Chet Moritz Lab Joins Reeve Consortium; UW Group Laser-Focused on SCI Solutions

The Chet Moritz laboratory at the University of Washington has joined the Reeve Foundation’s International Research Consortium on Spinal Cord Injury. Moritz was officially introduced to the full Consortium in October at its most recent meeting in Chicago.

Moritz’s primary research interest is “hot-wiring” the damaged nervous system, thus restoring volitional control of movement to paralyzed limbs. Much of his work has focused on engineering solutions, including brain-machine interfaces and neuroprosthetics. Trained as a biologist, however, Moritz is not strictly dealing with on-off switches. He is what you might call a transdisciplinary collaborator, open to merging ideas, and eager to work with others.

“Some of the most exciting advances in our field are occurring at the intersection of fields,” says Moritz. “We are very lucky to work closely with collaborators in engineering, neuroscience and cell biology. The magic happens when we can combine the tools from diverse fields to advance treatments for spinal cord injury, and membership in the Consortium provides these opportunities. We are laser-focused on developing solutions to improve quality of life after spinal cord injury, and are eager to collaborate with Consortium members to bring advanced treatments to the community.”

Indeed, Moritz is a good fit for the Consortium, says Reeve Executive VP for Research, Susan Howley. “Chet Moritz readily acknowledges his debt to those who laid the groundwork for his approaches to spinal cord repair. He is steeped in neurobiology, and his exciting use of neuroprosthetics and stimulation, alone and in combination with other Consortium interventions, represents some of the most cutting-edge research in the field today. His participation in the Consortium can only enhance and enrich the scientific dialogue, collaboration and discoveries.”

Moritz originally wanted to be a physical therapist but was smitten by laboratory research when, as an undergrad, he began to study how large insects control the flapping movements of their wings. He eventually segued into human movement studies, obtained his Ph.D. in integrative biology, did two postdoctoral stints, and became a full-time scientist.

Says Moritz, “Early on I became interested in engineering aspects of movement control and what we now call neural engineering. The idea is to develop devices that will improve the function of the hand and arm. We demonstrated we could restore control over paralyzed muscles in animal models and restore simple movement to the paralyzed wrist – all under the animal’s intentional control. I then became quite interested in stimulating the spinal cord, to try to affect syn-

Continued on page 2
ergistic or complex movements, which can be achieved by tapping into the neural circuits within the spinal cord.”

Moritz, an avid bicyclist who rides an hour each way to work every day, is now an associate professor in the Department of Rehabilitation Medicine at UW. Besides work in the lab, managing the output of 16 – postdocs, grad students and undergrads – he teaches physical therapy students the basics of exercise physiology. Moritz also co-directs the Center for Sensorimotor Neural Engineering, a research partnership with Massachusetts Institute of Technology and San Diego State University, one of 17 such centers funded by the National Science Foundation.

Moritz says he has no problem attracting students and postdocs to the lab. “The field is very compelling; it draws people in. They want to help people with spinal cord injury. We get trainees with engineering backgrounds, neuroscience or clinical backgrounds. I’m always turning people away, it’s a shame I can’t take more. Paralysis is a very compelling problem.”

The Moritz group is located just down the hall from the UW Rehabilitation Medicine Department, home of a federally funded Model System spinal cord injury unit. This benefits his research, Moritz says. “We have a lot of interaction with clinicians who treat spinal cord injury here – the rehab psychologists, MDs, PTs, OTs. Plus, we have frequent contact with patients living with paralysis. This helps keep us grounded. People with spinal cord injuries come in and talk to us about what they would like us to work on; it’s often bowel or bladder or sexual function, and some talk about hand and arm function. It’s a great chance for the trainees to meet someone with a spinal cord injury,

Members of the Moritz lab, l to r: Aiva lewins, Alice Bosma-Moody, Sarah Mondello, Oliver Stanely, Fatma Inanici, Tom Richner, Natalia Mesa, Chet Moritz.

