

## Jump Start for an Injured Brain

As anyone who's tried to perfect a topspin lob in tennis knows, motor skills can take weeks or longer to appear and then, without practice, they slip away, leaving a shadow of the seamless swing that went before. The stakes are obviously higher after a stroke, for example, when the time it takes to relearn something like swallowing puts normal life on hold.

"So whatever enhances our ability to acquire a skill and retain it is of huge practical interest," says Hopkins physiatrist/neurologist **Pablo Celnik**, who's spent the past decade testing ways to jump-start those processes.

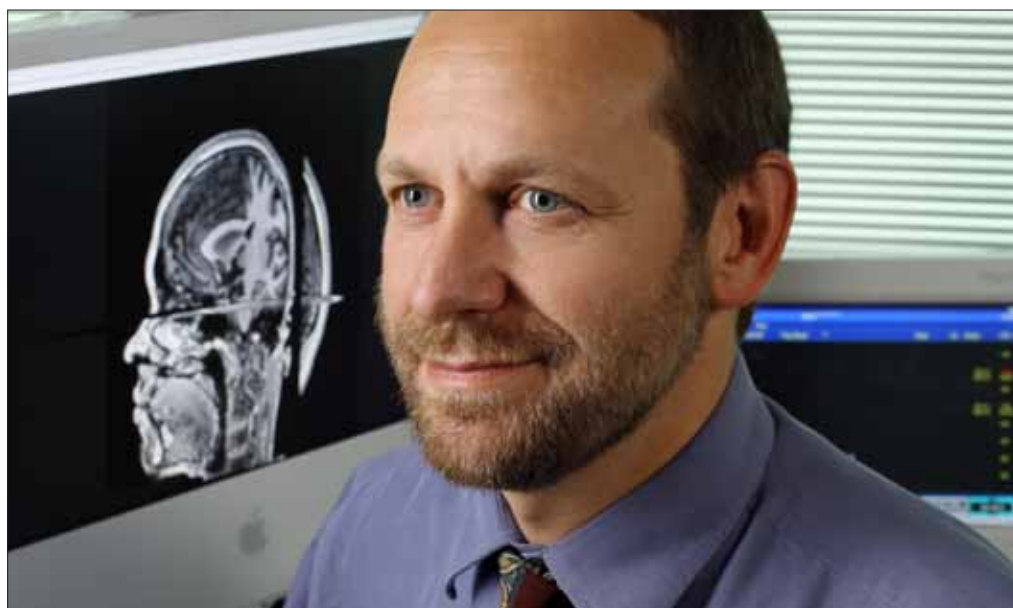
The news here is that Celnik has found what may be a lasting way to do that—to tap into the brain's cerebellar-cortical circuitry for motor movement and change it. And that, he admits, is our first inkling of a sea change in rehab for patients with stroke or other neurological problems.

Several years ago, Celnik made himself expert on various mild sorts of brain stimulation including the weak electrical currents of tDCS (transcranial direct current stimulation) that can penetrate the skull and impact the brain. He and collaborators began by studying tDCS delivered to the primary motor cortex in stroke patients with impaired hand movement. During tDCS, subjects were asked to perform fine motor tasks such as flipping a card or picking up beans with a spoon.

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**"WE NOW KNOW WE CAN ENHANCE HOW MOTOR INFORMATION IS BOTH CONSOLIDATED AND CONTROLLED—TWO HALLMARKS OF LEARNING."**

—PABLO CELNIK



**Pablo Celnik recently received the Presidential Early Career Award for Scientists and Engineers, a plum prize given to U.S. scientists for work with high promise.**

performance," says Celnik. The problem, though, is that under a single stimulus session, it doesn't last. "It's something like a pill," he explains. "Performance increases while tDCS's effect is in your system. But when it wears off, too bad."

So Celnik tinkered with stimulation programs with an eye to sparking the long-term changes that signal learning. This time, his team had people practice fine-motor tasks in set sessions over five days. Those with tDCS during training not only improved more than those without it, but they kept their new skills at a three-month follow-up.

