; the remaining time was spent in the Anatomy Department with a Professor who was anesthetizing adult cats by adding the agent to the cerebro- spinal fluid (CSF) and then mixing it by withdrawing and re-injecting it repeatedly (barbotage). The cats became somewhat

paralyzed, but only temporarily. Dick's studies of the spinal cord histologically after the barbotage (without the anesthetic) led to a very important discovery, revolutionary at the time--the disappearance and reappearance of myelin in the spinal cord periphery. This was the first demonstration of remyelination in the adult mammalian spinal cord-- not axon regeneration--but remyelination of axons that had been denuded of myelin by the barbotage.

Well for me, why not investigate the fine structure of demyelination and remyelination in the EM for a PhD? I chose to do this with Dr. Ris who had never worked with nervous tissue but his highest standards for electron microscopy and scientific research were what I needed and he provided. He was an outstanding and exacting mentor. He also was gender blind; I was one of a number of women in his lab in the 50s. I never felt second class. I shall always be thankful for my time in his lab.

Besides our marital collaboration by this time, this was my first scientific collaboration with Dick, a harbinger of so many more to come for 40 years. We discovered the way in which myelin was re-formed in the CNS, at this time controversial. The work was published in the early days of the Journal of Cell Biology. The Editors could not believe that unknowns from Wisconsin had submitted manuscripts showing such well-preserved spinal cord tissue--it was notoriously difficult to preserve. We had replaced the CSF with the fixative to yield these good results. These findings led to our first invitation to present at an international meeting in Munich in 1961.

Because of Dick, I was now a neuroscientist. Our personal and professional collaborations were fruitful and successful. We completed each other. Despite our similar ages, Dick was always an inspiring, talented, creative and valuable mentor for which I shall always be grateful.

With MD and PhD degrees in hand, we set out for NY and Columbia University College of Physicians and Surgeons in 1960 with a Multiple Sclerosis Society Fellowship for Dick with Dr. Margaret Murray, a founder of nerve tissue culture, and an NIH Fellowship for me. I was headed to an EM lab to bridge the two labs to initiate for the first time EM studies of a variety of differentiating nervous tissues in culture. One of my "Aha" moments at Columbia was to see the physical connection between the oligodendrocyte and the myelin sheath it was forming in the kitten spinal cord, not yet shown. This finding demonstrated that the oligodendrocyte was the cell that formed myelin in the CNS and that the mechanism was the same as that we had

Current and past members of the Bunge lab at the retirement celebration

discovered for remyelination. It was at this time in New York that we were blessed with the births of our two sons, Jonathan and Peter.

After 10 years at Columbia, we were recruited to join the faculty in the very outstanding Department of Anatomy and Neurobiology at Washington University School of Medicine in 1970. I will always be grateful for having been in such an environment of excellence for 19 years. Well attended departmental seminars were held on Saturday mornings! It was then that we started in earnest to study Schwann cell biology in novel tissue culture preparations developed by Dick and Dr. Patrick Wood. These cultures enabled unique studies of interactions between neurons, Schwann cells and fibroblasts of peripheral nerve. It was at this time in St. Louis that Pat entered our lives and for that there is everlasting gratitude and appreciation for his valuable contributions.

Despite our basic studies, we were always interested in applying our results to clinical problems. And so when Dick was chosen to be Scientific Director of the Miami Project in 1988, we seized this opportunity to expand our Schwann cell work to test the efficacy of their transplantation into rat spinal cord injury sites. Dick had envisioned since 1975 that Schwann cells could be extracted from a peripheral nerve in a spinal cord injured person, purified and greatly expanded in number in culture, and then autologously transplanted into the damaged spinal cord site. The Miami Project provided the welcome village that enabled years of very labor-intensive and challenging work; work that contributed to obtaining approval from the FDA in 2012 for the Schwann cell transplantation clinical trials now under way in the Miami Project.

'Twas the day of my retirement

by Mary Bartlett Bunge
November 17, 2017

'Twas the day of my retirement when all through the lab not a creature was stirring tho a productive time had been had.

The 45 year grant had come to an end,it was time now for me to begin to attend to the next phase of my life, a challenge to be newly creative, in the city of Manhattan where I long to be a native.

Chemicals and supplies were now nestled all snug in other places to make for others, newly accessible and welcome spaces.

No more injured rats were recuperating in their beds while visions of fruit loops danced in their heads!

Surgical instruments were gone, antibodies given away. Who would now occupy my 5th floor bay?

When all of a sudden there arose such a clatter we all sprang from our labs to see what was the matter!

It was not jolly old St. Nick with a belly like jelly! But Dalton, our chief, who has spoken on telly!

He was shouting this: Where's her bay? Its new use is for the Space Committee and me to say.

But, he added sadly, to clear her office will take quite a bit as she has saved so much memorabilia and all things writ.

I leave many medical students who learned all about tissue (tho with some of our exams they often took issue).

I leave you the sculpture named, "Noble Pursuit" with its reflections upon turning, it is a beaut!

And in the span of '96 to '97, that challenging year of grief and loss, my effort to maintain the Project's morale as the interim Scientific Boss.

And 3 trainees, now faculty, who study central recovery and the EM Core (with Vania) that enables novel discovery.

I leave you many lectures by pioneering women so wise—their mentoring sessions help postdocs and young faculty to rise.

I leave you a body of work that spurred axon regeneration—now this direction falls to the next generation.

And hopefully Schwann cells, heroines of peripheral nerve,with new combinations will perform with additional verve.

Before leaving the Project, and disappearing from sight, I shall call out some names with all of my might!

Bye Dalton, always a gentleman, grant reviewer and grant getter, the Miami Project could surely not have picked better.

And that is true also for Suzie and Steph, the great funders, at raising so much money, they are truly wonders.

Bye Diana and Randy and Kim Anderson too, we appreciate the many and varied tasks that you do.

And bye to Erika, so helpful and sweet, she deserves to receive only the most appreciative tweet.

Bye Paula, you are the guardian of Schwann cell biology now— to investigate molecular mechanisms I hope you will vow.

Bye to Pantelis, a friend and our most learned source— for student speakers he can sometimes cause remorse.

Bye to Barth, such a visionary and generous giver to me of the Christine Lynn Chair, for funding for my lab it was so key.

And bye to the Buonicontis who have exhibited so much generosity that has led to more and more work of desired luminosity.

And I also want to add with the most serious intention some advice for trainees, -do not follow convention.

But the most important trait for your success is to develop a passion for your work, in great excess.

It is not so much brilliance as it is also working very hard and being constant and creative: these shall deal you the winning card!

I shall be heard to exclaim ere I disappear from view my appreciation of the efforts of every one of you!

Thanks for the village that you all provided that enabled our work to be so many sided!

Thank you!

Jonathan Bunge with Dr. Mary Bunge and Connie Evans

The Long and Winding Path of Axon Regeneration

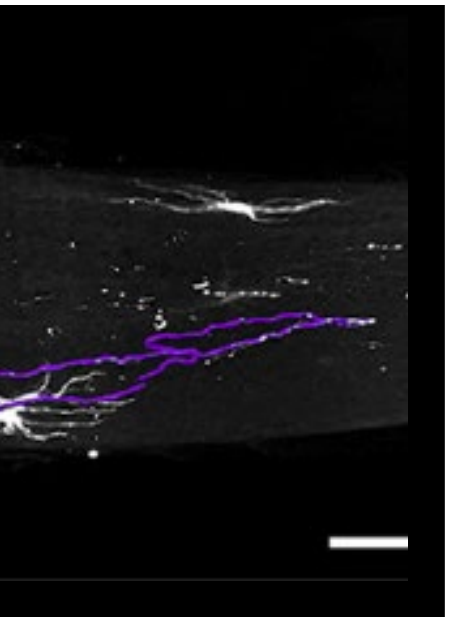
After spinal cord injury (SCI), nerve fibers (axons) have a hard time growing across the area of damage to reestablish functional connections, which often results in loss of sensation and movement below the level of injury. In research laboratories, many different models of SCI are utilized to better understand injury processes and develop therapies for improving function. In rodents, intraorbital optic nerve crush is commonly used as a model to study axon regeneration. The optic nerve transmits visual information from the retina to the brain and is composed of the axons of retinal ganglion cells (RGCs). After the optic nerve is crushed, axons degenerate and cell death occurs, similar to what happens in the spinal cord following injury.

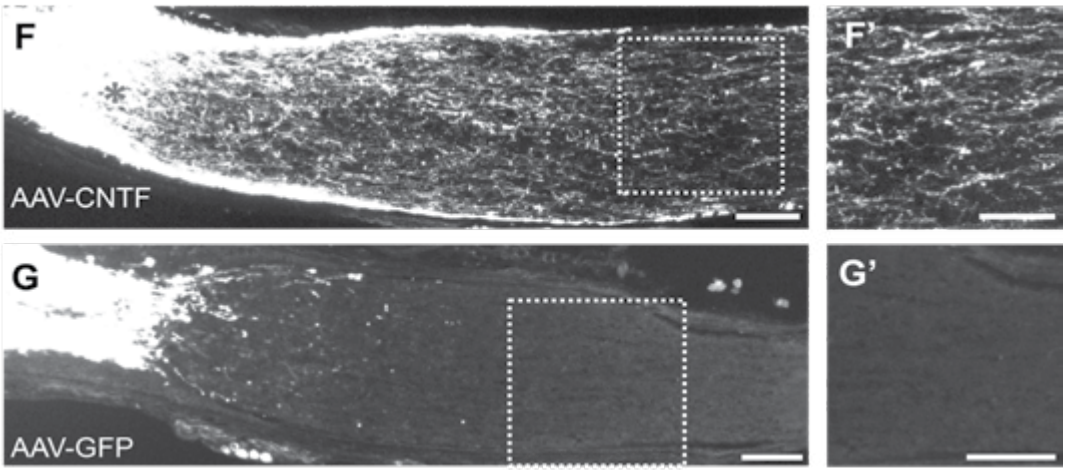
Scientists have developed various strategies to improve optic nerve regrowth and have identified numerous genes that play a role in axon regeneration. By modifying those genes, researchers can make axons grow longer into, and sometimes through, the injury site. However, the paths of regenerated axons are often misguided and end up growing in the wrong direction.

Kevin Park, Ph.D., an Associate Professor at The Miami Project, and the researchers in his lab noticed that the paths of regenerating axons were particularly misguided in areas around the injury site. They figured that glial cells, which become activated immediately following injury, might be disrupting the path of regenerating axons. They wondered what would happen if axons were encouraged to regenerate at a later time point, after the glial cells return to a normal "un-activated" state.

Dr. Park and his colleagues introduced a gene (ciliary neurotropic factor, CNTF) using a virus (adeno-associated virus, AAV), which allows the genetic material to enter the cells. The CNTF gene encodes a protein that has been shown to promote axon regeneration in previous studies. In one group of animals, they injected AAV2-CNTF immediately following injury. In the second group of animals, they waited eight weeks, which is considered the "chronic phase" of injury in a mouse model, before injecting the AAV2-CNTF. In both groups, they waited 3 weeks and then looked at how the axons were regenerating (Yungher et al, 2017).

They discovered that RGCs were able to regenerate long after injury, suggesting that there is not a critical time window for intervention. They saw enhanced growth rates in axons after AAV2-CNTF injection, even after treatments that was administered eight weeks following injury. However, they found that very few RGCs survived injury, with only 4% living eight weeks later. For this reason, they wanted to see whether a larger pool of cells could be triggered to regenerate their axons, as long as they are protected from cell death.





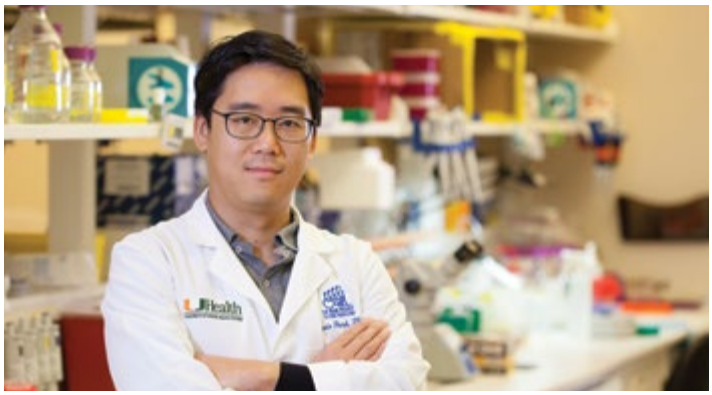
Immediate treatment with protein shown to promote axon regeneration (AAV-CNTF), but not a control (AAV-GFP), results in significantly greater axon regeneration.

