In this issue of *Rehab Progress* we announce the Department of Physical Medicine and Rehabilitation's involvement and leadership in an amazing and exciting trial on brain-computer interfaces (BCI). Our aim is to have patients with spinal cord injury (SCI) control prosthetic limbs, virtual environments, and computers by using their thoughts. Certainly SCI and amputation are prime diagnoses for this type of technology. But what about our patients with other impairments? Does BCI hold promise for them?

I think the answer is related to plasticity. Based on research involving intense usage of a paralyzed limb, we know that the brain has plasticity. But what if we could tap directly into the brain? BCI allows for this connection and could have amazing implications for our patients with stroke. Unfortunately, even if BCI technology can vastly improve neuroplasticity, it is unlikely to ever be a cure for strokes that involve substantial loss of brain matter. This fact points out another potential benefit of BCI technology.

We know from the work of Fabrisia Ambrosio, PhD, MPT, assistant professor, Department of Physical Medicine and Rehabilitation, that muscle stem cells need clues for appropriate differentiation. In the absence of signals related to exercise, muscle-derived stem cells are likely to turn into fibroblasts. However, exercise causes these same stem cells to turn into muscle and leads to cells that live longer and are more functional. Other research at UPMC has looked at stem cells in stroke with some positive findings. However, if we could provide better signaling to stem cells, could the result have been much better? I think the answer is yes, and BCI could be a pathway to enable this cellular signaling.

The possibilities for BCI technologies in our patients are wonderful to contemplate. Our amazing team is starting down an exciting path at the UPMC Rehabilitation Institute. It will be fun watching the multiple places it will lead.

Sincerely,

Michael L. Boninger, MD
Director, UPMC Rehabilitation Institute
Professor and Chairman
Department of Physical Medicine and Rehabilitation
University of Pittsburgh School of Medicine
Computer interfaces for people with spinal cord injury

Researchers at the University of Pittsburgh have been awarded funding for two projects that will place brain-computer interfaces (BCI) in patients with spinal cord injuries to test if it is possible for them to control external devices, such as a computer cursor or a prosthetic limb, with their thoughts.

The projects build on Pitt research conducted in epilepsy patients with interfaces temporarily placed on their brains who were able to move cursors and play computer games. In addition, researchers at Pitt implanted electrodes into the brains of monkeys, which were then able to guide a robotic arm to feed themselves marshmallows and turn a doorknob.

“We are now ready to begin BCI technology clinical trials in patients who might benefit from it the most, namely those who have lost the ability to move their upper limbs due to a spinal cord injury,” says Michael L. Boninger, MD, director, UPMC Rehabilitation Institute, chairman, Department of Physical Medicine and Rehabilitation.

Continued on Page 5
First Annual Symposium on Regenerative Rehabilitation

Medical advances in the field of regenerative medicine are accelerating at an unprecedented rate. Biological technologies such as stem cell transplantation, scaffolds, and artificial devices are now being tested in clinical trials throughout the country. With functional outcomes as the ultimate goal of these biological therapies, it is clear that the future of regenerative medicine is tightly intertwined with that of rehabilitation, which involves the optimization of function and performance, thus opening up a novel population of patients to clinicians and exciting new areas of investigation for rehabilitation scientists.

There are few opportunities available to bring together scientists and clinicians working in these two currently quite disparate fields. The First Annual Symposium on Regenerative Rehabilitation will be held November 3 and November 4 in Pittsburgh. The objectives of this symposium are to:

• Increase the synergy between the fields of rehabilitation and regenerative medicine.
• Encourage the development of novel interactions, collaborations, and insights between these two innovative areas of science.
• Integrate laboratory-based approaches to enhance regeneration with clinically available rehabilitation approaches.
• Identify barriers to regenerative rehabilitation approaches.
• Introduce the concept of regenerative rehabilitation to the next generation of scientists and clinicians.

Featured sessions

• Fusion of Regenerative Medicine and Rehabilitation
• Mechanotransduction in Tissue Healing
• Impact of Rehabilitation Strategies on Cell Therapies
• Impact of Rehabilitation Strategies on Device-Enabled Therapies
• Impact of Rehabilitation Strategies on Biomaterials

Keynote speaker

Thomas Rando, MD, PhD
Professor, Department of Neurology and Neurological Sciences
Stanford University School of Medicine

Who should attend?