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Filling Edgerton’s ‘Huge Shoes’

The Moritz lab replaces the Reggie Edgerton lab in the Reeve Consortium. “It’s an honor to be taking Reggie’s spot,” says Moritz, “but his are huge shoes to fill. He’s had such an impact on the field, and now on human health. It’s exciting that I might be able to have that same trajectory. Reggie’s work was instrumental in my biomechanics training when I was a grad student. I wish I were joining him on the Consortium, not replacing him – I’d love to work alongside him. I am eager to take what he has done in the area of spinal cord stimulation to the next level, in any way possible.”
to ask questions about their priorities, to hear what their challenges are.”

His lab’s focus, Moritz says, can be summarized in four main areas: restoration; reanimation; repair; and rehabilitation.

**Current Projects in the Lab**

Moritz and his group record neural messages from intact areas of the brain cortex. These signals are then rerouted to paralyzed muscles, or to the spinal cord below the injury, thus restoring volitional control of movement in animal experiments. The goal, says Moritz, “is to develop a human version of a brain controlled spinal interface. The pieces are starting to come into place.”

The Moritz lab has a grant from the Paul Allen Foundation to study how brain activity might be directed not just to muscle but also to the spinal cord. This would create a neural detour around the injury, but also may generate nerve growth, or plasticity, in the area of damage. “Our devices have the potential not only to reanimate the limb in real time, as a prosthetic device, but lead to long term improvements also. By recording from the brain and stimulating the spinal cord, pairing activity above and below the injury, there might be residual improvement even after the device is turned off, I don’t want to call it regeneration, that is too strong a term,” notes Moritz, “but we’ve seen evidence that stimulation reduces spasticity and improves motor function – and these effects last beyond the stimulation.”

Moritz says it’s not enough to bring movement to a limb. His lab also wants to bring back sensation. “We want to develop a system for sensory feedback – so while we are using brain activity to control the movement we are also conveying sensory activity back to the brain.” Using bi-directional connections between brain and computer, by way of electrodes in the brain cortex, Moritz says it may be possible to encode limb position or the sense of touch. If one could reanimate a paralyzed hand, for example to pick up an object, the feedback system would tell the person if the object is hot, or heavy, or fragile. “Moreover,” says Moritz, “the same principles of plasticity might apply. If we are able to pair sensation on the fingertip with direct stimulation of the brain, perhaps we can strengthen the ascending sensory nerves passing an incomplete injury as well.”

**Taking Plasticity Further**

Aiva leivins, a neuroscience graduate student in the Moritz lab, and now an Associate member of the Reeve Consortium, wants to take this plasticity one step further by promoting a more favorable environment for plasticity. She is working with the Consortium’s James Fawcett lab, in Cambridge, U.K., to add chondroitinase to the mix. Says Moritz, “We’re looking at the combination of chondroitinase and spinal stimulation. We know that chondroitinase does a lot of things. It reduces the lesion scar, increases axon regeneration, decreases perineuronal nets, and appears to make synapses more likely to undergo plasticity. It’s also been shown that spinal cord stimulation alone can drive plasticity. So, let’s combine them.”

The lab uses a lentiviral gene modification process to deliver chase.

Sarah Mondello, a postdoc and Consortium Associate in the Moritz group hopes to promote recovery not with electrical signals, but with light. This involves an exciting tool called optogenetics – researchers insert light sensitive channels into the membrane of a nerve cell, thus making it respond to light. Mondello has animal data to show that optical stimulation of the spinal cord evokes movement and may promote recovery. She developed an implantable microLED device to allow for long-term optical stimulation in freely moving rats.

Tom Richner, also a Moritz postdoc, is using optogenetics to create an implanted optical device that might control
Miami Schwann Cell Trial Moves to Second Phase

James Guest is a physician-scientist at the Miami Project to Cure Paralysis. He leads the Project’s team in the Reeve-funded North American Clinical Trials Network (NACTN).

Currently, Guest is a principal investigator for a unique and ambitious clinical trial – transplantation of Schwann cells into the lesion area of people with new spinal cord injuries. The Miami-based trial is unique in that the cells come from the bodies of the patients themselves (autologous). It is ambitious because Schwann cells are what make nerve growth possible in the peripheral nerves, those outside the brain and spinal cord. In animal models, Schwann cells transplanted into the spinal cord have been shown to promote nerve growth.