So, they brought in a special type of mouse that had been genetically engineered to undergo very little cell death following an injury to the nervous system. The Bax gene, which regulates cell death, was eliminated from the DNA of these mice, so they are called "Bax knockout (KO)" mice. Dr. Park and colleagues repeated their delayed intervention experiments with AAV2-CNTF and compared the response in Bax KO mice to the response in normal, wild-type mice.

In the Bax KO mice, they saw similar rates of axon regeneration, whether treatment was provided immediately or eight weeks later. In the animals that were treated immediately with the gene that promotes axon regeneration (CNTF), they actually found that a smaller portion of RGCs were capable of regeneration in the Bax KO mice, even though there were many more cells. Although it is unclear why the majority of RGCs failed to generate, it seems as though the surviving RGCs are resilient and able to generate axons long after injury.

When they compared the paths of regenerating axons, they found more linear growth in animals treated at the later time point. By then, the environment around the injury site may be more permissive, since many of the growth factors and cytokines present immediately after injury may be downregulated.

In order to more comprehensively evaluate the axon growth patterns near the injury site, Dr. Park and colleagues collaborated with other Miami Project researchers to label the axons, making individual axons easily visible



Kevin Park, Ph.D.

(Bray et al, 2017). With the help of Dr. Pantelis Tsoulfas, along with their laboratory groups, they were able to see that, although the axons are capable of regenerating long distances, particularly after CNTF treatment, the growth is not in the right direction. The results of their work highlight the importance of chronic regenerative and protective strategies, as well as encouraging axon growth in the right direction.

Yungher BJ, Ribeiro M, Park KK. (2017). Regenerative responses and axon pathfinding of retinal ganglion cells in chronically injured mice. *Investigative Ophthalmology Visual Science*. 58: 1743-1750.

Bray ER, Noga M, Thakor K, Wang Y, Lemmon VP, Park KK, Tsoulfas P. (2017). 3D visualization of individual regenerating retinal ganglion cell axons reveals surprisingly complex growth paths. *eNeuro.* 4(4). pii: ENEURO.0093-17.2017.

CLINICAL RESEARCH STUDIES

Scientists at The Miami Project are evaluating various aspects of spinal cord injury in clinical studies. Individuals with spinal cord injury may participate in specific studies as volunteers, depending on inclusion criteria. Below is a list of our active studies. To be considered for participation in current and future studies, visit our website and complete an intake form. The form can also be accessed directly at: redcap.miami.edu/surveys/index.php?s=P9T87MYKH4

Activity
- Fitness and Independence after SCI: Defining Meaningful Change and Thresholds
- Effects of Acute Body Weight Support Treadmill Training (BWSTT) and Acute Intermittent Hypoxia (AIH) on Metabolism, Dysglycemia, and Cardiovascular-Autonomic Functions in Persons with SCI
- A Lifestyle Intervention Targeting Enhanced Health and Function for Persons with Chronic SCI in Caregiver/Care-Receiver Relationships: Effects of Caregiver Co-Treatment
- Energy Expenditure During and After Electrically Stimulated Cycling in Persons with Spinal Cord Injury
- Lower Body Blood Flow During and After Electrically Stimulated Cycling in Persons with Spinal Cord Injury
- Stakeholder Perceptions and Clinical Assessment of Cardiometabolic Disease/Syndrome after Spinal Cord Injury
- Effects of Acute Intermittent Hypoxia (AIH) on Metabolism and Dysglycemia, in Overweight/Obese Persons with SCI

Fertility
- Male Fertility Evaluation

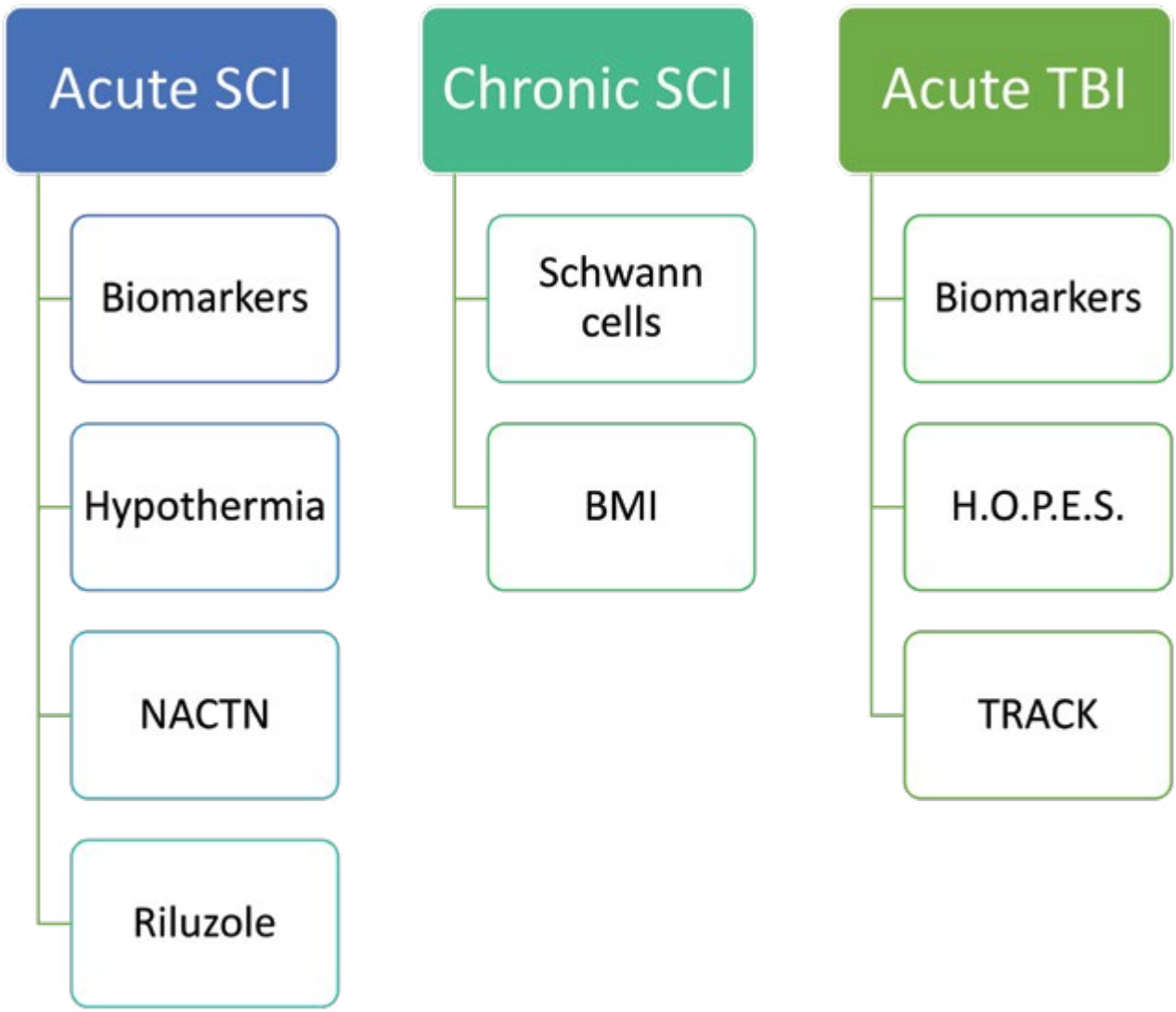
Pain
- Perspectives on Management of Severe Neuropathic Pain after Spinal Cord Injury
- Utility of MRS Brain Biomarkers of Pain Phenotypes after Traumatic Brain Injury (TBI)

Sleep
- Sleep Disordered Breathing in Chronic SCI: A Randomized Controlled Trial of Treatment impact on Cognition, Quality of Life, and Cardiovascular Disease

Motor Control
- Bilateral Control of Arm Movement after Spinal Cord Injury
- Synchronization of Corticospinal Volleys After Spinal Cord Injury
- Reorganization of Descending Pathways after Spinal Cord Injury
- Targeted Neuroplasticity after Spinal Cord Injury
- Relationship between Clinical and Physiological Outcomes of Sensorimotor Function and Spasticity
- Hand and Upper-Limb Motor Training
- Acute Intermittent Hypoxia and Motor Function

CLINICAL TRIALS

The Miami Project is currently conducting numerous clinical trials in spinal cord injury (SCI) and traumatic brain injury (TBI). In people with acute (newly injured) SCI, various therapeutic interventions (hypothermia) and drugs (riluzole) are being investigated, along with registry trials (biomarkers, NACTN). In people with chronic (> 1 year) SCI, we are investigating transplantation of a person's own Schwann cells, as well as a brain-machine interface (BMI) trial. In acute TBI, a hypothermia intervention (HOPES) and registry trials (biomarkers, TRACK) are currently active. For more information, contact the Education department at 305-243-7108.

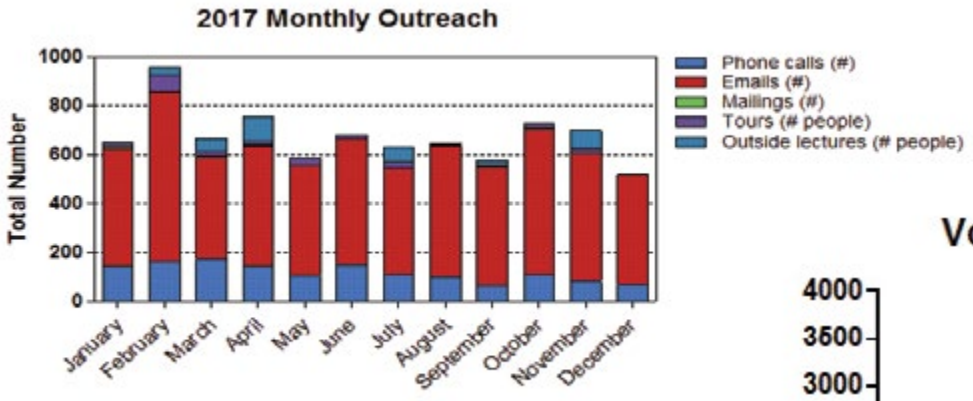


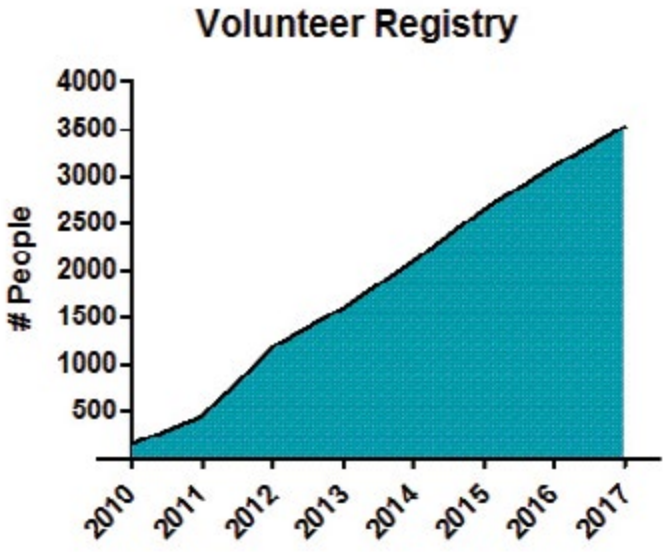
The Miami Project believes that an important component of developing treatments for paralysis involves communication with the community. The Education department, directed by Kim Anderson-Erisman, Ph.D., is responsible for helping thousands of our community members each year. The other valuable members of the department are Maria Chagoyen, Danielle Cilien, and Katie Gant, Ph.D. Each year the department answers thousands of phone calls and emails to provide people with information about all of our research programs and clinical studies as well as provide information about rehabilitation resources, clinical care referral, resources for living with paralysis, and advice about research from around the world. We also conduct numerous tours and lecturers about our research. The graph shows the total number of people interacted with each month during 2017 outreach activities.

