Frontiers in Rehabilitation
A Newsletter for Physicians | 2011–2012

Musculoskeletal Ultrasound-Guided Injections: Increasing Accuracy, Improving Outcomes
Dear Colleague,

As our department grows, there is no lack of achievement and discovery to report. Since last writing, the National Institutes of Health have recognized our staff with three major grant awards. The excellence exhibited by our researchers elevates all of our activities, bringing a spirit of innovation to our department.

One of this year’s signature accomplishments was the opening of the restructured Cleveland Clinic Rehabilitation Hospitals. With 120 beds spanning the main campus, Euclid Hospital, Lakewood Hospital and Cleveland Clinic Children’s Hospital, we provide coordinated acute inpatient rehabilitation care across the region.

I am also honored to lead the team of 650 therapists that comprise Cleveland Clinic Rehabilitation and Sports Therapy. The energy, diligence and intellectual resources of this group are astounding. They are leading the development of disease-based treatment models that cross traditional academic departments; carepaths are delivered from a platform where outcomes measurements are fully integrated into a flexible, centralized electronic medical record.

Our therapists, physicians and researchers discuss their work in this issue:

• In our cover story, Michael Schaefer explains the process and benefits of ultrasound guided injections.

• Matthew Plow discusses his work identifying and promoting wellness strategies in patients with disabling conditions.

• Our experience with the rehabilitation of patients with organ transplants is featured.

• Investigators Ela B. Plow, Ken Sakaie and Erik Beall discuss their research on the neural mechanisms of recovery from stroke.

• Kathy Szirony and Susan Linder outline a new standard of care for Parkinson’s disease that features the benefits of forced exercise.

• Two new programs for osteoporosis and vestibular rehabilitation are setting new standards for training physical therapists across the Cleveland Clinic health system.

• Mary Stilphen details the newly expanded rehabilitation services for Alzheimer’s patients at the Lou Ruvo Center for Brain Health in Las Vegas.

As always, your comments are welcome, and we look forward to sharing our future achievements and advances in patient care.

Sincerely,

Frederick Frost, MD
Interim Chairman, Department of Physical Medicine and Rehabilitation
Executive Director, Cleveland Clinic Rehabilitation and Sports Therapy
PM&R Research:
Three NIH Grants Boost Program

2011 marks a milestone in the growth of Cleveland Clinic’s PM&R research enterprise, with the announcement of three NIH grant awards. Vernon Lin, MD, PhD, facilitated this remarkable achievement, attracting world-class researchers with his vision and diligence. The principal investigators and their project staff support a prosperous academic environment that will generate tremendous momentum for recruiting and retaining talented colleagues.

The NIH awards reflect the broad spectrum of rehabilitation science that is supported by a platform of clinical collaboration across multiple disease-based institutes. The grants include:

• Zong-Ming Li, PhD: Hand Sensorimotor Function and Carpal Tunnel Syndrome (1R01AR056964), studying the biomechanical and neurological deficit resulting from CTS, using a series of novel experimental approaches. The results of this project will provide valuable information regarding how CTS develops and its subsequent debilitating manifestations.

• Yu-Shang Lee, PhD: Recovery of Bladder Reflexes and Nerve Regeneration After Spinal Cord Injury (5R01NS069765), investigating nerve regeneration strategies to uncover its underlying mechanisms and testing the effectiveness of a novel therapeutic approach to restore bladder function after spinal cord injury.

• Ela B. Plow, PhD, PT: Brain Stimulation-Aided Stroke Rehabilitation: Neural Mechanisms of Recovery (1K01HD069504), developing a new paradigm for promoting recovery of function in chronic stroke through the use of adjunctive cortical stimulation. With advanced neuroimaging, the mechanisms’ underlying response to rehabilitation will be examined so that predictive models can be developed for future clinicians and researchers.