• Program directors/faculty members of physical therapy and physiatry programs
• Scientists and clinicians working in the fields of regenerative medicine and/or physical medicine and rehabilitation
• Young investigators, clinicians, and graduate students with related interests

The symposium is being organized by Fabrisia Ambrosio, PhD, MPT, assistant professor, Department of Physical Medicine and Rehabilitation, and director of the Cellular Rehabilitation Lab; Alan Russell, PhD, founding director of the McGowan Institute for Regenerative Medicine; and Michael Boninger, MD, chairman of the Department of Physical Medicine and Rehabilitation, and director of the UPMC Rehabilitation Institute.

For more information about the symposium, contact Dr. Ambrosio at ambrosiof@upmc.edu.
Polytrauma is a common term used to describe injuries to multiple body parts and organs that often occur as a result of exposure to blasts. Polytrauma is typical in many returning wounded soldiers. To provide comprehensive, high-quality, and interdisciplinary care for veterans and active-duty service members exhibiting polytrauma, the Department of Veterans Affairs developed four Polytrauma Rehabilitation Centers (PRC), located in Richmond, Va.; Tampa, Fla.; Minneapolis, Minn.; and Palo Alto, Calif. The PRCs serve some of the most severely injured veterans and active-duty service members. Due to the severity of their injuries, these individuals often endure long-term physical, cognitive, sensory and/or psychosocial disabilities that impact their ability to live independently and to participate in everyday community activities. These difficulties can be alleviated with the use of assistive technology (AT), which has been shown to be effective in increasing access to or participation in employment options, education, and independent living.

The University of Pittsburgh’s Department of Rehabilitation Science and Technology (RST), in collaboration with the Department of Physical Medicine and Rehabilitation, was awarded a three-year, $3.6 million grant from the U.S. Department of Veterans Affairs to assist with the development of the AT labs at the PRCs. Somewhat modeled after the UPMC Center for Assistive Technology, the grant includes developing and/or implementing clinical practice recommendations, documentation templates, staffing, lab space design, demo equipment, product evaluations, outcomes management, staff training, and CARF accreditation.

Most recently, within our Education Milestone, the RST Department coordinated the second of three Assistive Technology “Deep Dive” Institutes at the School of Health and Rehabilitation Sciences. A total of 40 VA clinicians from various sites attended the “Deep Dive.” Instead of a traditional three-day sit-down workshop with formal presentations, the session was revised to a three-day hands-on workshop to address practical AT training needs of VA clinicians working in the polytrauma system of care.

On the first day, attendees rotated through a series of labs and activities in order to gain a general working knowledge of AT devices relevant to the VA-PRC AT labs, including wheeled mobility and
VA Polytrauma Assistive Technology Program

(Continued from Page 4)

seating, sports and recreation, adaptive driving, computer access, environmental control units, augmentative and alternative communication (AAC), and electronic cognitive devices (see Figures 1 and 2).

Figure 1 demonstrates the opportunity that clinicians were offered to trial specific devices that they normally would not work with on a routine basis. In Figure 2, a manufacturer is demonstrating to a clinician how to set up environmental control units through power wheelchair electronics. The joystick can act as the mouse on a computer screen, or with a click of the joystick one can turn on a fan and room lights, or play a movie on a television screen.

On the second day, attendees concentrated on a track specific to their area of interest. Live client case studies were utilized to allow attendees to work with mentors to complete comprehensive AT assessments and solve problems. Figure 3 shows a group of clinicians with their client demonstrating an AAC device.

Day three involved further troubleshooting of AT solutions for client cases, with group review and discussion of findings. The workshop was presented by experts in various areas of AT from the Department of RST with assistance from other resources, including more than 20 industry manufacturers.

Spinal cord injury (Continued from Page 2)

Rehabilitation, University of Pittsburgh School of Medicine, and a senior scientist on both projects. “It’s particularly exciting for us to be able to test two types of interfaces within the brain.”

“By expanding our research from the laboratory to clinical settings, we hope to gain a better understanding of how to train and motivate patients who will benefit from BCI technology,” says Elizabeth Tyler-Kabara, MD, assistant professor of neurological surgery and bioengineering, University of Pittsburgh Schools of Medicine and Engineering, and the lead surgeon on both projects.

In one project, funded by an $800,000 grant from the National Institutes of Health, a BCI based on electrocorticography (ECoG) will be placed on the motor cortex surface of a spinal cord injury patient’s brain for up to 29 days. The neural activity the BCI picks up will be translated through a computer processor, allowing the patient to learn to control computer cursors, virtual hands, computer games, and assistive devices, such as a prosthetic hand or wheelchair.