OUTREACH

TO THE COMMUNITY

The Education department also assists all of The Miami Project clinical research faculty with recruitment for their clinical studies and trials. To participate in research studies individuals must first complete an Intake form, which provides us with preliminary injury characteristics. Then you receive a phone call from us to discuss the studies that you pre-qualify for and determine whether you are interested in proceeding with any studies. If so, we set up an appointment for you to come to our research center for a neurologic exam ("ASIA") and introduction to the laboratories. The graph shows the cumulative number of individuals since 2010 that have volunteered to be contacted regarding research studies for which they may qualify. To complete an Intake Form go to the following link: https://redcap.miami.edu/surveys/index.php?s=P9T87MYKH4. A big thank you to the on-site participants at our research center and online participants in surveys!





Teaching kids about spinal cord injury at the Brain Fair.

Catching up with friends at the Working 2 Walk meeting.

On February 4, 2017 the Education department participated in the Miami-Dade STEAM (Science, Technology, Engineering, Art, and Mathematics) EXPO as part of the Brain Fair. We hosted a spinal cord injury exhibit, which provided hands-on and interactive activities to teach the public of all ages about how the spinal cord interacts with the brain and controls the body. This was demonstrated with examples of what functions are lost when the spinal cord is injured in different areas.

On October 12, 2017 the Education department participated in the inaugural meeting of the North American SCI Consortium (NASCIC). The NASCIC has the mission to bring about unified achievements in research, care, and policy by supporting collaborative efforts across the spinal cord injury community. The purpose of the Consortium is to bring together the many organizations in North America that advocate, represent, or communicate with people living with SCI, their family, and caregivers. Representatives from over 30 organizations and sponsors participated in the meeting and by the end of the day the NASCI Consortium was officially launched! NASCIC now has a charter under which it operates and an Executive Council leading the way. Members of the Executive Council are: President, Kim Anderson; Vice-President, John Chernesky; Treasurer, Barry Munro; Delegates, Jen French, Sasha Rabchevsky, Matthew Rodreick, Rob Wudlick.

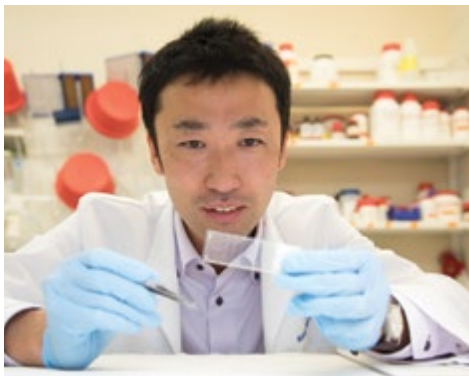
On April 21, 2018 the Education department will host the 7th Annual Miami Project Community Open House. **We enjoy this opportunity to open up our doors to the public to answer questions and share information, as well as to hear direct input from our community.** If you have questions, don't hesitate to email us at mpinfo@med.miami.edu or call us at 305-243-7108.

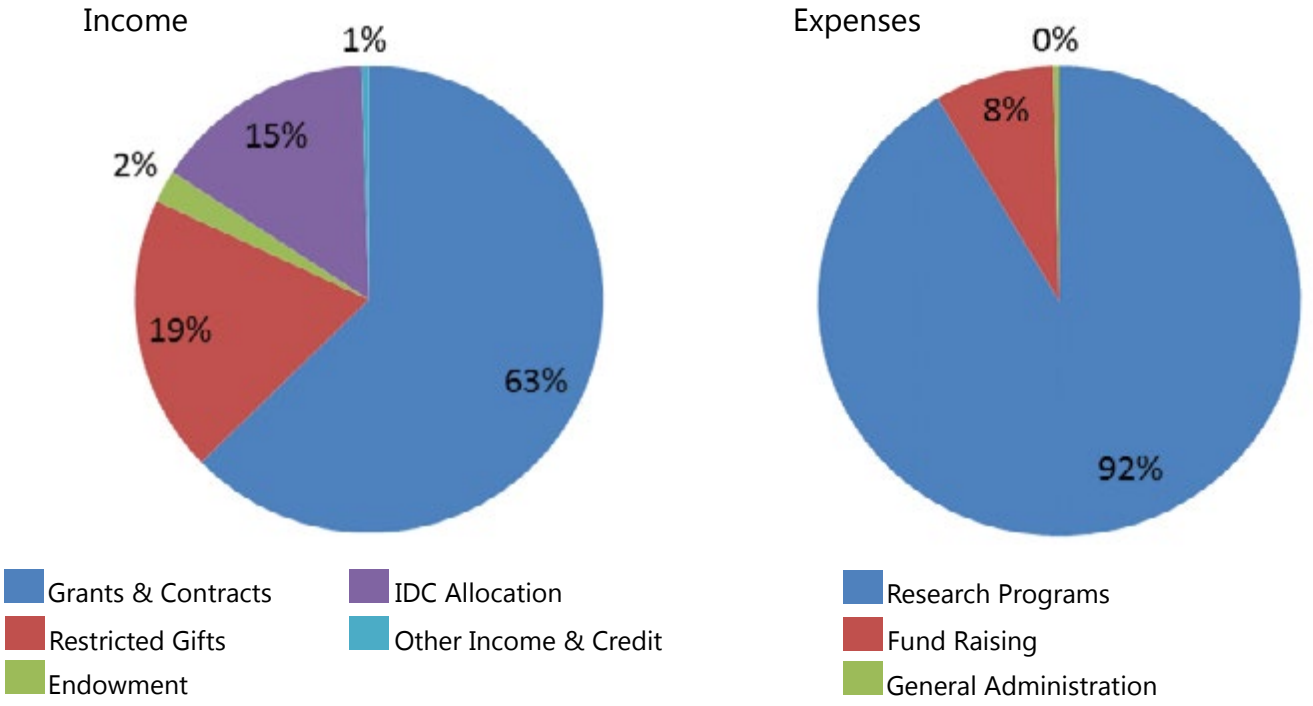
Participants of the inaugural North American Spinal Cord Injury Consortium.

Research Funding

Each year, Miami Project scientists seek funding for their research by submitting proposals to the National Institutes of Health, the premier scientific body in the United States, as well as other funding agencies and foundations.

Their scientific peers rate the merits of these proposed experiments in a highly competitive process and only the best are funded. The agencies and organizations listed below supported the Principal Investigator(s) and the scientific project(s) indicated during 2017.





Bryon Reisch Foundation
Dr. Kim Anderson-Erisman (P.I.)
-The Safety of Autologous Human Schwann Cells in Subjects with Chronic SCI Receiving Rehabilitation – Screening

Charcot-Marie-Tooth Association
Dr. Paula Monje (P.I.)
-Effect of Agents With Known Activity on PMP22 in Primary Human Schwann Cells

Christopher & Dana Reeve Foundation
Dr. James Guest (Center P.I.), Dr. Howard Levene (Co-I.)
-North American Clinical Trials Network and the Riluzole in Spinal Cord Injury Study

Craig H. Neilsen Foundation
Dr. Kim Anderson-Erisman (P.I.)
-Miami Project Education Program

Dr. Nancy Brackett (P.I.), Dr. Charles Lynne (Co-I.), Dr. Emad Ibrahim (Co-I.), Dr. Kim Anderson-Erisman (Co-I.) -*Management of Infertility in Men with SCI: An Educational Program for Practitioners and Clients*

Dr. Catherine Craven (P.I.), Dr. Mark Nash (Co-I.), Dr. Kim Anderson-Erisman (Co-I.)
-Statin Monotherapy for Treatment of Endocrine Metabolic Disease Risk

Dr. James Guest (P.I.)
-Neuroprotective Effects of Internal Decompression of the Spinal Cord

Dr. Paula Monje (P.I.)
-Identity-function Definitions for Transplantable Human Schwann Cells

Dr. Mark Nash (P.I.)
-A Time-Course Study of Experimental Cardiometabolic Risk/Disease after SCI

Dr. Martin Oudega (P.I.)
-Restoring Motor Axon Circuits After Spinal Cord Injury

Dr. Monica Perez (P.I.)
-Corticospinal Excitability of Leg Muscles After Spinal Cord Injury

Dr. Monica A. Perez (Mentor)
-Movement Asymmetries Following Spinal Cord Injury (Fellowship)

Dr. Christine Thomas (P.I.)
-Weakness and Fatigue with Age after Spinal Cord Injury

Conquer Paralysis Now
Dr. Mary Bartlett Bunge (Co-P.I.), Dr. Christine Schmidt (Co-P.I.)
-A New Injectable Matrix to Maximize Schwann Cell Transplantation Efficacy Following Spinal Cord Injury

Danish Medical Research Council
Dr. Roberta Brambilla (Co-P.I.), Dr. Kate Lambertsen (Co-P.I.)
-Microglial-derived Transmembrane TNF Versus Soluble TNF: The Good and the Bad?

Department of Defense (DOD) Spinal Cord Injury Research Program of the Office of the Congressionally Directed Medical Research Programs
Dr. Treena Arinzeh (P.I.), Dr. Mary Bartlett Bunge (Site-P.I.)
-A Combination Tissue Engineering Strategy for Schwann Cell-Induced Spinal Cord Repair

Dr. Rachel Cowan (P.I.)
-Fitness and Independence After SCI: Defining Meaningful Change and Thresholds

Dr. W. Dalton Dietrich (P.I.), Dr. Michael Wang (Partner P.I.)
-Biomarkers for Spinal Cord Injury-Related Medical Complications

Dr. Jonathan Jagid, (P.I.), Dr. Ian Hentall (Co-I.), Dr. Alberto Martinez-Arizala (Co-I.), Dr. Eva Widerström-Noga (Co-I.)
-Treatment of Pain and Autonomic Dysreflexia in Spinal Cord Injury with Deep Brain Stimulation

Dr. Jae Lee (Co-P.I), Dr. Nagi Ayad (Co-P.I.)
-Epigenetic Pathways in Spinal Cord Injury

Dr. Allan Levi (P.I.)
-Systemic Hypothermia in Acute Cervical Spinal Cord Injury – A Prospective Case Controlled Study

Dr. Brian Noga (P.I.), Dr. James Guest (O.Q.I.), Dr. Jonathan Jagid (Co-I.)
-Gait Ignition Using DBS Following SCI

Dr. Damien Pearse (P.I.), Dr. Howard Levene (Partner P.I.)
-Translation of Novel PDE4 Inhibitors for the Treatment of Acute Spinal Cord Injury

Dr. Jacqueline Sagen (P.I.)
-Engineered Neural Progenitor Transplants in Combination with Exercise to Maximize Neuropathic Pain Reduction Following SCI

Dr. Shirin Shafazand (Co-P.I.), Dr. Mark S. Nash (Co-P.I.)
-Neuro-cognitive Decline and Sleep-Disordered Breathing After SCI

Dr. Eva Widerström-Noga (P.I.), Dr. Kim Anderson-Erisman (Co-I.), Dr. Alberto Martinez-Arizala (Co-I.)
-Perspectives in Management of Severe Neuropathic Pain After a Spinal Cord Injury

Department of Defense (DoD) Psychological Health and Traumatic Brain Injury Program of the Office of Congressionally Directed Medical Research Programs
Dr. M. Ross Bullock (P.I.)
-Preclinical Evaluation of FDA Approved Human Neural Stem Cells in a Rat Model of Severe Traumatic Brain Injury

Dr. W. Dalton Dietrich (P.I.), Dr. Helen Bramlett (Co-I.)
-Operation Brain Trauma Therapy Extended Studies

-The Importance of Temperature in the Pathophysiology of Mild Repetitive Brain Injury

Dr. W. Dalton Dietrich (P.I.), Dr. Helen Bramlett (Co-I.), Dr. Thomas Sick (Co-I.)
-The Use of Pro-Neurogenic Molecules to Promote Recovery of Function Following Acute and Chronic Traumatic Brain Injury

Dr. Eva Widerström-Noga (P.I.)
-Utility of MRS Brain Biomarkers of Pain Phenotypes after TBI

FISM Fondazione Italiana Sclerosi Multipla (Italian Multiple Sclerosis Foundation)
Dr. Roberta Brambilla (P.I.)
-Molecular Mechanisms of the Protective Function of Oligodendroglial TNFR2: A New Therapeutic Target in Neuro-immune Disease

Florida Department of Transportation
Dr. Gillian Hotz (P.I.)
-Transportation Alternative Program: School Age Pedestrian and Bicycle Education and Injury Prevention Program in MDC

-Safe Routes to School: WalkSafe & BikeSafe Pedestrian and Bicycle Safety Program in the State of Florida

International Spinal Research Trust
Dr. Stuart Baker, Dr. Monica A. Perez (Co-Mentors)
-Improving Grasp in Spinal Cord Injury Via a Wearable Electronic Device (Fellowship)

Mazor Robotics
Dr. Michael Wang (Site P.I.)
-ADDRESS: Adult Deformity Robotic

vs. Freehand Surgery to Correct Spinal Deformity

-MIS ReFRESH: Robotic vs. Freehand Minimally Invasive Spinal Surgeries

National Eye Institute

Dr. Ivanov Dmitri (P.I.), Dr. Kevin Park (Co-I.)
-Mechanisms of Toll-like Receptor-mediated Neurotoxicity in the Ischemic Retina

Dr. Abigail Hackam (P.I.), Dr. Kevin Park (Co-I.)
-Mechanisms of Optic Nerve Regeneration

Dr. Kevin K. Park (P.I.)
-Regeneration and Reconnection of Damaged Optic Nerve

-Development and Characterization of Guided Optic Nerve Regeneration

Dr. Kevin Park (Co-P.I.), Dr. Sanjoy Bhattacharya (Co-P.I.), Dr. Vance Lemmon (Co-P.I.)
-Novel Targets to Promote RGC Axon Regeneration: Insights from Unique RGC Cohorts

National Institute of Child Health and Human Development

Dr. Vance Lemmon (Co-P.I.), Dr. John Bixby (Co-P.I.)