In addition to these efforts, Dr. Lin was the recipient of a $700,000 U.S. Department of Defense award that supports a multifaceted rehabilitation project. This project will explore novel treatment approaches for multiple sclerosis, gastrointestinal disorders, epilepsy and stroke. These researchers were recruited by Dr. Lin, who emphasized the department’s history of collaboration and fertile working relationships with clinicians and researchers across the enterprise. Though Cleveland Clinic has enormous physical and intellectual resources, it is the ability to demonstrate inter-institute cooperation and alignment of research goals that makes grant applications stand out. Great researchers attract students, enrich meetings and provide opportunities for clinicians to advance their academic careers. In return, the researchers obtain support and mentorship from colleagues across Cleveland Clinic – something that is less likely to occur in a system tied to a traditional academic hierarchy.

Ela Plow, PhD, PT, applying magnetic brain stimulation – part of an investigation of enhancements in stroke recovery.
Ultrasound imaging is a clinical tool that is rapidly gaining popularity in many medical specialties. Advantages of ultrasound include immediate accessibility at the patient’s bedside, identification of soft-tissue pathology, avoidance of radiation exposure, low cost, improved accuracy of injection, enhanced patient comfort during procedures, and better outcomes.

Cleveland Clinic now offers ultrasound guidance for musculoskeletal conditions. Ultrasound is used to accurately and quickly identify pathology and to precisely guide needles directly to the desired target.

**Ultrasound Scanning and Injection Technique**

During a typical musculoskeletal ultrasound session, at the patient’s bedside, images are obtained with a laptop-sized unit. A small transducer is passed over the affected areas in multiple positions and angles, and the patient’s body part is placed in standardized positions to obtain optimal images. Assessment is made for joint effusion, synovitis, or connective tissue disruption. For dynamic imaging, the patient is asked to reproduce his or her symptoms during real-time image collection. In cases with mechanical symptoms, the physician is able to see which specific structure may be catching or subluxing within the joint. Bony surfaces are often visible with ultrasound, but sound waves are unable to penetrate through bone. Therefore, an X-ray or CT scan is typically used to complement the ultrasound images.

Before the injection, the procedure site is prepared and draped, and a sterile barrier is placed over the ultrasound transducer. During the injection an optimal image is obtained, including a sonographic “window” that allows visualization of the needle as it advances toward the target tissue. In cases where aspiration is necessary, the amount and location of abnormal fluid is identified.

Subsequently, the “color Doppler” mode of the device is activated, showing vascular structures (Figures 1 and 2). If needed, the injection approach can be changed to avoid accidental damage of vessels and nerves. Finally, under real-time guidance, the tip of the needle is inserted and seen advancing through the overlying tissues. When the target is reached, aspiration of fluid and injection of medication is visualized, again, under real-time conditions. Therefore, the physician is able to determine if accurate delivery has been achieved.

When images are obtained at the patient’s bedside, they are stored electronically in Cleveland Clinic’s electronic medical record, and are accessible to any provider within Cleveland Clinic’s network, even outside of the Greater Cleveland area.

**Improved Outcomes**

Multiple research studies have shown improved accuracy with the addition of ultrasound guidance. In two recent research articles, patients reported less pain during shoulder injection procedures compared to the same procedures done without guidance. When compared to fluoroscopy, one study reported significantly less procedural time was required for injection of the glenohumeral joint. Most importantly, however, there is evidence for improved pain relief after accurately placed injections.

**Current Clinical Application**

Ultrasound guidance is most commonly used during deeper joint injections such as shoulder or hip joints, but it is also very effective for small structures such as acromioclavicular joints, carpal-metacarpal joints and tendon sheaths in the hand. Superficial injections may be attempted without ultrasound guidance, but in our current practice, patients are often directed to follow up for ultrasound-guided procedures if the initial attempt was not successful. Patients with abnormal anatomy or severe obesity are often sent directly for ultrasound guidance. For cases with chronic tendinopathy, ultrasound is used for accurate placement of platelet-rich plasma injections, autologous blood injections or needle tenotomies, which are guided to the areas showing the most tendon degeneration.

**The Future of Musculoskeletal Ultrasound**

Musculoskeletal ultrasound is expected to become even more popular, both in frequency of use and scope of practice. Currently, the greatest limitation is provider skill level, particularly in diagnostic assessments. There is a lack of structured training programs and an absence of official certification criteria. Also, ultrasound can be time-consuming for the provider, and
documentation of multiple images requires investments in personnel and electronic equipment. Further research is needed to determine appropriate use of ultrasound both in bedside diagnosis and in treatment algorithms. Quality standards for technicians and practitioners are currently in development.