Guest and key colleagues, building on over 30 years of Schwann cell research by Richard and Mary Bunge (Mary, a former Reeve-funded North American Clinical Trials Network [NACTN] principal investigator), have designed the trial and helped guide it through a gauntlet of institutional and governmental reviews. “This trial,” said Guest, “is based on some of the most heavily studied preclinical research that has ever been done.”

Describe the work for us.

We are currently doing a safety and feasibility study of autologous Schwann cells. One of the features of using cells from one’s own body is that, as far as we know, immune suppression is not needed. Our first Schwann cell trial is a dose escalation subacute study starting the first patients at five million cells, then increasing to 10 and then 15 million. The subjects have no motor or sensory function below their lesion area. We treat them at around 40 days after injury, which means that the chances these patients would recover [to a higher level of function] by way of spontaneous recovery are not high.

We recently completed enrollment in the first phase; those patients are still being assessed. We don’t have data now to share, but I can say that it appears there are no safety concerns. Further, the autologous methods are feasible. Regarding efficacy, at this early stage we do not really expect to see a robust effect – but there is a lot to be learned. We are undertaking detailed electrophysiological studies as well as the standard assessments of function. It is important that the outcome measures are sensitive enough to detect any changes that might happen. There are some interesting findings we hope to describe next April or May, after 12 month assessments.

The trial continues, yes?

A second phase of the trial has begun; the second patient was treated in November. In this phase the patients have been injured for at least 12 months; they are chosen by way of a very rigorous selection process, and are involved in an intensive three-month training and rehab program upfront. The training is intended to improve cardiovascular health and includes quite a bit of stepping, either with a Lokomat [robotic stepping device] or on an FES [functional electrical stimulation] cycle. The idea is to train the system so that it might potentially respond to any plasticity [nerve tissue growth] that the Schwann cells might engender.

The trial design, which we worked out with the FDA, is intended to escalate from least risk to greater degree of risk. The first two subjects were motor and sensory complete thoracic injuries. The next subjects will be incomplete – they are already in the exercise program. We want to see what we can do with a damaged but somewhat intact spinal cord.

Any trouble finding patients?

It was challenging to enroll the first trial. For the chronic study our pool of patient candidates is large, but one of the main issues is lesion size. We are taking the approach that the Schwann cells are intended to fill the lesion area, so we don’t want it to be larger than 3 cm in length and not to exceed 2cc in volume of the cavity. This has been our most limiting factor with complete injuries; for incomplete injuries the cavity is well within parameters.

No outer limit on time since injury?

We are being flexible about length of time post injury date. It was hard to say that a particular post-injury interval would be non-responsive. What we see is that people have come to some sort of recovery plateau. Then, when we train them, we think there may be a new plateau – there may be some improvement. Then we do the Schwann cell transplant. We have seen in our first patients who were more than a year post-injury that they showed a good response to the exercise program. We don’t know yet how the cells will add to that.

What do you think Schwann cells do?

As for the mechanism, initially we can actually see the transplant in the spinal cord, either with ultrasound or MRI soon.

U of L Study Implants 10th Patient

While the first four individuals implanted with epidural stimulators continue to publicly demonstrate their recovery of function, the team at the University of Louisville has pressed on. Six more subjects, all men, have been implanted in recent months. Two more, both women, will be recruited soon.

According to principal investigator Susan Harkema, two projects are ongoing. “The original study, launched with Rob Summers in 2009, now has enrolled seven of a total eight subjects. In a second study looking primarily at cardiovascular response, we have implanted three of four participants.”

The cardio study has recruited subjects with cervical injuries, said Harkema, and thus with low blood pressure and impaired respiratory function. “We are hoping to show that we can normalize blood pressure with stimulation alone. We also want to know if there are specific stimulation parameters for each behavior, or physiological response.”

Harkema says several papers are “in the hopper” but results are not yet published. “We can’t put results out before we are published in the literature,” she said, “but we are very optimistic. The results appear to be very consistent with what we have seen in the first four individuals who were implanted.”