"It's very powerful to see stimulation playing a part in the way the brain incorporates what someone is practicing," Celnik says. "We now know we can enhance how motor information is both consolidated and retained—two hallmarks of learning."

But that's still not enough, says Celnik. For rehab patients, there's a need to increase what information is acquired in the first place. That, he says, shifts focus to the

cerebellum, a key motor system site. Because little research exists on cerebellar learning, stimulating that organ was a black box, he says, and his team first had to check tDCS's effect, choosing a basic circuit connecting cerebellum to cortex to hand muscles. That's in part to see what happens, says Celnik, "but it's also to make sure what we're doing is confined to the cerebellum and doesn't affect the whole brain."

So does cerebellum-stimulating hasten acquiring a visuo-motor task? It's looking that way, he says from the midst of the next round of studies. It's looking like tDCS to the cerebellum improves what you acquire and tDCS to the motor cortex makes it stick. "Ultimately," Celnik says, "the form of stimulation we deliver may let us tailor ways to enhance the efficiency of a patient's brain as it is."

"Things have to be worked out, of course, but this field is really going to change in the next few years. The move to the clinic will come sooner rather than later." ■

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Among the numerous traits that are essential to practicing physical medicine and rehabilitation, one emerges at the forefront: perseverance. It's a characteristic exhibited daily, not only by our physicians and staff, but by our patients who so bravely face treatment challenges every day. And, just as it informs all the work we do, it's evident in the pages of this newsletter.

Whether treating brain injuries or muscle dysfunction, our physicians demonstrate the special brand of determination needed to make long-term recovery a reality. We're teaching that to our medical students with a brand new month-long clerkship called Chronic Disease and Disability: Improving Quality of Life (page 3). We see it in Pablo Celnik's research on relearning and enhancing motor function in brain injury patients (page 1), and in Marlis Gonzalez-Fernandez' painstaking research on racial differences in dysphagia (page 4).

Most importantly, that resolve and long-term vision play a crucial role in our clinical practice. It's present in Dale Needham's pioneering work with ICU patients who have muscle weakness and atrophy (page 2), and it's a defining characteristic of Celnik and Kathleen Kortte's Outpatient Neuro-Rehabilitation Program (page 3). And, because every member of our faculty shares that determination and commitment, our patients know they can rely on us for the ongoing care and dedication they need to get the results they want.

**Jeffrey Palmer, M.D.**

*Lawrence Cardinal Sheehan Professor  
and Director  
Johns Hopkins Department of Physical  
Medicine and Rehabilitation*

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1-888-JHU-REHAB  
For urgent referrals  
and consultations:  
1-800-765-5447  
(Hopkins Access Line)



**“With technology,” says Dale Needham, “we’re overcoming barriers for our weaker ICU patients.”**

## Muscling Through Intensive Care

**W**hen patients come to the ICU, they're crashing. Oxygen and blood pressure are dropping and everything, in short, is getting worse. “Our response has been to improve life support,” says critical care expert **Dale Needham** of the ICU changes he's surveyed. Fortunately, that's tipped the scales in favor of life for increasingly sick patients.

But it's also had a perverse effect that Needham is trying to correct.

“As survival has increased,” he says, “we're seeing many ICU survivors whose physical abilities and quality of life aren't up to par.” The very measures that save their lives have left them frail.

These patients may benefit most from the rehab technology that Needham has brought into the ICU—a means to waylay potentially debilitating effects of time spent there. And two techniques especially—neuromuscular electrical stimulation (NMES) and cycle ergometry—are making a true difference.

Neither is new. NMES, for example, was introduced as “galvanism” in the 1940s in the hope that a weak electrical current would prevent disuse atrophy while increasing muscle strength. Now it's a rehab staple. And cycle ergometry—a sophisticated variation on the exercise bike—proved itself as well. But using either of these alongside the life support paraphernalia that crowds a modern ICU is unusual.

As director of the critical care physical medicine and rehabilitation program at The Johns Hopkins Hospital, Needham has made both techniques part of a new ICU care model that includes early-stage rehab. “Studies tell us that,

done properly, early rehab for very sick ICU patients is safe, feasible and beneficial,” he says.