The second project, funded by the Defense Advanced Research Projects Agency for up to $6 million over three years, will further develop the technology tested in monkeys by Andrew Schwartz, PhD, professor of neurobiology, University of Pittsburgh School of Medicine, and also a senior investigator on both projects.

It uses an interface that is a tiny, 10-by-10 array of electrodes that is implanted on the participant’s brain to read activity from individual neurons. Those signals are processed and relayed to maneuver a sophisticated prosthetic arm that will be mounted on the patient’s wheelchair.

“Our animal studies have shown that we can interpret the messages the brain sends to make a simple robotic arm reach for an object and turn a mechanical wrist,” Dr. Schwartz said.

“The next step is to see not only if we can make these techniques work for people, but also if we can make the movements more complex.”

In future research efforts, the technology may be enhanced with an innovative telemetry system that would allow wireless control of a prosthetic arm, as well as a sensory component.

“Our ultimate aim is to develop technologies that can give patients with impairments control of devices that will help restore their independence,” Dr. Boninger said.
Recent contributions by UPMC Rehabilitation Institute faculty

Following is a sampling of recent presentations by UPMC Rehabilitation Institute faculty members.

Orthopaedic Research Society 57th Annual Meeting
Jan. 13 to Jan. 16, Long Beach, Calif.

Presentations

Association of Academic Physiatrists Annual Meeting
April 12 to April 16, Phoenix, Ariz.

Workshops and Courses
Michael Boninger, MD was co-planner of the course, "Advances in Rehabilitation Technology," which provided education in robotic therapies used in neurorehabilitation, neuroplasticity, and updates in pain control using neuromodulation techniques. He presented “Neural Plasticity and Direct Brain Interfaces.”

Presentations
Melissa Riggins, BSc; Padmaja Kankipati, MS; Michelle Oyster, MS; Rory Cooper, PhD; Michael Boninger, MD. “Quality of life of individuals with spinal cord injury who transition from walking to wheelchair use.” This presentation earned the 2011 AAP Best Scientific Presentation Award.

American College of Sports Medicine 58th Annual Meeting
Second World Congress on Exercise in Medicine
May 31 to June 4, Denver, Colo.

Workshops and Courses
Gary Chimes, MD, PhD, assistant professor and director, Musculoskeletal Sports and Spine Fellowship, with co-fellowship director, Joseph Ihm, MD, Sports and Spine Rehabilitation, Rehabilitation Institute of Chicago were course directors of “Physical Examination of the Low Back.”

2011 International Conference in Spinal Cord Medicine and Rehabilitation
ISCOS and ASIA
June 4 to June 8, Washington, DC

State of the Science in SCI
Michael Boninger, MD, chairman and co-moderator, “Technology for Mobility and Function Track.”

Scientific Program: Paper Presentation
Jennifer Nagy, MPT; Amy Winslow, MPT; Jessica Brown, BS; Lisa Adams; Kathleen O’Brien; Michael Boninger, MD; Gregory Nemunaitis, MD. “Pushrim kinetics during advanced wheelchair skills in manual wheelchair users with spinal cord injury.”

Poster Presentations
Michelle Oyster, MS; Ian Smith, MS; R. Lee Kirby, MD; Rory Cooper, PhD; Suzanne Groah, MD, MSPH; Jessica Pedersen, MBA, OTR/L; Michael Boninger, MD. “Wheelchair skill performance of manual wheelchair users in SCI.”

Jennifer Collinger, PhD; Michael Boninger, MD; Timothy Bruns, PhD; Kenneth Curley, MD; Wei Wang, MD, PhD; Douglas Weber, PhD. “Attitude towards brain-computer interface technology among veterans with spinal cord injury.”
Selected publications from the faculty of the UPMC Rehabilitation Institute


Awards

The faculty of the Department of Physical Medicine and Rehabilitation at UMDNJ-New Jersey Medical School selected Michael Boninger, MD, as recipient of the New Jersey Medical School PM&R Teaching Award for 2011. Dr. Boninger is director of the UPMC Rehabilitation Institute, and chairman and professor in the Department of Physical Medicine and Rehabilitation.

Gwendolyn Sowa, MD, PhD, has been chosen as the recipient of the AAPMR 2011 President’s Citation Award for her abstract, “Alterations in Intervertebral Disk Matrix Homeostasis by In Vivo Dynamic Compression.” This work was highlighted in the February 2011 edition of The Physiatrist.