In the future, ultrasound will be more frequently employed intraoperatively to guide minimally invasive surgical techniques, or preoperatively to place markers to guide surgical techniques. As advanced biological therapies are further developed for musculoskeletal conditions, ultrasound will probably play a role in ensuring their accurate delivery to target locations.

Case Study

A 46-year-old personal fitness trainer with a remote history of rotator cuff repair was seen for chronic shoulder pain. He complained of severe anterior pain that had been present for about two years. He had physical therapy and an injection of the subacromial space by a different physician 18 months prior, with temporary relief. A subsequent injection into the glenohumeral joint provided no relief, so he sought another opinion.

Upon examination, he had tenderness in the anterior aspect of the shoulder, pain with forward flexion, and mild impingement. At Cleveland Clinic’s Arthritis Center, a biceps tendon sheath injection was performed with ultrasound guidance. However, as part of the routine pre-injection sonographic assessment, it was also noted that the patient had a longitudinal split tear of the long head of the biceps tendon (Figures 3 and 4), and the possibility of a small tear in the supraspinatus tendon was noted. Within four days, the patient was seen by an orthopaedic surgeon, and the findings were confirmed by MRI scan. Arthroscopic surgery was scheduled eight days later. The patient underwent a biceps tenodesis and a rotator cuff repair with excellent relief. After eight weeks he had no pain in the shoulder and started physical therapy. By 16 weeks, he had returned to weight lifting, still without shoulder pain.

In this case, the application of ultrasound imaging at the patient’s first visit to the Arthritis Center resulted in an expedited diagnosis and referral to the appropriate surgeon, likely bypassing another prolonged course of therapy. The patient was able to obtain an excellent outcome in a very short period of time.

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REFERENCES

A Paradigm Shift in Rehabilitation Research: Focusing on Wellness While Living With a Disabling Condition

By Matthew Plow

Individuals with disabilities are two to four times more likely to be morbidly obese. This is because disabling conditions can cause health-related barriers (e.g., fatigue, pain and mobility impairments) to engaging in healthy behaviors. Furthermore, the social and physical environment can be unsupportive for individuals with disabling conditions. Our research team focuses on identifying effective strategies to help individuals overcome health-related barriers to engaging in healthy behaviors and move toward a state of wellness. Specifically, our research includes promoting physical activity through interactive video game technology, tailoring educational material to the needs of the patient (rather than a one-size-fits-all approach) and rearranging the social environment to foster engagement in healthy behaviors.

Rehabilitation research tends to focus on alleviating or accommodating underlying pathologies and impairments. While this research is extremely important, there is also a need to identify strategies to promote wellness. Engagement in routine physical activity and healthy eating, as well as the utilization of strategies to manage emotions (e.g., anxiety and depression) are important in achieving wellness while living with a disabling condition. Unfortunately, common symptoms such as fatigue, pain and mobility impairments can make it difficult to engage in healthy behaviors. This initiates a vicious circle of inactivity and deconditioning, weight gain and further mobility problems, and chronic stress and depression, all of which make it more difficult to engage in healthy behaviors and ultimately lead to poorer quality of life.

Our Research

The premise of our research is that patients with disabling conditions should be encouraged to pursue the maximum fitness and psychological health allowed by their clinical circumstances, and to achieve a rewarding quality of life regardless of the limitations set by the disease. We have received funding from the National Institutes of Health, the National Multiple Sclerosis Society, the American Heart Association, and the Agency for Health Care Research and Quality to identify strategies to promote health and wellness in individuals with stroke, multiple sclerosis (MS), and Parkinson’s disease.

Our research can be divided into two phases — first, developing, then testing interventions to promote healthy behaviors in individuals with disabling conditions. In the developmental phase, we believe that it is extremely important to involve all major stakeholders. Thus, this stage of our research involves conducting interviews with patients, family members and clinicians. For example, we are interviewing patients and rehabilitation professionals to obtain their opinions on how to incorporate interactive video game technology into clinical practice. Eventually, we hope to demonstrate through evaluation research that this technology can be used to increase efficiency and effectiveness of outpatient rehabilitation programs and promote long-term exercise adherence in patients with disabling conditions.