One main advantage of the technology is that patients needn't be awake to be helped. With NMES, for example, the passive contraction of target muscle groups mimics the effect of mild exercise. That appears to ward off muscle atrophy—a key culprit in patient weakness in the ICU and long afterward. “We now know it increases protein synthesis in muscle,” says Needham. New studies show quadriceps muscles, for example, shrink less. It also boosts muscle microcirculation.

Currently, a Hopkins trial of NMES is under way to determine the best protocols for ICU patients. The technique is applied twice daily for 30 minutes to subjects' quadriceps, plantar flexors and dorsiflexors—the leg and calf muscles where lower-limb weakness in ICU survivors is common and slow to recover.

As for cycle ergometry, studies show that it too promotes muscle strength and reduces atrophy. “Ergo's” main advantage is that the device adapts to patient recovery. The compact, ICU-adapted version used at Hopkins has a motor. So coma patients, for example, can be “attached” to it and passively improve range of motion. As they awake and gain strength, patients progressively move from “active assisted” cycling to truly active exercise.

“Right now,” says Needham, “we're evaluating who benefits most and how both cycling and NMES fit into our new comprehensive program in the ICU.” ■

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# The Long View of Brain Injury Rehab

**A**lthough rehabilitation for a hip replacement can concentrate on the injured limb, restoring neural and mental function following a brain injury requires a broad and long-range focus.

“There’s a significant difference,” says rehabilitation neuropsychologist **Kathleen Kortte**, “between helping a patient with a hip or knee replacement and a patient who’s had something happen to the brain. A piecemeal program doesn’t help patients with brain dysfunction.”

Kortte directs the Outpatient NeuroRehabilitation Program at The Johns Hopkins Hospital. The specialized program, which she launched five years ago with several colleagues, including physiatrist **Pablo Celnik**, is geared singularly at treating adults who’ve lost mental and physical function to brain injuries caused by stroke, tumors, infection or head trauma.

Because the consequences of brain injuries are rarely limited to a single problem, patients are likely to have not only motor and sensory loss but cognitive and behavioral issues as well. Addressing all these potential complications in a coordinated outpatient setting may be unusual. But Kortte says it’s working here because they’ve combined forces across the institution, bringing all of the players to the same table, including neuropsychologists, physiatrists, speech language pathologists, occupational and physical therapists and social workers.

“We need that tailored continuum of care,” Kortte explains. “All of our patients coming from neurosurgery, stroke or the emergency department say they need more treatment when their inpatient rehab stay is done. They need to learn how to get back into life.”

It’s a lesson some patients may have to learn more than



In the program Kathleen Kortte directs, patients can count on a lifetime of support.

once, which is why the program never technically discharges its patients.

“Following a brain injury,” Kortte says, “patients are going to need help across the lifespan. They can go through the program, go into the community and be functioning well. But then they age or something else happens, and their brain and body change, leading to new problems. So they come back and we redo their program to help address the new issues. We’re here for them for life.” ■

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## A Clerkship Helps Med Students See Through Patients’ Eyes

For decades, medical training has focused predominantly on acute care and hospital settings. Trainees learned that if a patient had a stroke, you treat the stroke. Other complications would be treated as they arose.

But with the growing incidence of chronic diseases, understanding and properly treating them has taken on new urgency. A survey of Johns Hopkins Medical School alumni revealed that most believe medical providers need better education in

the treatment of chronic disease. And with the medical school launching an entirely revamped curriculum this year, Hopkins faculty decided the time was ripe for such training. Enter a new, month-long clerkship called Chronic Disease and Disability: Improving Quality of Life, based in the hospital’s Department of Physical Medicine and Rehabilitation (PM&R) and the Division of Geriatrics.

“We want to bring students out of the acute hospital and have them see patients

in rehab, outpatient and home settings,” says **R. Sam Mayer**, PM&R’s vice chair of education. With so many patients dealing with chronic illnesses like stroke, arthritis or spinal cord injuries, PM&R and geriatrics provide the ideal platform for bringing the course to trainees.