-Novel Gene Targets for CNS Axonal Regeneration

National Institute on Disability, Independent Living, and Rehabilitation Research

Dr. Michael Boninger (P.I.), Dr. Kevin Dalal (Site P.I.), Dr. Rachel Cowan (Site Co-P.I.)

-Collaboration on Mobility Training

Dr. Elizabeth Felix (P.I.), Dr. Mark Nash (Co-P.I.), Dr. Diana Cardenas (Co-I.), Dr. Rachel Cowan (Co-I.), Dr. Eva Widerström-Noga (Co-I.)

-South Florida Spinal Cord Injury Model Systems

Dr. Mark Nash (P.I.), Dr. Kim Anderson-Erisman (Co-I.), Dr. Rachel Cowan (Co-I.), Dr. Eva Widerström-Noga (Co-I.)
-A Lifestyle Intervention Targeting Enhanced Health and Function for Persons with Chronic SCI in Caregiver/Care-Receiver Relationships: Effects of Caregiver Co-Treatment

Dr. William Z. Rymer (P.I.), Dr. Monica Perez (Site P.I.), Dr. Rachel Cowan (Site Co-I.)
-A Multi-Center Clinical Trial to Evaluate the Effectiveness of Intermittent Hypoxia Therapy in Individuals with Spinal Cord Injury

Dr. Heather Taylor (P.I.), Dr. Eva Widerström-Noga (Co-I.)
-The Relations among Pain, Depression, and Resilience and their Prediction of Life Satisfaction in Men and Women with Spinal Cord Injury

National Institute of Heart, Lung and Blood

Dr. Stephan Schurer (P.I.), Dr. Vance Lemmon (Co-I.)

-Data Coordination and Integration Center for LINCS-BD2K

National Institute of Neurological Disorders & Stroke

Dr. Kim Anderson-Erisman (Co-P.I.), Dr. W. Dalton Dietrich (Co-P.I.)

-NIH Neurotrauma Summer Research Experience Program

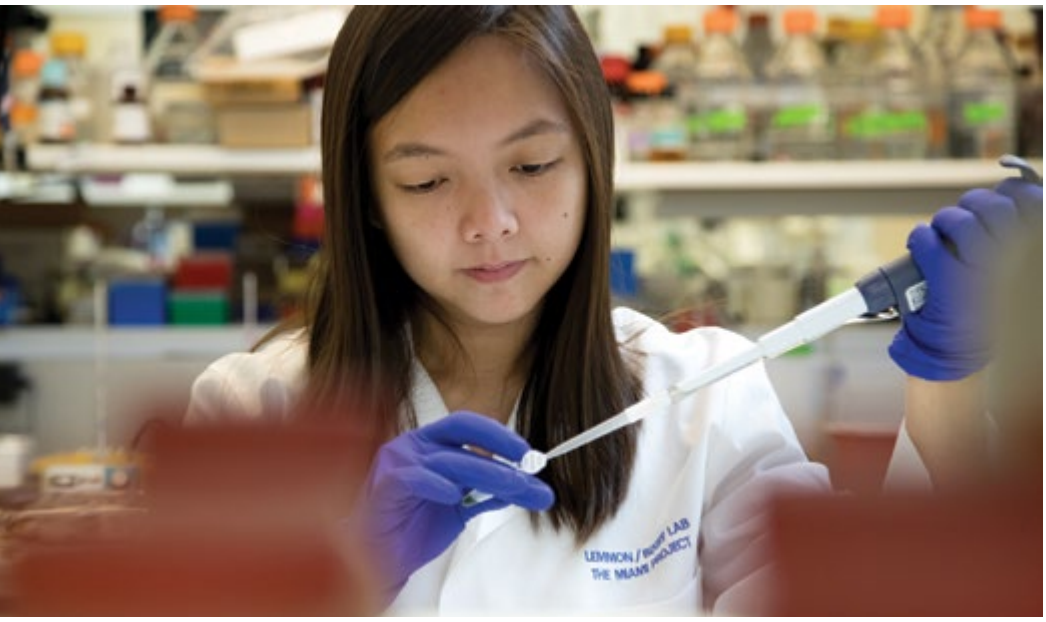
Dr. Coleen Atkins (Sponsor P.I.)
-The Role of Phosphodiesterase 4B in Inflammation after Trauma (Fellowship)

Dr. Coleen Atkins (Co-P.I.), Dr. W. Dalton Dietrich (Co-P.I.)
-Cyclic Nucleotide Regulation in Traumatic Brain Injury

Dr. Coleen Atkins (P.I.), Dr. Thomas Sick (Co-I.)
-Rehabilitation Strategies for Memory Dysfunction after Traumatic Brain Injury

Dr. Nagi Ayad (P.I.)
-Epigenetic and Kinase Pathway Interactions in Medulloblastoma

Dr. Mary Bartlett Bunge (Co-P.I.), Dr. John Bethea (Co-P.I.), Dr. Ian Hentall (Co-



I.), Dr. Paula Monje (Co-I.), Dr. Kevin Park (Co-I.), Dr. Patrick Wood (Co-I.)
-Cytological Studies of Developing and Mature Neurons

Dr. Roberta Brambilla (P.I.), Dr. Juan Pablo De Rivero Vaccari (Co-I.)
-Molecular Mechanisms of the Protective Function of Oligodendroglial TNFR2: A New Therapeutic Target in Neuro-immune Disease

Dr. Helen Bramlett (Co-P.I.), Dr. W. Dalton Dietrich (Co-P.I.), Dr. Daniel Liebl (Co-I.)
-A Novel Combination Strategy for Protection and Repair After TBI

Dr. W. Dalton Dietrich (P.I.), Dr. Helen Bramlett (Co-I.), Dr. Juan Pablo De Rivero Vaccari (Co-I.)
-The Importance of Temperature on the Inflammatory and Microvascular Consequences of Mild TBI

Dr. W. Dalton Dietrich (Co-P.I.), Dr. Robert Keane (Co-P.I.), Dr. Juan Pablo De Rivero Vaccari (Co-I.)
-Therapeutic Neutralization of the Inflammasome after Spinal Cord Injury

Dr. Edelle Field-Fote (P.I.), Dr. Eva Widerström-Noga (Co-I.)
-Dose-response Effects of Whole Body Vibration on Spasticity and Walking in SCI

Dr. Weiyong Gu (P.I.), Dr. Howard Levene (Co-I.)
-Modeling of Intervertebral Disc Degeneration

Dr. Gillian Hotz (Site-P.I.), Dr. Ross Bullock (Site Co-P.I)
-Transforming Research and Clinical Knowledge in Traumatic Brain Injury

Dr. Jae Lee (P.I.)
-Role of Fibroblasts in Axon Regeneration After SCI

-Targeting Lipid Clearance Pathways to Promote Repair After SCI

Dr. Vance Lemmon (Co-P.I.), Dr. John Bixby (Co-P.I.), Dr. Hassan Al-Ali (Co-.I.),
-Targeting Multiple Kinases to Treat Experimental Spinal Cord Injury

Dr. Vance Lemmon (Co-P.I.), Dr. John Bixby (Co-P.I.), Dr. Stephan Schürer (Co-P.I.)
-Regenbase: A Searchable Database to Organize Regeneration Knowledge via Ontologies

Dr. Daniel Liebl (P.I.)
-Stabilizing the Tripartite Synaptic Complex Following TBI

-Modulating Post-Injury Gliotransmitter levels Leads to Improved Synaptic Function (Fellowship)

Dr. Brian Noga (P.I.), Dr. James Guest (Co-P.I.), Dr. Jonathan Jagid (Co-I.)
-Gait Ignition After SCI

Dr. Martin Oudega (P.I.)
-Mechanisms of 6-AN Facilitated Schwann Cell-Astrocyte Intermingling

Dr. Monica Perez (P.I.), Dr. Christine Thomas (Co-I.)
-Corticospinal Function After Human Spinal Cord Injury

Dr. Gaofeng Wang (P.I.), Dr. Mary Bartlett Bunge (Co-I.)
-Epigenetic Prevention of Diabetic Neuropathy by Vitamin C

National Multiple Sclerosis Society

Dr. Jae Lee (P.I.)
-Mechanisms of Fibrosis After Experimental Autoimmune Encephalomyelitis

New Jersey Commission on Spinal Cord Injury

Dr. Treena Arinzeh (Co-PI.), Dr. Mary Bartlett Bunge (Co-P.I.)

-Testing Proteoglycan Subunits for Axon Growth Permissivity/Inhibition

Dr. Ki Bum Lee (P.I.), Dr. Jae Lee (Co-I.)
-A Biodegradable Nanoscaffold for the Co-Delivery of Patient Derived Neural Stem Cells and BET Inhibitor for Anti-Inflammation and Synaptic Restoration Post-SCI

Paralyzed Veterans of America
Dr. Monica A. Perez (Mentor)
-Cortical Plasticity After Spinal Cord Injury (Fellowship)

Pfizer, Inc.
Dr. Michael Wang (Site P.I.)
-STRIVE: Staphylococcus Vaccine Trial for Elective Spinal Surgery

Scythian Biosciences
Dr. Gillian Hotz (P.I.)
-The Effects of Cannabinoids on MTBI

State of Florida
Dr. Jacqueline Sagen (P.I.)
-Design of Inflammation-Driven Regulatable Gene Therapy for Management of Neuropathic SCI Pain

State of Florida, James and Esther King Biomedical Research
Dr. Helen Bramlett (P.I.), Dr. W. Dalton Dietrich (Co-I.)
-Whole Body Vibration Improves Stroke Outcome

Dr. W. Dalton Dietrich (P.I.)
-The Therapeutic Effect of P7C3-A20 on Stroke

State of Florida Brain and Spinal Cord Injury Program, Department of Health, and Red Light Camera Fund
-These three state funds contribute to several research programs within The Miami Project to Cure Paralysis

The Childhood Brain Tumor Foundation
Dr. Nagi Ayad (P.I.)
-A Novel CK1δ/Brd4 Pathway for the Treatment of Medulloblastoma

UM Dean's Bridge Funding Program
Dr. Daniel Liebl (P.I.)
-A Novel Mechanism of Cell Death in the Traumatic Injured Brain

Dr. Nagi Ayad (P.I.)
-Epigenetic and Kinase Pathway Interactions in Medulloblastoma

UM Equipment Funding Program
Dr. Daniel Liebl (P.I.)
-Stabilizing the Tripartite Synaptic Complex Following TBI

UM Scientific Advisory Council Award
Dr. Jae Lee (P.I.)
-BET Proteins as Epigenetic Regulators of Spinal Cord Injury Pathogenesis

Dr. Kevin K. Park (Co-P.I.), Dr. Hassan Al-Ali (Co-P.I.)
-In Vivo Screening to Identify Neuroprotective Compounds for Treating Optic Neuropathy