To avoid “reinventing the wheel” when developing health behavior interventions, we are selecting and adapting existing state-of-the-art interventions shown to be effective in other population segments, such as healthy adults. For example, we are currently adapting a print-based physical activity intervention for individuals with MS, designed by a research team led by Bess Marcus at Brown University. Instead of the commonly used one-size-fits-all approach, the intervention is tailored to both the physical and psychological needs of patients through an initial evaluation. We believe the tailored aspect of this intervention is extremely important for patients with MS because the disease often manifests with wide-ranging symptoms, affecting which health-related physical activity barriers are experienced and the stage of psychological readiness to change behavior. Thus, participants receive tailored print materials and exercise prescriptions based on their individual evaluations. We hope to demonstrate that this low-cost intervention can be an effective strategy that rehabilitation clinicians can implement to promote long-term physical activity in patients with MS.
We are also adapting a face-to-face group weight management intervention for stroke survivors, designed by a research team led by Shirley Moore at Case Western Reserve University. This intervention is innovative because it contrasts with existing cognitive-behavioral approaches for promoting healthy behaviors. The intervention focuses on redesigning the social environment using trial-and-error experiments, rather than cognitive-behavioral interventions that focus on changing a person’s viewpoint of a situation and increasing motivation. Thus, patients are encouraged to create a positive social environment to increase the likelihood of changing their behavior in spite of wavering motivation. Because patients with disabling conditions may face many health-related barriers to engaging in healthy behaviors, the social environment and social support can play an extremely important role in reducing those barriers.

The goal of our research is to maximize a patient’s physical and mental health within the parameters established by his or her disease and to possibly expand those parameters. Ultimately, we want to create a cost-effective therapeutic program that incorporates exercise, nutrition, and stress reduction strategies tailored to meet each patient’s identified health needs.

Matthew Plow, PhD, is a project scientist in the Department of Biomedical Engineering and in the Department of Physical Medicine and Rehabilitation. His research interests are promoting initiation and maintenance of physical activity for persons with chronic disabling conditions, developing and testing outcome measures and promoting the self-management of symptoms and translating interventions. He can be reached at 216.445.3288 or at plowm@ccf.org.
Rehabilitation of transplant patients requires close integration with the resources of the acute hospital. Since 1993, Cleveland Clinic’s inpatient rehabilitation facilities have provided comprehensive services for lung, liver, kidney and heart transplant patients, helping to improve outcomes and smooth transitions between hospital and home.

In 2003, Cleveland Clinic physiatrists were faced with accelerated pressure from third-party payors who were denying inpatient rehabilitation facility (IRF) admission of transplant patients, based on poor initial performance when evaluated by physical therapists in the acute hospital. Cleveland Clinic staff responded by undertaking a systematic review of the sickest, most debilitated and medically complex of their transplant populations — liver transplant patients. Our published findings demonstrated unequivocally that these patients achieved significant functional gains with impressive efficiency during their acute rehabilitation stay, despite their complex medical condition and initial level of debility. These findings reaffirm and validate Cleveland Clinic’s continued commitment to advocate for and treat a patient population frequently turned away by hospitals and insurance companies.

Transplant Patients in the Inpatient Rehabilitation Facility Setting

By Frederick Frost and John Lee

Transplant patients have limited options for rehabilitation. An extended stay in the acute hospital may not be covered by insurance, nursing homes may not be adequately staffed or trained to handle transplant rehabilitation, and discharge to the home can be risky if the patient family and support infrastructure are not adequately prepared. The question often raised is: Can the patient tolerate intensive rehabilitation treatment in an acute rehabilitation unit?

Challenges and Barriers to Transplant Rehabilitation

Hospitals and patients face enormous challenges when approaching transplant surgery and rehabilitation. The overall costs associated with a liver transplant can exceed $1 million. Hospital systems strain to shoulder the high burden of nursing care for these patients along with pharmacy costs, which are often more than $800 per day. As prices spiral upward, insurance companies balk, hospitals may become avoidant and families are faced with bankruptcy when the patient is no longer able to work or maintain health insurance.