Dr. Sowa is assistant professor in the Department of Physical Medicine and Rehabilitation and assistant dean of Medical Student Research at the University of Pittsburgh School of Medicine. She holds joint appointments in the departments of Orthopaedic Surgery and Bioengineering. Dr. Sowa is currently conducting molecular-level research on disk and spine deterioration and the mechanisms of back pain.

Brad Dicianno, MD, is the recipient of the 2011 Association of Academic Physiatrists’ Young Academician Award.

Dr. Dicianno is assistant professor and director of Medical Student Education in the Department of Physical Medicine and Rehabilitation. He has received numerous awards for his work throughout his training and career, including several AAP Best Paper Presentation Awards (Faculty, Resident, 2004; Medical Student, 1999 and 2001).

Dr. Dicianno joins the ranks of past department honorees Amy Wagner, MD (2005), Gwen Sowa, MD, PhD (2009), and Michael Boninger, MD (1998).

Andrew Schwartz, PhD, is the recipient of the 2011 DeLisa Lectureship from the Association of Academic Physiatrists. The lectureship was established to provide a forum for outstanding work at the AAP annual meeting.

Dr. Schwartz is a professor of neurobiology in the Department of Neurobiology at the University of Pittsburgh School of Medicine. He holds joint appointments in the departments of Physical Medicine and Rehabilitation and Bioengineering, as well as the Center for Neural Basis Cognition and the McGowan Institute for Regenerative Medicine.

Jennifer Collinger, PhD, was awarded honorable mention for the 2010 AAP Excellence in Research Writing for the paper, “Validation of Grayscale-Based Quantitative Ultrasound in Manual Wheelchair Users: Relationship to Established Clinical Measures of Shoulder Pathology.” The paper was published in the May 2010 issue of the American Journal of Physical Medicine & Rehabilitation.

Dr. Collinger is assistant professor in the Department of Physical Medicine and Rehabilitation and research biomedical engineer with the Human Engineering Research Laboratories.
Amputee Walking School clinics improve performance

The UPMC Rehabilitation Institute sponsored free Amputee Walking School clinics to help individuals with leg amputations improve performance. The clinics were led by co-founders Todd Schaffhauser and Dennis Oehler, amputees and former Paralympians, both of whom won gold medals for sprinting in the Paralympics and other international track-and-field events.

Mr. Oehler and Mr. Schaffhauser teach amputees how to walk, run, and participate in physical fitness using standard track-and-field exercises adjusted for the older, non-athletic patient. The athletes stress that 45 minutes of strength and balance exercises three times a week is enough, so that after three years the patient will be doing almost everything he or she did before the amputation.

Jaspaal Singh, MD, director of rehabilitation services for amputees at UPMC Passavant, enthusiastically endorses the clinics, because they fill a large gap in rehabilitation for this community.

Read more about the clinics in the Pittsburgh Post-Gazette at www.post-gazette.com/pg/11115/1141499-114-0.stm.

Department of PM&R ranks No. 1 in National Institutes of Health funding

The Department of Physical Medicine and Rehabilitation at the University of Pittsburgh School of Medicine received nearly $3.5 million for research from the NIH in 2010, making it the top-ranked PM&R department in NIH funding in the country. Up from a fifth-place ranking in 2006, this improvement is a direct result of the extraordinary work by our scientists and physicians, from bench-level research to clinical trials. The Blue Ridge Institute for Medical Research (www.brimr.org/NIH_Awards/2010/NIH_Awards_2010.htm) compiled the data.

Members of our research and clinical faculty have been awarded multiple grants in NIH categories, including:

- K08: Mentored clinical scientist development award
- K12: Mentored clinical scientist development program award
- K23: Mentored patient-oriented career award
- R01: Research project
- R21: Exploratory, development grant grants
- T32 & T35: Training grants
- U01: Research project

Other funding sources include the U.S. Department of Veterans Affairs, U.S. Department of Education, U.S. Department of Defense, and the U.S. Army Medical Research and Material Command. Private foundations, including the Claude D. Pepper Older Americans Independence Center, the Craig H. Nelson Foundation, and the American Geriatric Foundation also are important sources of funding for our researchers. Funding contributes to the department's mission to advance the science and practice of rehabilitation medicine, and has helped develop important collaborations with many departments and schools within the University of Pittsburgh, as well as with Carnegie Mellon University, the University of California at Davis, the University of Washington, and the U.S. Department of Veterans Affairs.