Veterans Administration Rehabilitation Research and Development
Dr. Christopher Cardozo (P.I.), Dr. Helen Bramlett (Co-I.)
-Role of Ryanodine Receptor Dysfunction

Dr. Mousumi Ghosh (P.I.), Dr. Damien Pearse (Co-P.I.), Dr. Jacqueline Sagen (Co-P.I.)
-Modulating Microglial Phenotype to Prevent SCI-induced Central Neuropathic Pain

Dr. Michael Norenberg (P.I.), Dr. Helen Bramlett (Co-I.)
-Chronic Traumatic Encephalopathy: Role of Astrocytes

Dr. Martin Oudega (Co-P.I.), Dr. Monica Perez (Co-P.I.)
-Maximizing Spike Timing-Dependent Plasticity After Spinal Cord Injury

Dr. Damien Pearse (P.I.), Dr. Moushumi Ghosh (Co-I.)
-Enhancing the Reparative Efficacy of Schwann Cells Following Chronic SCI

Dr. Monica Perez (P.I.)
-Enhancement of Hand Motor Function After Cervical Spinal Cord Injury

Dr. Monica A. Perez (P.I.)
-Grasping Function After Spinal Cord Injury

Dr. Weiping Qin (P.I.), Dr. Helen Bramlett (Co-I.)
-Novel Pharmacological and Non-pharmacological Interventions for Bone Loss in SCI

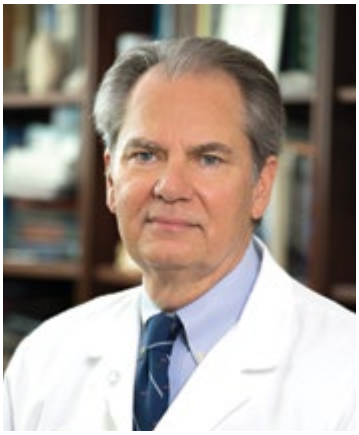
Vivian L. Smith Foundation for Neurologic Research
Dr. Jonathan Jagid (Site-P.I.)
-Hypothermia for Patients requiring Evacuation of Subdural Hematoma (HOPES) Trial

Wallace H. Coulter Foundation
Dr. Hassan Al-Ali (P.I.), Dr. John L. Bixby (Co-I.), Dr. Vance P. Lemmon (Co-I.),
-Developing a Multi-Target Small-Molecule Drug for Treating CNS Injuries

The Miami Project To Cure Paralysis

Faculty

The faculty of The Miami Project are a talented multidisciplinary team. In the following profiles, each faculty member describes their specific research focus and highlights of recent progress.



W. DALTON DIETRICH, PH.D.
Scientific Director
Kinetic Concepts Distinguished Chair in Neurosurgery
Senior Associate Dean for Discovery Science
Professor, Departments of Neurological Surgery, Neurology, and Cell Biology

Neuroprotection and Improved Recovery of Function following CNS Trauma

My research interest is the pathobiology and treatment of CNS injury in both the acute and chronic setting. Animal models of spinal cord injury, traumatic brain injury, and stroke are utilized to investigate the cellular and molecular mechanisms of tissue injury. The ultimate goal is to target secondary injury processes for various interventions that may protect vulnerable cell types or promote reparative processes to enhance neuroprotection, circuit plasticity, and recovery of function. The use of therapeutic hypothermia and targeted temperature management in preclinical and clinical settings is currently a focus of discovery and clinical investigations in the laboratory.

ALLAN D. LEVI, M.D., PH.D., F.A.C.S.
Robert. Buck Distinguished Chair in Neurological Surgery
Professor, Departments of Neurological Surgery, Orthopedics, and Physical Medicine & Rehabilitation
Chairman, Department of Neurological Surgery
Chief of Neurosurgery, Jackson Memorial Hospital

Cellular Transplantation Strategies after SCI/Systemic Hypothermia after Acute SCI

My clinical research interests currently focus on developing cellular transplantation strategies to repair injuries within both the human central and peripheral nervous system. I am currently Co-PI on our clinical trial "Transplantation of Autologous Human Schwann Cells (SCs) to Repair the Injured Spinal Cord - Phase I - safety study". This represents a first-in-man dose escalation study of autologous human SCs for patients with sub-acute thoracic SCI (T3 to T11). We are also very interested in the use of SCs for peripheral nerve injuries with long segmental defects and have performed such transplantations in patients with acute sciatic nerve injuries. Hypothermia continues to show promise in a variety of acute central nervous system injuries. There are various factors that need to be considered with systemic cooling of the SCI patient, including methods of cooling, window from injury to initiation, duration and depth of hypothermia, rate of re-warming, etc. While profound levels of hypothermia (T <32°C) can be difficult to administer and are subject to increased complication rates, mild (modest) levels of hypothermia (T 32-34°C) have been shown to provide significant protection against traumatic and ischemic neuronal cell death. I am currently the PI of our institutional protocol as well as a multi-center Department of Defense funded randomized trial studying systemic hypothermia induced via an intravascular catheter and continued for 48 hours after acute cervical SCI.

BARTH A. GREEN, M.D., F.A.C.S.

Professor of Neurological Surgery, Neurology, Orthopaedics, and Rehabilitation
Co-Founder and Chairman, The Miami Project to Cure Paralysis
Executive Dean for Global Health and Community Service

Translational Interventions

Over the recent years my research efforts have mainly involved taking the cutting edge basic neuroscience work product and data created by our Miami Project team from the bench to our UM affiliated clinics and hospitals. A good example of such translational research efforts has included the use of modest hypothermia for neuroprotection both in cases of acute spinal cord injury and for use in the operating room for patients undergoing high risk spinal cord surgery. I am also privileged to be able to collaborate with The Miami Project cellular transplantation programs and have been working on projects involving adult mesenchymal stem cells as well as being part of the major effort transforming our successful Schwann cell laboratory model into clinical trials. Other areas of research and clinical interest include the diagnosis and treatment of tethered cord syndrome, spinal cord cysts, and Chiari I malformation.

MARY BARTLETT BUNGE, PH.D.

Christine E. Lynn Distinguished Professor in Neuroscience
Professor Emeritus, Departments of Cell Biology, Neurological Surgery, and Neurology

Development of Combination Strategies with Schwann Cells to Repair the Injured Spinal Cord

The goal in my laboratory is to foster regeneration of axons across and beyond a spinal cord injury (SCI). To improve regeneration of axons, we are investigating reducing the accumulation of proteoglycans (molecules that inhibit axonal growth), improving survival of transplanted Schwann cells (SCs), genetically engineering SCs before transplantation to improve their growth factor-secretion capability or neurons to enhance their ability to regrow axons, and testing matrices (in which the SCs are transplanted) for efficacy after injury. We pay particular attention to the interfaces between the SC implant and the host spinal cord.

JOHN BIXBY, PH.D.

Professor, Departments of Molecular & Cellular Pharmacology and Neurological Surgery, Center for Computational Science, Hussmann Institute for Human Genomics, Sylvester Cancer Center
Vice Provost for Research

VANCE LEMMON, PH.D.

Walter G. Ross Distinguished Chair in Developmental Neuroscience
Professor, Department of Neurological Surgery, Center for Computational Science, Hussmann Institute for Human Genomics, Sylvester Cancer Center

High Content Screening and Functional Genomics of the Nervous System

Our laboratory has developed methods to test thousands of genes or chemicals in hundreds of thousands of neurons each week to obtain quantitative information about cell morphology and gene expression. This "high throughput" capability allows us to tackle questions about axon growth and regeneration using systems biology approaches, and to take them into animal models of injury. The Lemmon-Bixby lab has several ongoing projects related to axon regeneration. One project is to test the roles of known signaling proteins called protein kinases. In this screen we have tested >1600 kinase

inhibitors, many of which strongly promote neurite growth in vitro. Using bioinformatics, biochemistry, and machine learning we can identify critical kinases and their signaling networks as well as potential lead therapeutic compounds, one of which has proven active in two different models of spinal cord injury. A second project is based on the observation that injured peripheral sensory neurons initiate a genetic program appropriate for axonal regeneration. Our laboratory has combined next-generation sequencing with cell-based phenotypic screening to identify genes, especially transcription factors, and microRNAs that appear to regulate this genetic program, and is testing them in vitro and in vivo. Finally, in collaboration with Dr. S. Schürer, Dr. Ubbo Visser, and Drs. Nigam Shah and Alison Callahan (Stanford), we are developing RegenBase, an information system that includes an online tool for annotation of data and metadata, a knowledge base of diverse data on nerve regeneration, and an ontology that allows structured queries of the database.

HELEN M. BRAMLETT, PH.D.

Professor, Departments of Neurological Surgery and Psychology, Undergraduate Neuroscience Program Director, and Health Scientist Veterans Affairs

The Pathophysiology and Treatment of CNS Injury

The focus of my neurotrauma laboratory is to investigate both acute and long-term consequences of brain and spinal cord trauma. My current research interests are on the pathophysiology of traumatic brain and spinal cord injury with an emphasis on the pathogenesis of progressive white matter damage as well as the benefits of therapeutic hypothermia. My laboratory is also investigating mechanistic events leading to the development of posttraumatic epilepsy. Additionally, our current work is also focusing on complex traumatic brain injury models that mimic polytrauma as this type of injury has become more prevalent in combat areas.

M. ROSS BULLOCK, M.D., PH.D.

Professor, Department of Neurological Surgery

Director, Clinical Neurotrauma

Preclinical Mechanistic and Neuroprotection Research in Traumatic Brain Injury and Clinical Trials, and Neuromonitoring Techniques in the Injured Brain

We recently completed an extensive series of studies funded by the Department of Defense (DoD) to evaluate the neuroprotective effect of Perfluorocarbons in four rodent models of traumatic brain injury (penetrating brain injury, closed traumatic brain injury with secondary hypoxia, tissue culture with stretch injury, and mechanistic and safety studies). These oxygen carriers have shown benefit in previous studies involving fluid percussion injury and subdural hematoma models. Unfortunately, we could not demonstrate efficacy with 3 of the PFC's tested. We are also evaluating hypothermia neuroprotection, in humans and animals, using novel biomarkers. We are currently funded by the DoD to obtain efficacy and safety data with FDA approved human stem cells, transplanted into the rat brain, as therapy for Penetrating TBI.

ROBERT W. KEANE, PH.D.

Professor, Departments of Physiology & Biophysics, and Neurological Surgery

Regulation of Innate Immunity after CNS Trauma

Innate immunity is the first line of defense against pathogens and host-derived signals of cellular stress. My research focuses on investigating mechanisms that direct normal innate immunity and its dysregulation in central nervous system injury and disease, including (1) agonists and activation mechanisms of inflammasomes, (2) regulatory mechanisms that potentiate or limit inflammasome activation after injury, and (3) emerging data linking inflammasome proteins as biomarkers for CNS injury.

DANIEL J. LIEBL, PH.D.

Professor, Department of Neurological Surgery

Molecular Mechanisms that Regulate Cellular Dysfunction and Death Following CNS Injury, and Mechanisms to Promote Regeneration and Recovery

The goal of my laboratory is to identify the mechanisms that lead to CNS pathophysiology and its regenerative potential. We focus on growth and guidance molecules, which play important roles in the developing, regenerating, and injured nervous systems. Specifically, we are currently interested in areas of adult neurogenesis, neuroprotection, apoptotic cell death, synaptic plasticity, angiogenesis, regeneration, and therapeutic strategies. Overall, our approach is to develop novel strategies to minimize CNS damage and maximize regeneration/tissue repair, which can be best achieved through a comprehensive mechanistic approach.

MARK S. NASH, PH.D., F.A.C.S.M.

Professor, Departments of Neurological Surgery, Physical Medicine & Rehabilitation, Physical Therapy, and Kinesiology & Sports Sciences

Physiological Assessment of Secondary Complications following SCI: Electrical Stimulation, Cardiometabolic and Vascular Physiology, Cardioendocrine Pathology and Intervention, and Exercise and Nutritional Biochemistry

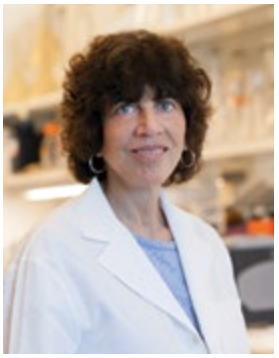
One of the enduring goals of The Miami Project has been to test and then translate strategies that optimize health of persons with SCI. A significant target for this strategy has focused on physical activity to lessen secondary risks of SCI associated with physical deconditioning. We also examine complementary themes to optimize exercise prescription after SCI, identify optimal nutritional intake, and use prescription and non-prescription agents that reduce hazards of fasting and postprandial lipid disorders, dysglycemia, and vascular inflammatory stress.