Results for those men, which inspired the Reeve Foundation to conceptualize The Big Idea study, showed recovery of voluntary movement and standing when stimulation is on, plus significant residual benefits to autonomic functions, including improved bowel, bladder and sexual function. The Big Idea will enroll 36 more people into the epidural stimulation study. See ReeveBigIdea.org
after surgery. From what we have learned, the Schwann cells are confined to the area of injury. Their ability to migrate is limited. They induce the formation of bridging tissue that connects the still intact portions of the spinal cord. Within that area they may repair damaged myelin. They probably need to find an axon in order to survive long-term. An argument for the safety of Schwann cells is that some enter the spinal cord spontaneously after injury and that has not been linked to any harm. Also, Schwann cells are quite trophic. They express various growth factors – NGE, BDNF, etc., not in huge amounts but enough perhaps to improve nerve conduction. They also produce axon growth promoting laminin.

So, a long run-up for regulatory issues? Our preclinical requirements were quite rigorous. The FDA required a pivotal data set from animal studies, but we were on a clinical hold for quite a few months in order to provide them more information. We eventually provided animal data from rats, mice, pigs and primates – we came to the table with three species. We showed that the cells could be implanted, they could survive, and that there was some indication of activity. Importantly, we showed in animals that cultured purified Schwann cells could again form myelin after transplantation; that’s what these cells normally do.

They wanted you to go beyond rats? The choice to conduct large animal studies was our own. We wanted to determine the safety of our actual doses and the injection methods before transplanting people. We studied the pig, using it to develop our delivery method and maximum tolerable dose. The pigs were also very responsive to locomotor training; they are able to progress from moving limbs with no weight-bearing to some stepping, if they received rehabilitation in addition to the Schwann cells. Pigs model the human nervous system reasonably well.

We also used a primate model to verify the survival and function of autologous Schwann cells. They survive without immune rejection in primates, a good predictor for what will happen in people.

Schwann cells may work better in combination with other agents, yes? We hope to move toward combination strategies. We are now doing primate studies using viral vectors to induce expression of chondroitinase [an enzyme that breaks up spinal cord scarring], this in combination with Schwann cell transplants. Chondroitinase is a very interesting enzyme but there are a number of questions, for example, is immune response to the protein going to be a problem or not?

We also did a small pilot study using Schwann cells and epidural stimulation. The pigs were very responsive to the stimulation. That could be a useful combination, helpful for patient selection – determining those who appear to be complete injuries but are not.

Patients now reveal study detail via social media. How do you keep the lid on this? We know this happens and it’s not going away. Self-reporting of results by patients is usually based on and optimistic and not rigorous assessments. We tell subjects we would appreciate it if they would not give out information to the media. So far, it has worked. We also have a very substantial vetting process. Subjects meet with a clinical psychologist. We try to get them to understand equipoise. For the experiment they are participating in, we do not know if this will help them, but it is reasonable to anticipate it may. This education and detailed follow-up has an impact on the way people talk about the study. It could be unethical to enroll people in a trial with falsely exaggerated expectations of recovery. In fact, the research subjects are very brave to cope with the uncertainty. Finally, these trials are the work of many people and would not be occurring without the dedication of our team of scientists and clinicians.