The complexity of the patient’s condition lies at the root of the problem. Already the sickest of sick patients, their severe physical debility may be compounded by cognitive deficits. Disrupted executive functioning, including poor initiation, planning and problem solving, are often a barrier to discharge from the hospital. In the case of liver transplant patients, hepatic encephalopathy may present as their most disabling condition. In some cases, underlying alcoholism, substance abuse and depression must be identified and treated.

Finally, the families of transplant patients face a long, uphill journey. Many are exhausted from years of medical crises, traveling long distances to deliver their family members for care and navigating insurance coverage entanglements. Post-transplant, families are confronted with a new set of challenges, as they are called upon to help the patient deal with postoperative pain, take care of large surgical incisions, and forestall progressive muscle deconditioning.

Meeting the complex medical needs of transplant patients demands a healthy partnership between physiatrists and rehabilitation nurses.
Meeting these challenges requires seamless transitions between phases of care and close communication among treating physicians and therapists. A standardized approach to transplant care allows nursing services to become adept at monitoring patient status and responding to problems as they arise. In an integrated, cross-venue enterprise, specialized social, psychological and family support services can be easily shared with the surgical transplant team.

Integration between venues of care is facilitated by a common electronic medical record platform, and by treatment protocols that are shared by the transplant surgical teams. Currently, Cleveland Clinic Rehabilitation Hospitals encompass 120 beds across four venues in Greater Cleveland. Three facilities serve adults — Cleveland Clinic’s main campus, Euclid Hospital and Lakewood Hospital. Inpatient pediatric rehabilitation services are available at Cleveland Clinic Children’s Hospital Shaker Campus.

Positive Outcomes for Complex Cases

Close medical supervision is needed to monitor and address the issues of post-transplant rejection, immunosuppression, polypharmacy and infection. This level of medical intensity is not available in a skilled nursing facility. When given intensive inpatient rehabilitation services, even the most complex transplant patients have proven their ability to achieve substantial functional improvement, usually within a two- to three-week IRF stay where daily physician care is provided.

IRF is the ideal treatment environment for bridging the hospital and the patient’s home, providing the physical, intellectual and emotional support resources needed for a smooth transition. Time spent with proficient rehabilitation nurses and therapists provides patients with the opportunity to learn about new medications, self-assess their symptoms, challenge their physical limitations and stretch their capabilities. Family members are essential members of the team, receiving expert education as well. The investment in rehabilitation care provided in the IRF pays benefits in the months and years after transplant surgery.

In the face of rising costs and reduced reimbursement, transplant patients risk being diverted from inpatient rehabilitation to other settings. Pressured to discharge patients early, hospitals may push for discharge from the ICU into long-term acute care facilities. Third party payors have every incentive to funnel patients into lower-cost skilled nursing rehabilitation settings.

As a premier provider of transplant rehabilitation services, even the most complex transplant patients have proven their ability to achieve substantial functional improvement, usually within a two- to three-week IRF stay where daily physician care is provided.

Case Study: Heart Transplant

A 56-year-old man presented with hypertension, chronic renal insufficiency and chest pain. The diagnosis was MI, and studies with cardiac catheterization and echocardiogram revealed 100 percent right coronary artery occlusion and ventricular septal rupture.

An intra-aortic balloon pump was placed, a bovine patch was placed over the rupture and the patient eventually required both left- and right-ventricular assist devices. He was transferred to Cleveland Clinic and kept on ventricular assist devices until a suitable donor was identified. Heart transplant surgery took place slightly more than a month later.

The patient’s post-transplant course was complicated by the need for extracorporeal membrane oxygenation and hemodialysis. Further complications included sternal wound dehiscence that required negative pressure wound therapy, and pleural effusion requiring chest tube drainage.

With this constellation of medical and surgical issues, plus a prolonged hospital stay with relative immobility, the patient had become severely deconditioned. Because he required assistance for mobility and daily tasks, he was admitted to acute rehabilitation less than a month after the transplant surgery.

During his two-week stay in rehabilitation, the patient achieved medical stability and was able to focus on his main concern: becoming physically independent once more. Therapies consisted of a progressive functional exercise program that focused on increasing strength and endurance as well as training in compensatory strategies. He was discharged after achieving independence with activities of daily living and mobility.