DAMIEN D. PEARSE, PH.D.

Professor, Department of Neurological Surgery

Exploration and Translation of Therapeutic Strategies to Repair the Injured Spinal Cord and Brain

My laboratory focuses on several key aspects of CNS injury repair, including (1) the utility and clinical translation of exogenous and endogenously harnessed cell therapeutics (particularly when used in combinatory approaches), (2) understanding the role of, and developing therapies for, altered cyclic AMP (adenylyl cyclase, phosphodiesterases, and PKA) and MAPK signaling in neurons and glia after CNS injury, (3) the use of nanotherapeutics for multifunctional and site-directed gene/drug targeting to the injured CNS, and (4) the application of methodologies for improved imaging of axonal regeneration and cell integration within the injured CNS such as 3D ultramicroscopy and diffusion tensor imaging.



JACQUELINE SAGEN, PH.D., M.B.A.

Professor, Department of Neurological Surgery

Cellular Implants and Gene Therapy for the Alleviation of Chronic Pain and CNS Injury

Our laboratory is exploring novel and more effective strategies in the therapeutic management of chronic debilitating pain. Our recent research is focused on (1) identification of more effective analgesic agents and combinations for alleviating pain using SCI and peripheral neuropathic pain models and (2) development of emerging therapeutic interventions, including cell transplantation and gene therapy, which have the potential to provide long-term alleviation in people with intractable pain, overcoming the need for repeated pharmacologic administration.

THOMAS J. SICK, PH.D.

Professor of Neurology and Physiology/Biophysics

Cellular and Neuronal Circuit Alterations after Traumatic Brian Injury That Contribute to Cognitive Decline and Epilepsy

My laboratory is conducting electrophysiological assessments of neuron and brain circuit alterations that occur after traumatic brain injury. Long-term clinical consequences of brain injury include declines in cognitive function and in many cases the development of epilepsy. We are trying to understand how circuits in the brain change over time after injury and how these changes might lead to alterations of brain function and behavior.

CHRISTINE K. THOMAS, PH.D.

Professor, Department of Neurological Surgery, and Physiology/Biophysics

Neuromuscular Weakness, Fatigue, Spasms, and Regeneration

Our laboratory is currently asking two main questions regarding SCI. First, in studies on people with SCI, we want to understand how age at SCI and SCI duration impact muscle strength because injured people report new declines in physical function at 45-50 years of age. Second, in our animal studies, we are exploring how to protect neurons from death because of SCI. Neuron death is common at the injury site and results in severe muscle weakness.

MICHAEL Y. WANG, M.D., F.A.C.S.

Professor, Departments of Neurological Surgery and Physical Medicine & Rehabilitation

Spinal Cord Injury Outcomes

My primary research has been in the investigation of SCI Outcomes. I work with Miami Project researchers Drs. Allan Levi and Barth Green in studying the clinical effects of Hypothermia. Currently, a multi-center randomized, prospective study on the effects of hypothermia in SCI is planned. In addition, I am studying the clinical application of SCI biomarkers to predict the effects of both injuries as well as therapeutic interventions with Drs. Dalton Dietrich and Ross Bullock.

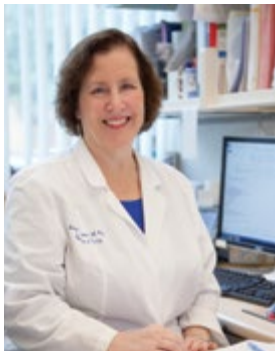
KIM ANDERSON-ERISMAN, PH.D.

Research Professor, Department of Neurological Surgery

Director of Education, The Miami Project to Cure Paralysis

Translational Investigations for Chronic Spinal Cord Injury

My research focuses on translational investigations and bridging the gap between basic science, clinical science, and the public community living with SCI. My current projects focus on 1) SCI consumer engagement in research, 2) determining the minimum amount of exercise and locomotor training required for clinical trials targeting chronic SCI, and 3) identifying the facilitators and barriers to clinical trial participation from the SCI consumer perspective. In addition, I direct our entire Schwann cell clinical trial program (5 trials) in collaboration with Dr. Levi.

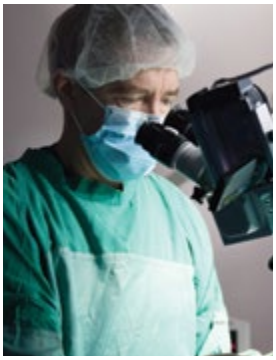


NANCY L. BRACKETT, PH.D., H.C.L.D.

Research Professor, Departments of Neurological Surgery and Urology

Male Fertility following Spinal Cord Injury

Our research is focused on understanding and improving impairments to male fertility which occur following SCI. A major aim is to determine the cause of impaired semen quality in men with SCI. Our recent evidence indicates that the problem is related to the seminal plasma. Our current research is investigating inflammatory factors, including semen cytokine levels, as contributors to the problem. Our ultimate goal is to develop therapies to normalize semen quality in men with SCI, so that chances of biological fatherhood are increased.



JAMES D. GUEST, M.D., PH.D., F.A.C.S., F.R.C.S.(C)

Clinical Professor, Department of Neurological Surgery

The Preclinical to Clinical Spectrum in Spinal Cord Injury Therapeutics: The Path to Clinical Testing and Establishing Clinical Evidence

Our SCI research spans preclinical proof-of-concept (POC) studies of therapeutics into early Phase, and pivotal clinical trials of SCI. We are translational scientists using a variety of clinically-relevant tools within the complex process of determining which potential human therapeutics have a probability of success in clinical trial testing. We use our experience and expertise to test combinations of cellular, molecular, tissue engineering and neuromodulatory therapeutics in large animal models. We have expertise in tissue physiologic monitoring, neurophysiology and kinematic analysis of gait. In addition, we have experience in device development and testing. The lab group has members and colleagues ranging from senior medical faculty to postdoctoral students, medical students, neurosurgery residents, and undergraduate students. This is a good setting for those trainees who aim for careers in neurologic therapeutics both in academia and industry and with an interest in how medical evidence is developed. We are simultaneously involved with animal and human studies across the translational spectrum including Phase 1-3 studies.

GILLIAN A. HOTZ, PH.D.

Research Professor, Department of Neurological Surgery

Director, KiDZ Neuroscience Center; Director, Concussion, WalkSafe™ & BikeSafe™Programs

Neurocognitive Deficits Associated with Brain Injury; Injury Prevention

As a behavioral neuroscientist my clinical interests have always been investigating the neurocognitive deficits of those individuals that have sustained a traumatic and acquired brain injury. I have co-authored two neurocognitive tests, The Brief Test of Head Injury for adults and the Pediatric Test of Brain Injury for children. My research has focused on developing evidenced based injury prevention programs in order to prevent brain and spinal cord injuries in children. In 2003, our team developed the WalkSafe program, which has been shown to decrease the number of elementary school age children that get hit by cars, and in 2009 we developed the BikeSafe program which educated middle school age children on bicycle safety skills. As the Director of the Concussion Program we have spent many years developing and implementing a comprehensive countywide high school sports concussion care program, which includes neurologic evaluation, neuroimaging, neuropharmacological management, neuropsychological testing, and baseline test with ImPACT, a computerized neurocognitive screening measure. We also have developed a Concussion Injury Surveillance system. Our program is multidisciplinary and assesses and treats athletes from all levels of play. I am also the PI on many local and federal grants: Safe Routes to School initiatives, Transportation Alternative Programs, GE/NFL MRI Phase 2 study, Brainscope EEG study, one of the TRACK TBI sites, and a new project that will study the Effects of Cannabinoids on Mild TBI.

ALBERTO MARTINEZ-ARIZALA, M.D.

Clinical Professor, Departments of Neurology, Neurological Surgery, and Physical Medicine & Rehabilitation

Chief, SCI Service Miami VA Medical Center

Pathophysiology and Treatment of Secondary Complications in Spinal Cord Injury

My research interests focus on common complications that are seen following spinal cord injury: pain, spasticity, syringomyelia, and tethered cord syndrome. My interests include investigating the basis for the development of the different spasticity and pain profiles in the spinal cord injured population and to study potential novel treatments for those conditions.

EVA WIDERSTRÖM-NOGA, D.D.S., PH.D.

Research Professor, Departments of Neurological Surgery, Physical Medicine & Rehabilitation, and Health Scientist Veterans Affairs

SCI-related Neuropathic Pain Phenotypes and Biomarkers

My research program is focused on the identification of clinical correlates of underlying mechanisms of neuropathic pain associated with neurological trauma in order to facilitate the translation of basic research findings to treatments tailored to specific mechanisms. We are also examining the personal experiences of people living with chronic pain and SCI to increase our understanding about factors that help or hinder obtaining optimal pain relief. My research program is highly collaborative and includes extensive interdisciplinary protocols for a multimodal evaluation of self-reported pain symptoms and its psychosocial impact, quantitative assessment of neurological function, and biomarkers including non-invasive brain imaging.

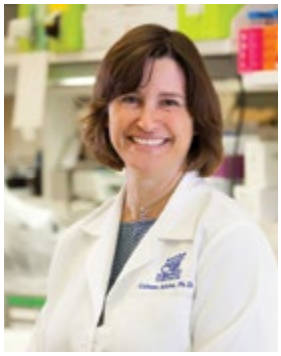
PATRICK M. WOOD, PH.D.

Research Professor (Retired), Department of Neurological Surgery

Changes in the Molecular and Biological Properties of Human Schwann Cells

Schwann cells have shown promise in animal studies in promoting recovery from SCI. We have developed protocols that allow the generation, from a small biopsy of human peripheral nerve, of large numbers of a person's own Schwann cells that can be transplanted back into their injured spinal cord. Efficient growth of human Schwann cells in culture requires the addition of recombinant neuregulin and the cAMP enhancer forskolin. To better understand the effects of these reagents on Schwann cells, we are performing basic research to determine the mechanisms by which neuregulin and cAMP enhancers promote interaction between axons and Schwann cells, including axon-induced proliferation and the formation of myelin sheaths.

COLEEN ATKINS, PH.D.



Associate Professor, Department of Neurological Surgery

Developing Novel Therapies for Traumatic Brain Injury and Spinal Cord Injury

The research in my laboratory focuses on developing novel therapeutic interventions for traumatic brain injury (TBI) and spinal cord injury (SCI). The research goal of my laboratory is to enhance rehabilitation and recovery by manipulating synaptic plasticity at specific levels of the neuroaxis following TBI and SCI. We have found that specific synaptic plasticity signaling pathways are altered after TBI and we are currently using pharmacotherapies to target those pathways to improve behavioral recovery after TBI.

NAGI AYAD, PH.D.

Associate Professor, Department of Psychiatry and Behavioral Sciences

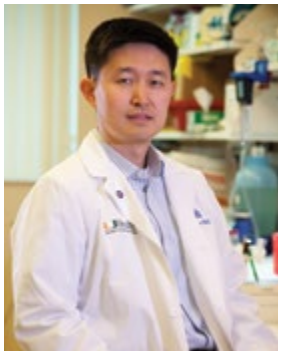
Epigenetic and Kinase Pathways in the Developing and Diseased Nervous Systems

The main research objective of the Ayad laboratory is to identify therapeutic combinations for nervous system disorders. These include brain cancers such as glioblastoma and medulloblastoma, as well as spinal cord injury and traumatic brain injury. We are working closely with chemists to generate novel brain/spinal cord penetrant epigenetic enzyme and kinase inhibitors. We are also working with the LINCS consortium to identify small molecules that target epigenetic and kinase pathways simultaneously. We collaborate with a large group of basic scientists and clinicians to move our small molecules into clinical trials. These include Dr. Ricardo Komotar, Dr. Michael Ivan, Dr. Antonio Omuro, Dr. Macarena de la Fuente, Dr. Nori Kasahara, Dr. Claes Wahlestedt, Dr. Stephan Schürer, Dr. Mary E. Hatten, Dr. Martine Roussel, and Dr. Jann Sarkaria for the brain tumor work, and Drs. Jae Lee, Vance Lemmon, and John Bixby for the spinal cord injury studies. Interestingly, we find that the same small epigenetic/kinase molecule inhibitors we are developing for brain cancer are effective in spinal cord injury as they reduce inflammation.