— Sam Maddox

Current Clinical Trials

<table>
<thead>
<tr>
<th>Acute trials</th>
<th>Enrollment/Sponsor</th>
<th>Detail</th>
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<tbody>
<tr>
<td>Riluzole by mouth once 24 hours, plus administration for 15 days after injury, vs. placebo</td>
<td>Early acute, multi-center U.S. and Canada. 351 cervical patients, sponsor A0 Spine, collaborators: Revere North American Clinical Trials Network, U.S. Department of Defense, Pack Haims Institute.</td>
<td>Phase 2/3 study to assess neuroprotective effect for drug already FDA approved for ALS. Astrotrope shown to be safe in acute SCS. Detailed pharmacology studies underway to establish optimal dose.</td>
</tr>
<tr>
<td>Minocycline once seven days with discontinuation prior spine surgery and blood pressure management</td>
<td>Canada, multicenter 248 cervical patients, under 12 hours post-injury. Reck Harron Institute, University of Calgary, Alberta Paraplegia Foundation.</td>
<td>Phase 3 trial, hoping to establish neuroprotective effect for drug already FDA approved as bacterial antibiotic.</td>
</tr>
<tr>
<td>Blood pressure management for 7 days following SCS</td>
<td>Enrolling 1094 patients, treatment under 12 hours. University of Virginia.</td>
<td>Phase 3 study, outcome of BP management on motor scores.</td>
</tr>
<tr>
<td>Spinal fluid drainage and elevation of brain pressure</td>
<td>30 patients, treatment within first 24 hours, cervical injuries. St. Joseph’s Hospital and Medical Center, Phoenix, Arizona.</td>
<td>Early stage trial to assess effect of acute spinal cord pressure and potential treatment.</td>
</tr>
<tr>
<td>Glyburide 2 hour IV infusion</td>
<td>Multicenter, 10 cervical patients, within six hours of SCS. Ohio State University.</td>
<td>Safety study: FDA approved for diabetes, may be neuroprotective.</td>
</tr>
<tr>
<td>Zoledronic acid 5 mg IV infusion</td>
<td>50 patients C5-T10, complete, under 23 days post-injury; Thomas Jefferson University and Hospital, Philadelphia.</td>
<td>Hoping to reduce loss of bone mass at the hip and knee regions in SCI.</td>
</tr>
<tr>
<td>Hypothermia (cooling of spinal cord)</td>
<td>100 patients, all levels, complete and incomplete, early acute administration; University of Miami.</td>
<td>To determine if intracerebroventricular hypothermia results in a beneficial outcome.</td>
</tr>
<tr>
<td>Denosumab given by injection.</td>
<td>24 patients, complete, fewer than 12 post-injury; Kessler Foundation, West Orange, NJ.</td>
<td>FDA approved agent demonstrated to preserve hip and knee bone mass.</td>
</tr>
<tr>
<td>Embryonic stem cells surgical implant of oligodendrocyte progenitor cells, dose escalation 2, 10, or 20 million cells</td>
<td>Multicenter, 13 cervical patients, 14-30 days after injury. Assuta Biotherapeutics.</td>
<td>Phase 1/2a dose escalation, safety study. Same cell line as discontinued Geron trial; early safety data reported as positive.</td>
</tr>
<tr>
<td>Spinal cord scaffold surgical implant of polylactide</td>
<td>Multi-center, 13 patients, T5-T12-L1 patients within 4 days of injury, left 2 therapies.</td>
<td>Endopore is safety, looking at motor scores and function compared to non-treated patient database.</td>
</tr>
</tbody>
</table>