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Suggested Reading:
Research has identified a mechanism perpetuating residual dysfunction: maladaptive transcallosal inhibition (TCI). The contralesional (intact) motor cortex exerts abnormal inhibition via transcallosal pathways (through the corpus callosum connecting the stroke-affected and unaffected hemispheres) upon the ipsilesional (stroke-affected) motor cortex. Although contemporary rehabilitation and advanced techniques, such as neuromodulation involving brain stimulation attempt to reduce maladaptive TCI, effects are modest, variable and poorly replicated in large-scale trials. We are addressing this research problem by using two exclusive yet complementary aims — accurate examination of transcallosal connectivity (TCC) and modulating TCI to facilitate stroke rehabilitation.

Accurate Examination of Transcallosal Connectivity

By applying noninvasive, novel imaging approaches to understanding and estimating TCC, we seek to overcome a critical barrier to advancing rehabilitation and modern neuromodulation in stroke patients. The unique tools developed at the Imaging Institute more closely approach direct functional and structural imaging of TCC. Modulated functional connectivity MRI (mod-fcMRI) defines functional TCC based on temporal coherence between activities of bilateral motor cortices, while probabilistic tractography identifies structural tissue integrity of TCC (Figure 1).

Next, we are validating these novel imaging-based TCC measures (Figure 2) with neurophysiologic and clinical evaluation of the phenomenon of TCI, using transcranial magnetic stimulation (TMS) and functional assessments, respectively. In doing so, we are investigating the superiority of these novel imaging methods over traditional illustration of TCC in defining TCI and its change in recovery from stroke. This will improve the prognostic value of novel markers for the future, aiding advancement of rehabilitation and neuromodulation.

Implications for Scientific Knowledge and Clinical Practice

Inconsistency and ineffectiveness of contemporary rehabilitation and brain stimulation raises doubts about their ability to target TCI. If successfully validated, our novel imaging markers of TCC will either help confirm such speculations or encourage the study of alternate mechanisms or treatment strategies. If successful, our imaging markers will be optimized for cost-effectiveness in the future and serve as routine assessment tools in clinical practice for defining rehabilitation prognosis and helping develop new methods for modulating TCI directly through noninvasive and invasive brain stimulation.

Modulating TCI to Facilitate Recovery in Stroke Rehabilitation

Contemporary rehabilitative methods of normalizing TCI in stroke address residual deficits by promoting use of the paretic upper limb during restraint of the non-paretic limb. Despite promising evidence, clinical utility of these methods is limited due to labor-intensive protocols that are expensive and impractical to follow. Furthermore, variable outcomes and persistent deficits prevent drawing definitive conclusions about efficacy. Delivering cortical stimulation may accelerate or enhance normalization of TCI in rehabilitation, making it less labor-intensive and more effective in promoting function. In fact, animal and preclinical studies show that stimulating surviving motor cortical regions and perilesional areas during rehabilitation offers a synergistic functional advantage compared to rehabilitation delivered alone.

Despite its preliminary success, the efficacy of combining cortical stimulation and rehabilitation remains unconfirmed in large-scale studies. In our research, we are addressing numerous inconsistencies in past research that may explain these null findings. Our efforts include 1) choosing alternate...
loci of stimulation based on their potential to survive and function vicariously for lesioned areas, 2) adopting methods of cortical stimulation that can be applied concurrently in rehabilitation, and 3) examining comprehensive functional and structural neural indices that define response to the synergism of stimulation and rehabilitation.

By aiming to improve the efficiency and effectiveness of current methods of rehabilitation, our paradigm intends to promote the therapeutic utility of current interventions, thereby reducing excessive healthcare costs associated with stroke. Furthermore, the scientific knowledge created in our research will foster an understanding of comprehensive mechanisms of recovery, ultimately developing paradigms optimized to patients’ lesions, function and neural resources.