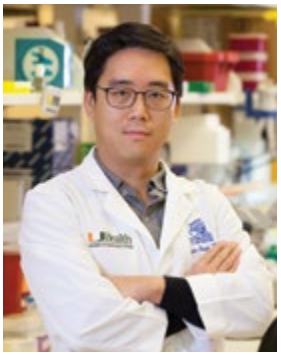
JAE K. LEE, PH.D.

Associate Professor, Department of Neurological Surgery

Promoting Proper CNS Wound Healing Response to Enhance Regeneration



The long term research goal in my laboratory is to elucidate the mechanisms of cellular interactions in the injured CNS that create an environment inhibitory to cellular regeneration. Similar to other tissue, injury to the CNS triggers a wound healing response characterized by inflammation, cellular proliferation, and matrix remodeling. Sometimes this wound healing response is incomplete and leads to tissue cavitation, while other times it is excessive and leads to scar formation (both gliotic and fibrotic). A better understanding of this scarring process will help identify novel therapeutic targets that can promote a more permissive environment for CNS regeneration.



KEVIN K. PARK, PH.D.

Associate Professor, Department of Neurological Surgery

Intrinsic Mechanisms of Axon Regeneration

My lab is interested in understanding mechanisms that account for axon growth, guidance and circuit formation in the central nervous system (CNS). Previously, I and others have identified several key proteins that regulate axon regeneration, which are present in mature CNS neurons. In my current research, I seek to better understand the cellular and molecular mechanisms governing axon growth and connectivity during development and in adults after injury, and to explore the potential of developing therapeutic strategies for spinal cord injury and other neurodegenerative conditions.

MONICA A. PEREZ, P.T., PH.D.

Associate Professor, Departments of Neurological Surgery, Biomedical Engineering, Physical Therapy, Health Scientist Veterans Affairs

Motor Control in Humans with and without Spinal Cord Injury

The focus of our research is on understanding how the brain and spinal cord contribute to the control of voluntary movements in humans with and without spinal cord injury. This theme is mainly investigated from a neurophysiological point of view, using a combination of transcranial magnetic stimulation (TMS), magnetic resonance imaging (MRI), and peripheral nerve stimulation techniques. The population of individuals with SCI is heterogeneous. The severity of

impairments depends on the site and extent of the injury. We use electrophysiological outcomes to design neuroplasticity protocols aiming to enhance functional outcomes. Current research projects focus on topics such as studying (1) the contribution of the primary motor cortex, the corticospinal system, and subcortical pathways to the control grasping, (2) the organization of paired-pulse TMS-induced indirect (I) waves, and (3) the use of spike-timing dependent plasticity to enhance the activity of residual corticospinal projections after spinal cord injury.

PANTELIS TSOULFAS, M.D.

Associate Professor, Departments of Neurological Surgery and Cell Biology & Anatomy

Neurotrophins: Specificity of Action

My laboratory is interested in two areas of neurobiology that are significant for developing new strategies for spinal cord injury repair. Over the past years, we have worked to modify neurotrophins that are better suited for use in SCI. We are also interested in understanding the processes involved in maintaining and differentiating neural stem cells.

IAN D. HENTALL, PH.D.

Research Associate Professor (Retired), Department of Neurological Surgery

Brainstem Influences on Neurotrauma

Our research is centered on the general idea that activity in brainstem neurons influences natural repair processes following brain or spinal cord injury, and indeed in many other neurodegenerative disorders, such as multiple sclerosis. Our main focus is to study in rodents how the prolonged electrical stimulation of these brainstem neurons influences functional and anatomical recovery in acute or chronic stages of neurodegeneration. This includes examining various molecular and cellular processes in damaged regions, and diverse types of impairment in visceral and behavioral functioning. Electrical deep brain stimulation in non-eloquent regions can potentially be used to promote long-lasting recovery in people with early or chronic injury.

JONATHAN R. JAGID, M.D.

Clinical Associate Professor, Department of Neurological Surgery

Interventions in SCI and TBI

My research includes projects investigating the use of Deep Brain Stimulation for spinal cord injury, novel brain machine interfaces to improve quality life in spinal cord injury, as well as hypothermia for traumatic brain injury. Presently, we are looking at the use of a novel Deep Bain Stimulation device modified to act as a brain machine interface in an effort to bypass spinal cord injury and restore cortically controlled limb movement. In traumatic brain injury, a prospective multicenter study is underway looking at the effects of modest hypothermia on the surgical evacuation of subdural hematoma's (HOPES Trial).

BRIAN R. NOGA, PH.D.

Research Associate Professor, Department of Neurological Surgery

Brain and Spinal Mechanisms Controlling Walking

Neuromodulation technologies are increasingly looked at as potential treatment options for paralysis associated with spinal cord injury (SCI). Deep brain stimulation is one such method that so far has had little or no application in persons with SCI even though most new and chronic injuries are incomplete. Recent work in our laboratory has pointed to a brain target for controlling walking. We are currently investigating the usefulness of stimulating this site to enhance walking in a translational large animal model of SCI.

MARTIN OUDEGA, PH.D.

Research Associate Professor, Department of Neurological Surgery

Bioengineering Cell-based Spinal Cord Repair

We employ animal models to better our understanding of the neuroanatomical and functional consequences of spinal cord injury and to use this information to generate and guide cell-based strategies to maximize functional recovery. Bioengineering principles are tightly integrated in our studies; the versatility of natural and artificial biomaterials offers important possibilities to address questions related to the failed or limited repair by cell transplants. The overall goal of our scientific efforts is to develop repair approaches that lead to significant anatomical restoration resulting in functional restoration after spinal cord injury that can be translated into the clinic.

ROBERTA BRAMBILLA, PH.D.

Assistant Professor, Department of Neurological Surgery

Modulation of the Neuro-Immune Response in Neurologic Disease

The main focus of my research is to understand the role of neuroinflammation in the pathophysiology of neurodegenerative disorders (e.g., multiple sclerosis, spinal cord injury and stroke), with a specific interest in the contribution of glial cells. We study astrocytes and microglia for their involvement in the neuro-inflammatory response to injury, and oligodendrocytes and oligodendrocyte precursor cells for their role in axon myelination, metabolic support of neurons and myelin repair. Currently, our primary lines of research in the area of neuroimmunology are centered on: (1) investigating the role of tumor necrosis factor and its receptors in the processes of neuroinflammation, demyelination and remyelination, and (2) understanding how mitochondrial dysfunction in oligodendrocytes may be involved in the etiopathology of multiple sclerosis.

HASSAN AL-ALI, PH.D.

Research Assistant Professor, Department of Neurological Surgery

Drug Discovery for CNS Repair

As a chemical and computational biologist, my lab focuses on identifying pharmacological targets that can induce robust axon regeneration in the injured central nervous system. To accomplish this, I developed a unique drug discovery platform that combines phenotypic screening, target-based profiling, and sophisticated machine learning algorithms. The methodology identified a promising lead compound that is now in preclinical drug development. We continue to develop this methodology into a modular platform to advance drug discovery in spinal cord injury, as well as in other therapeutic areas, including cancer and kidney disease.

RACHEL E. COWAN, PH.D.

Research Assistant Professor, Department of Neurological Surgery

Enhancement and Preservation of Maximal Transfer and Wheelchair Propulsion Ability

Our first focus is defining what level of fitness and 'skill' are required to independently perform transfers to and from the bed, car, shower, and ground and if these are different for various levels of SCI. Our second focus is defining how changes in fitness and wheelchair configuration can meaningfully reduce the effort required to propel a manual wheelchair and how these changes may differ by level of SCI.

JUAN PABLO DE RIVERO VACCARI, PH.D.

Research Assistant Professor, Department of Neurological Surgery

Underlying Mechanisms of the Innate Immune Response and Contributions to Various CNS Diseases

My research focuses on understanding early inflammatory events in central nervous system (CNS) injury. Currently, my laboratory is studying the effects of pattern recognition receptor (PRR)-activation after spinal cord injury (SCI), traumatic brain injury (TBI), and stroke. In addition, my laboratory studies how natural-aging produces inflammation in the brain, a phenomenon known as brain inflammaging, which potentially precedes the onset of age-related neurodegenerative diseases.

MOUSUMI GHOSH, PH.D.

Research Assistant Professor, Department of Neurological Surgery

Altering Host Glial Responses following CNS Injury and Disease to Promote Repair

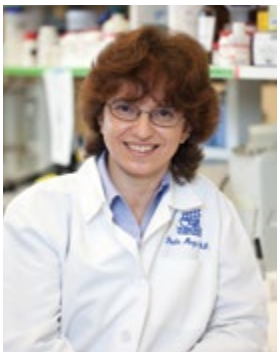
My research interests are focused on altering the hostile environment of the injured or diseased CNS to one that is conducive to repair through altering inflammation. Specifically our work focuses on delineating the intrinsic and extrinsic signals present after injury that antagonize the conversion of activated microglia and macrophages to a reparative phenotype in experimental models of CNS injury and disease. We are also interested in understanding how altering the immunophenotypical profile of macrophages and microglia can modulate spinal cord injury induced central neuropathic pain, affect host glial responses, including glial scar formation, as well as influence the ability of transplanted cells, such as Schwann cells and stem cells, to mediate neurorepair.

HOWARD B. LEVENE, M.D., PH.D., F.A.A.N.S.

Clinical Assistant Professor, Department of Neurological Surgery

Phosphodiesterase Inhibitors and Schwann Cell Transplantation after SCI

Secondary injury after spinal cord injury remains an active area for proposed therapy. With my co-PI Dr. Damien Pearse, we are investigating the effect of novel phosphodiesterase inhibitors after SCI. Phosphodiesterase inhibitors are proposed to sustain cAMP to abate cytotoxic processes during secondary injury, resulting in neuroprotection. Our work currently is transitioning from murine to porcine models. Another proposed therapy for spinal cord injury is to introduce cells to the injury site to help repair, restore, or support existing neurons. I worked with my colleagues on a large animal model to study the effect and behavior of transplanted autologous Schwann cells. I have been involved in the refinement of this animal model. This approach allows for the scientific study of the behavior of implanted cells and generates the groundwork for clinical trials. Research utilizing this model is done in collaboration with clinicians and scientists at the Miami Project such as Drs. Guest, Solano, Pearse, Wood, Bunge, and many more.



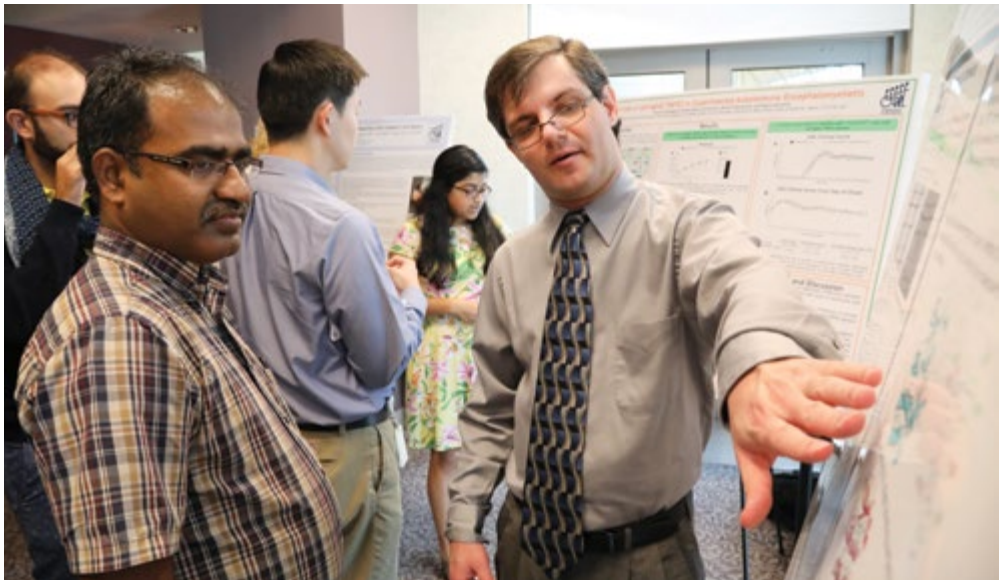
PAULA V. MONJE, PH.D.
Research Assistant Professor, Department of Neurological Surgery
Schwann Cell Biology and Their Applications in Cell Therapy
Work in my laboratory combines signal transduction research on mechanisms of Schwann cell differentiation and assay development strategies for the use of Schwann cells in cell therapy. We study the role of the second messenger cAMP in the reciprocal interactions between Schwann cells and neurons underlying the regulation of Schwann cell proliferation, myelination and repair. We also work on the development of new cellular platforms and laboratory assays to isolate, purify and characterize the phenotype and function of Schwann cells derived from human donors and experimental animals. One important goal is to improve the potency and myelinating capability of the cells in culture prior to transplantation in the central and peripheral nervous systems.