Required for all Hopkins medical students in the new curriculum, the clerkship steps away from the traditional ritual of students accompanying attending physicians on rounds. Instead, students will follow patients through different levels of care and get the patient’s perspective by spending a day in a wheelchair, managing medications (with M&Ms serving in place of pills), monitoring their own blood pressure and trying to adhere to special diets.

“To work in this field,” Mayer says, “you have to have a lot of patience, be goal oriented, work in teams and be very democratic in working with other providers. We want our students to see that it’s worthwhile, because the treatments they’re giving will improve quality of life.” ■

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### Education rethinker **R. Sam Mayer**



# Dysphagia: More Mysteries of the East

**W**hen dysphagia researcher **Márlis González-Fernández** first looked at the survey she ran on a large database of stroke patients in California, her initial thought was, something has to be wrong.

Because there's only a smattering of research on patients suffering swallowing problems after a stroke, González-Fernández has been trying to remedy that. Recently, she's begun systematically holding patient characteristics up to the light, in case gender, age or the like might pinpoint who's most at risk.

But she didn't think that race would make much difference. Specifically, she didn't expect Asian patients to stand out so starkly. In her survey, they were, amazingly, close to 60 percent more likely to experience dysphagia after a stroke than whites or blacks.

Her team was so puzzled that they pulled another database, this time one of New York state patients. "Results were in the same ballpark," she says. Likewise, figures from a look at a national database of Medicare subscribers—she'll present this at the 2010 Dysphagia Research Society meetings—hovered at the same, almost two-thirds higher risk.

Assuming the statistic's solid, the next question is, what's the cause? Do Asians suffer more dysphagia because of anatomical differences? "We don't think so," says González-Fernández, "though we expect an MRI study would confirm that." To that end, a survey of stored images from Hopkins Asian stroke patients is in the offing.

"Our current hypothesis," she says, "is



Physiatrist González-Fernández directs Hopkins' outpatient Physical Medicine and Rehabilitation clinic.

that Asians have either a higher likelihood of strokes in the first place or that their strokes hit crucial brain areas more frequently." It's well known that the brainstem is the main region for swallowing control. If Asians have more strokes at sites that affect circulation to the brainstem, she adds, it follows that dysphagia would be higher.

Last year, *Stroke* reported González-Fernández's work to extend the search for dysphagia's brain regions outside of the brainstem—where most strokes occur. In her study of 29 stroke patients plus controls, sev-

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—MÁRLIS GONZÁLEZ-FERNÁNDEZ

eral new areas emerged as suspect. And they warrant a new, larger look. Having a complete brain map of dysphagia-prone spots would help answer the Asian question.

Until that happens and, ideally, prompts some sort of preventive or treatment approach, "the best thing is to increase surveillance of our Asian stroke patients," says González-Fernández. "Checking for dysphagia should always be one of the first things we do with a stroke patient, Asian or not, because of the risk of aspirating fluids," she adds. But knowing Asians are more vulnerable makes it a must.

Meanwhile, her research continues. "We still need to answer the basic, foundational questions," González-Fernández says. Dysphagia fades within two weeks for most patients, for example. Is that true for Asians? Are their symptoms more severe? "Just knowing who's most likely to improve would change what we do." ■

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**innovations**  
in physical medicine and rehabilitation

This newsletter is published for the Johns Hopkins Department of Physical Medicine and Rehabilitation by Johns Hopkins Medicine Marketing and Communications.  
901 South Bond St. / Suite 550  
Baltimore, MD 21231

**Department of Physical Medicine and Rehabilitation**  
Jeffrey Palmer, M.D., Lawrence Cardinal Sheehan Professor  
and Director

**Marketing and Communications**  
Dalal Haldeman, Ph.D., M.B.A., vice president  
Marjorie Centofanti, Lauren Manfuso, writers  
Mary Ann Ayd, managing editor  
Maxwell Boam, designer  
Keith Weller, photographer

For questions or comments, contact:  
mayd@jhmi.edu or 410-955-2902  
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