Chronic/sub-acute trials

| Epidural stimulation original implant of electrodes array to facilitate standing and walking | First two cohorts, 12 patients, at least one year post-injury, T10 and above; University of Louisville, UCLA, Revere Foundation, Helmsley Charitable Trust, Kessler Foundation, Cong-H. Noh, Nohain Institute. | Epidural stimulation activates spinal cord circuits, facilitates volitional hand and arm movement to paralyzed individuals. Large 50 patient study planned (Revere Foundation). |
| Schwann cells autologous Schwann cells from sural nerve, transplanted transmucosal into epicenter of injury site | Enrolling 10 patients at least one year post-injury, thoracic; cohort followed by cervical group; Miami Project. | Phase 1 safety study. All patients get rigorous rehab training before and after transplant. |
| Stem cells human adult central nervous system cells transplanted into spinal cord | Multicenter, 50 patients 12 weeks post-injury, cervical lesions, temporary immunosuppression; StemCell, Inc. | Phase 2 trial; sensitive outcome measures to detect any motor or sensory effect. Early data supports safety and motor or sensory effect. Early data supports safety. |
| Intermittent hypoxia breathing air with low oxygen vs. room air; normal air; Four trials on different settings. | Enrolling 124 patients in four separate studies, at least one year post-injury, studies include all injury levels; Emory University, Atlanta. | Intermittent hypoxia is non-invasive; training effect may improve function in arms or legs. |
| Nerve transfer two-levels, hand fingers to anterior interosseous nerve; supinator branch to anterior interosseous nerve | Cervical SCI patients, six to 12 month post-injury; 20 patients to be enrolled at Washington University; 10 patients at University of British Columbia. | Surgical nerve transfer for improving upper extremity strength in patients with tetraplegia. |
| Non-surgical stimulation non-invasive, not for improved bladder function | Enrolling 54 patients at least one year post-injury, T8 to C2 motor control; UCLA. | Transcutaneous spinal stimulation may affect same circuits as implanted stimulation. |
| Transcranial stimulation high or low magnetic stimulation to spine or combination with electrical stimulation | Cleveland Clinic: 10 incomplete cervical patients, six months post-injury; Miami Project: 514 subjects, L5 or higher, six months post. Bronx VA: 50 cervical subjects, one year post. | Cleveland to modulate plasticity in regions of the brain to enhance function of upper limbs. Miami uses laser on anterior and leg function. VA, hand dexterity. |
| Motor cortex arrays implanted to facilitate movement using brain-computer interface technology | Cleveland, University of California, Rancho Los Angeles, Carlsbad, University of Pittsburgh, Johns Hopkins, Rehabilitation Institute of Chicago, Miami Project, other centers. | Brain-computer interface technology, translating brain signals via transcutaneous technology to make movement possible. Has restored volitional hand and arm movement in paralyzed individuais. Research is ongoing. |
| FES functional electrical stimulation systems, surgically implanted | Numerous studies in Cleveland at Case Western Reserve University and at the Brooks VA Medical Center to facilitate above stimulation of paralyzed muscle. | Improvements with integrated FES system shown in standing, walking, reaching and grasping, cough, bowel, bladder control. |

Note: this chart, based on data from clinicaltrials.gov, includes trials in North America. For a full list of all trials listed with the National Institutes of Health, including overseas trials, see: Spinal Cord Outcomes Partnership Endeavor (SCOPE, www.scope-sci.org). Special thanks to Dr. Dan Lammertse for compiling and updating the SCOPE data.
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Produced and edited by Sam Maddox and Susan Howley

Moritz Lab ...

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bladder function. The drug company SmithKline granted the Moritz lab and collaborators $1.2 million for the project. The team, which includes the James Fawcett lab, is also competing for an additional $1 million prize, part of a SGK innovation challenge.

Says Moritz, “For spinal cord patients, restoring sexual function and bladder function are some of their top priorities – usually higher than regaining the ability to walk.”

The team is experimenting with a wirelessly powered implant nicknamed “Lollipop,” developed by UW electrical engineering professor Joshua Smith.

“The vision is for these sorts of neural devices to be as ubiquitous as pacemakers or deep brain stimulators – a surgeon implants the device and it’s seamless for the patient.”

Moritz says a project is being planned with the Consortium lab of Aileen Anderson (UC Irvine) to explore how epidural stimulation improves autonomic function. “Aileen has a blood pressure model, which will allow us to see how stimulation affects day-to-day blood pressure fluctuations.” A related Consortium collaboration is in the works to better understand how spinal cord stimulation actually works. “What is the mechanism by which stimulation activates the cord? How does stimulation improve function in both the near- and long-term?” Moritz will be working with the Sam Pfaff lab at the Salk Institute in San Diego to look at circuits in spinal cord, possibly using designer drugs to activate or silence neural activity.

Finally, Moritz says his group is planning a clinical trial at UW to see if an implanted spinal cord stimulator can improve the recovery of patients with cervical myelopathy (a disorder in the spinal cord that interrupts the normal flow of neural signals). Doctors at UW regularly treat these patients with decompressive surgery; the spinal stimulator would be implanted at the same time. The goal is to explore activity-dependent stimulation of the spinal cord, with an eye toward eventual brain control of spinal stimulation for people with spinal cord injuries.