Summer Student Research

Students and young scientists beginning their careers gain skills from The Miami Project's state-of-the-art comprehensive research and academic environment.

A major role of The Miami Project is to provide education and training for the next generation of neuroscientists. Our long-term educational goal is to increase the number of scientists and laboratories working on paralysis research and central nervous system disorders around the world. Students and young scientists beginning their careers gain skills from The Miami Project's state-of-the-art comprehensive research and academic environment.

In 2017, Drs. Anderson-Erisman and Dietrich embarked on year five of a 5-year NIH Summer Student Research Grant, which enables a handful of stellar undergraduate students the opportunity to work in the laboratory of a Miami Project faculty member for ten weeks during the summer. Each week, the students attended two lectures and participated in one journal club, in addition to 37 hours of hands-on laboratory work (for a total of 40 hours each week). These twelve students wrote an abstract about their specific research project and presented a poster at the 7th Miami Project Summer Student Research Session on July 28, 2017.



Summer student, Justin Cropsey, presenting his research poster.

Summer students enjoying a picnic.

Summer students attempting an escape from studies.

Summer Students and Their Research Projects:

Name	Summer mentor	Summer project
Ahmed, Nida	Dr. Paula Monje	"Myelin Isolation, Purification and Labeling for use in Cell-Based Assays"
Balasubramanian, Aditi	Dr. Brian Noga	"The Characterization of Cholinergic Neurons within Brainstem Motor Pathways of the Micro Yucatan Pig"
Canizares, Melanie	Dr. Dalton Dietrich	"Role of Hyperthermia in Worsened Outcome After TBI"
Cropsey, Justin	Dr. Hassan Al-Ali	"Molecular Modeling and Cell-based Studies to Guide the Development of a Small-Molecule Drug for Promoting Axon Regeneration"
Dulla, Kireeti	Dr. Vance Lemmon	"Effect of Jun Dimers on Neurite Outgrowth"
Elias, Aura	Dr. Monica Perez	"Voluntary Activation of Elbow Extensors after Spinal Cord Injury"
Goo, Irene	Dr. Jae Lee	"Genetic Deletion of the Scavenger Receptor CD36 Delays Disease Onset in EAE Model of Multiple Sclerosis"
Hill, Andrea	Dr. Coleen Atkins	"The Role of Phosphodiesterase 4B Inhibition in Histopathology Following Traumatic Brain Injury"
Izabel, Sarah	Dr. Mousumi Ghosh	"Alteration of the Host Innate Immune Response Following Schwann Cell Transplantation into the Injured Spinal Cord"
Lavorgna, Tessa	Dr. Mark Nash	"The Effect of Exercise Conditioning on Autonomic Dysfunction After Spinal Cord Injury"
Manfrini, Denise	Dr. Damien Pearse	"Assessing Neurotrophin Receptor Localization on Axons"
Mudalegundi, Shwetha	Dr. Roberta Brambilla	"The role of astroglial TNFR2 in Experimental Autoimmune Encephalomyelietis"

Gail F. Beach Memorial Lecture Series

The Miami Project has brought many renowned neuroscientists from around the world to our campus as part of The Gail F. Beach Memorial Visiting Lectureship Series. The lectureship series is dedicated to Gail F. Beach, a schoolteacher and person with SCI, whose generosity and foresight provides outstanding educational opportunities for The Miami Project researchers and our neuroscience colleagues at the University of Miami.

October 4, 2017
Ben Emery, Ph.D.
Oregon Health and Science University – Portland, OR

November 1, 2017
Greg Lemke, Ph.D.
The Salk Institute for Biological Sciences – San Diego, CA

December 6, 2017
Ed Boyden, Ph.D.
Massachusetts Institute of Technology – Cambridge, MA

January 17, 2018|
Ona Bloom, Ph.D.
The Feinstein Institute for Medical Research – Manhasset, NY

February 7, 2018
Dana McTigue, Ph.D.
Ohio State University – Columbus, OH

March 14, 2018
Ki-Bum Lee, Ph.D.
Rutgers, The State University of New Jersey – Piscataway, NJ

May 1, 2018
Grégoire Courtine, Ph.D.
Swiss Federal Institute of Technology Lausanne – Geneva, Switzerland

Scientific Publications

Published studies that have passed the test of peer review are the benchmark of scientific progress. Listed here are the 2017 research publications by Miami Project scientists and colleagues.

Ahmad FU, Frenkel MB, Levi AD. (2017). Spinal stability after resection of nerve sheath tumors. *Journal of Neurosurgical Science.* 61(4):355-364.

Ahmad FU, Wang MY. (2017). Letter to the Editor. Percutaneous posterior cervical transfacet fixation. *Journal of Neurosurgery Spine.* 27(4):482-483.

Al-Ali H, Beckerman SR, Bixby JL, Lemmon VP. (2017). In vitro models of axon regeneration. *Experimental Neurology.* 287(Pt 3):423-434.

Al-Ali H, Ding Y , Slepak T, Wu W, Sun Y, Martinez Y, Xu XM, Lemmon VP, Bixby JL. (2017). The mTOR substrate S6 kinase 1 (S6K1) is a negative regulator of axon regeneration and a potential drug target for central nervous system Injury. *Journal of Neuroscience.* 37(30):7079-7095.

Al-Ali H, Gao H, Dalby-Hansen C, Peters VA, Shi Y, Brambilla R. (2017). High content analysis of phagocytic activity and cell morphology with PuntoMorph. *Journal of Neuroscience Methods.* 291:43-50.

Alberga L, Menendez I, Landy HJ, Morcos JJ, Levi AD. (2017). Neurosurgery at the University of Miami. *Journal of Neurosurgery.* 126(4):1285-1295.

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Alperin N, Loftus JR, Bagci AM, Lee SH, Oliu CJ, Shah AH, Green BA. (2017). Magnetic resonance imaging-based measures predictive of short-term surgical outcome in patients with Chiari malformation Type I: a pilot study. *Journal of Neurosurgery Spine.* 26(1):28-38.

Andersen ND, Monje PV. (In press). Isolation, culture, and cryopreservation of adult rodent Schwann cells derived from immediately dissociated teased fibers. Chapter 4. In: Monje P.V., Kim H.A (eds) Schwann cells: methods and protocols. *Methods in Molecular Biology*.

Anderson KD, Guest JD, Dietrich WD, Bartlett Bunge M, Curiel R, Dididze M, Green BA, Khan A, Pearse DD, Saraf-Lavi E, Widerström-Noga E, Wood P, Levi AD. (2017). Safety of autologous human Schwann cell transplantation in subacute thoracic spinal cord injury. *Journal of Neurotrauma.* 34(21):2950-2963.

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Atkins CM, Bramlett HM, Dietrich WD. (2017). Is temperature an important variable in recovery after mild traumatic brain injury? *F1000 Research.* 6:2031.

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PM, Guest JD, Dietrich WD, Bartlett Bunge M, Pearse DD. (2017). Human Schwann cells exhibit long-term cell survival, are not tumorigenic and promote repair when transplanted into the contused spinal cord. *Glia.* 65(8):1278-1301.

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Burks SS, Cajigas I, Jose J, Levi AD. (2017). Intraoperative imaging in traumatic peripheral nerve lesions: correlating histologic cross-sections with high-resolution ultrasound. *Operative Neurosurgery (Hagerstown).* 13(2):196-203.

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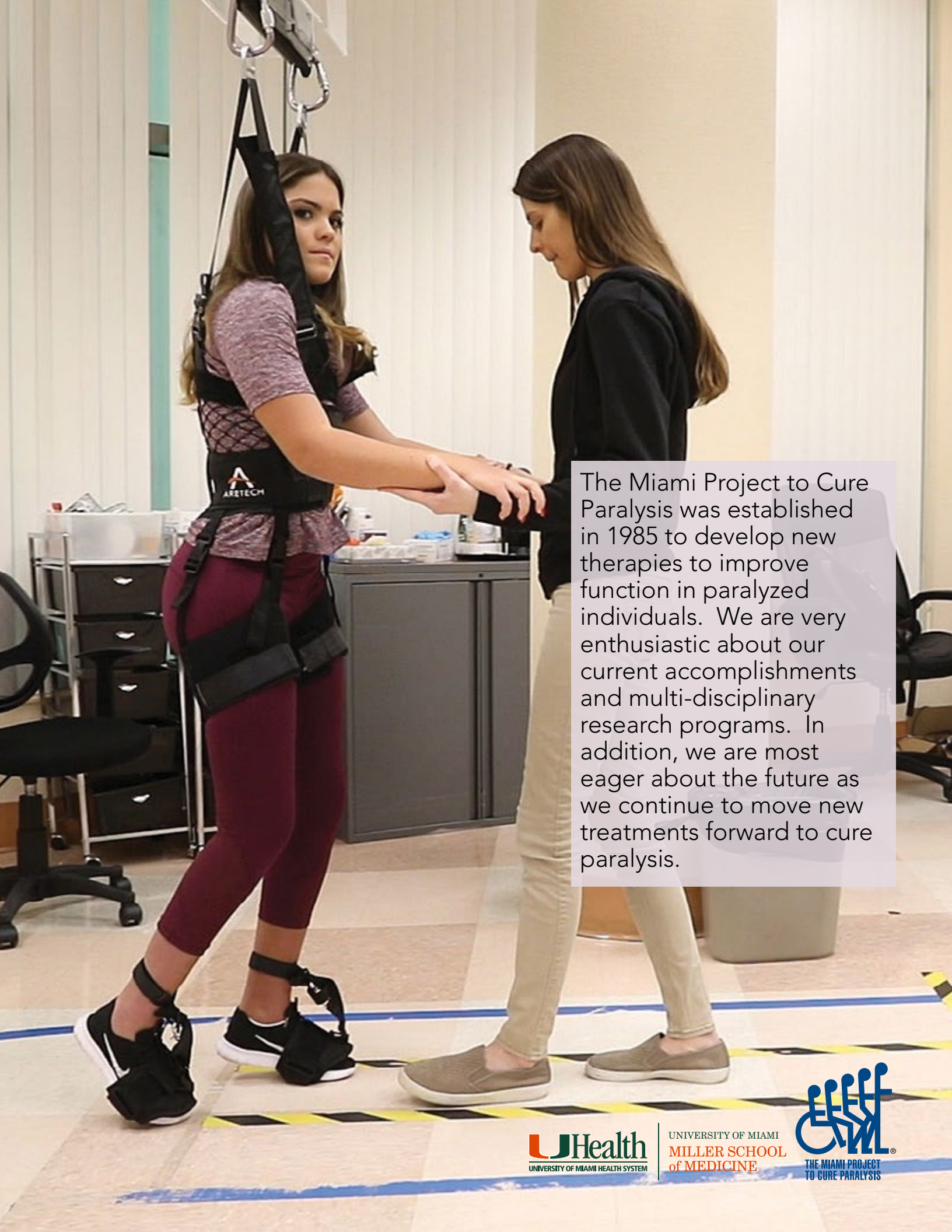

The Miami Project to Cure Paralysis was established in 1985 to develop new therapies to improve function in paralyzed individuals. We are very enthusiastic about our current accomplishments and multi-disciplinary research programs. In addition, we are most eager about the future as we continue to move new treatments forward to cure paralysis.

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