— Sam Maddox

Special thanks to Acorda Therapeutics for sponsorship support that makes this newsletter possible.
Biology vs. Engineering: The Combination May be the Cure

During each bi-annual meeting of the Reeve International Research Consortium on Spinal Cord Injury, the Associates – comprising two or three postdocs or grad students from each of the seven Consortium labs – organize a discussion or problem-solving session on a particular topic or research paper. This time, the Associates decided to stage a debate.

Shane Liddelow, an Associate in the lab of Ben Barres at Stanford, organized the debate and arbitrarily assigned each of his counterparts to defend one side of the discussion. Here’s his take on it.

Since the Consortium had just added a new member, Chet Moritz, whose approach is somewhat more on the engineering side [see cover story], we thought it would be instructive to debate the usefulness of biological approaches versus engineering research. We intentionally worded the debates in the most polarizing way:

**Repair vs. Regeneration**  
biologists have no right investigating spinal cord injury.

**Feet vs. Function**  
researching locomotor function is a waste of time.

People got pretty fired up. Angry even. But everyone got involved. It was great! I argued against research for walking, making me one of the more hated persons in the room. We argued that we should focus on incremental levels of freedom for a person who regains autonomic function, such as bowel and bladder control, or sexual function.

Notwithstanding mobility problems, a poorly functioning urogenital system creates a whole host of problems not only for health and well-being but also with independence and self-esteem. As is normally the case with such discussions, we pointed to research from Kim Anderson (herself a person living with paralysis) showing that walking is not the highest priority for many people with spinal cord injury. Should we focus on research that looks good in the public eye, or on what patients say they really want?

The opposing side made a case that walking is a lofty and worthwhile goal, one that if successful, would provide patients the most freedom. Although both environmental and engineering improvements have made it easier for people with SCI to navigate the world in a wheelchair, walking, and upright posture, provide a wide range of additional benefits including trunk stability and improved bone density.

The argument that one should reach for the stars and tackle the complex goal of walking, and enjoy the serendipitous improvement in many autonomic benefits along the way, is one that everyone in the room agreed with full heartedly

My side closed its case noting that walking is not freedom. Freedom is going on a date without neuropathic pain, without incontinence, and with a happy ending. Not being able to walk is a real tough thing, but lack of autonomic function kills people.

Christopher Bohlen, also from the Barres lab, adds his view of the debate on engineering vs. the waste of time, biology.

If the idea was to get people’s blood boiling, it really worked. People really got fired up. My task was to defend engineering type approaches – an exoskeleton or a brain machine interface, as opposed to trying to understand the biology of the spinal cord or the injury itself. The argument against the biological process starts with the rate of progress; bioengineering has outpaced biological advances. Look at how your cell phone has advanced over the last ten years, and compare that to how far the biology has gotten – sure, there have been a lot of advances but the cell phone has completely transformed into a different kind of device.

One of strongest positions against engineering, one that seemed to take hold, was that what we are really looking for is a cure; an engineering approach is ultimately going to give you more and more advanced crutches. These devices will substitute for function but won’t restore ability to perform things in a natural way. Users will always be dependent on plugging them in at night, or having to take them on and off.

The main advantage for the engineering approach: it will be a much quicker process than looking at how a therapy affects various types of outcomes. Devices will come along, and they will really improve the lives of patients.

A conclusion I reached after hearing the discussion from the senior scientists on the Consortium is that these kinds of artificial engineered stopgaps are going to be part of what patients deal with in the future. We biologists might allow our approaches to dovetail, to some extent, with the engineering solutions that are coming along.
Don’t Call it A Miracle
The Movement to Cure Spinal Cord Injury

By Kate Willette

This 238-page book, available for free from the Reeve Foundation, explains the basic biology of the injured cord, what approaches scientists are taking to heal, mend or bypass the nervous system, and what you, as a non-scientist, can do to speed things along.

Willette is married to Bruce Hanson, who injured his spinal cord in a skiing accident. Says she: “The fight to fix spinal cord injury is on. Every small gain is the result of untold effort. There’s no magic involved, just the raw power of the human spirit.”

Easy to read and beautifully illustrated. Download from iBooks, iTunes or Kindle. Please visit the Reeve website ChristopherReeve.org/Willette to download PDF, or call for a free hard copy, 800-539-7309.