**Future Directions**

Stroke offers an excellent clinical-theoretical model to explore the functions of different regions of the brain during movement, their interactions in neuromotor recovery and the effects of differentially weighting those networks to further facilitate function. Our research in stroke has helped us prepare for translating learned concepts to other spheres of neurological rehabilitation, such as impaired upper limb control in incomplete spinal cord injury and geriatric rehabilitation. Through funding from the National Institutes of Health, the Department of Defense, the Clinical and Translational Science Initiative at Cleveland Clinic and collaborative support from investigators, including Guang Yue, PhD, Frederick Frost, MD, Andre Machado, MD, PhD, Mark Lowe, PhD, and Stephen Jones, MD, PhD, we believe we have key opportunities for diversification of our research portfolio.

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Traditionally, caring for Parkinson’s disease (PD) patients has meant teaching them how to compensate for the debilitating effects of the disease in its advanced stages. Recent literature and research suggest a new standard of care that is proactive, calls for earlier intervention and has been found to improve PD symptoms.

PD patients often do not enter rehabilitation until late in their disease course. With earlier intervention, there may be more opportunity for reducing symptoms as well as delaying symptom progression. Cleveland Clinic’s Department of Physical Medicine and Rehabilitation, in collaboration with researchers at Cleveland Clinic’s Lerner Research Institute, is leading the development of a new standard of care based on early intervention with physical rehabilitation and introducing leading-edge research into the clinical setting.

The idea for creating this new standard of care arose in 2010, as a way to address the relative lack of resources offered to PD patients in the early stages of the disease. Since then, a team of physicians, therapists and researchers at Cleveland Clinic has been working to develop a state-of-the-art, evidenced-based program to address this need.

Physical Fitness Is a Key Component

The new carepath is designed to prepare patients for the physical issues of declining coordination, endurance and loss of balance that they are likely to encounter as their disease progresses. Promoting good health and fitness is fundamental to these new therapy protocols. A decade ago, conventional wisdom assumed that energy conservation was a better strategy for PD patients. We now realize the need to meet this disease head-on with fitness and endurance training. All patients are now directed toward a healthy lifestyle with regular exercise.

The rehabilitation carepath for early intervention focuses on:

- Improving aerobic fitness, muscle force and soft tissue extensibility
- Training patients in movement and cognitive strategies
- Encouraging regular physical activity and balance training for fall prevention
- Promoting neuroplasticity through moderate to vigorous exercise
PD patients have a lifetime need for exercise, but “maintenance level” therapy is not covered by insurance. Four sites within the health system will soon offer gym availability under a self-directed exercise model. Attendance and outcomes for these patients will be tracked and analyzed using an integrated information database. Over the course of therapy, the patients will be advised to have periodic re-evaluations with their therapists to adjust or modify their exercise program as needed. This ongoing, interval rehabilitation model aligns with the progressive nature of the disease.

Applying New Knowledge in the Clinical Setting

Cleveland Clinic clinicians play an active role in research on forced exercise, encouraging patients in early stages of PD to employ a more rapid rate when pedaling on a stationary bike or walking on a treadmill. The concept, introduced by Jay Alberts, PhD, of Cleveland Clinic’s Lerner Research Institute, suggests that patients who exercise at a more intense level than they would voluntarily (i.e., pedaling faster on a bicycle) experience improvements in upper limb motor function, in addition to improvements in cognition and quality of life. It is speculated that intense exercise early in a patient’s disease course might affect the neurodegenerative process, slowing disease progression and motor deterioration. A clinical trial on the concept is under way at Cleveland Clinic’s main campus and at Cleveland Clinic’s Lou Ruvo Center for Brain Health in Las Vegas. The results from these trials will continue to shape the PD rehabilitation program.

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A disease-based rehabilitation enterprise is built upon an investment in staff education. Subspecialty training extends to all members of the treatment team. Cleveland Clinic’s Department of Physical Medicine and Rehabilitation supports the efforts of Cleveland Clinic Rehabilitation and Sports Therapy, most recently devoting resources to therapist training programs related to two conditions – vestibular dysfunction and osteoporosis. Both conditions have seen a huge increase in demand for specialized rehabilitation programming.

Thanks to two comprehensive training efforts in vestibular and osteoporosis therapy, patients are benefiting from an expanded network of rehabilitation professionals, skilled in the most current treatment protocols. In the last year, the number of certified vestibular therapists has increased nearly five-fold, thanks to a training program designed to meet high patient demand throughout Cleveland Clinic’s health system. In an allied educational program, 400 therapists completed training aimed at delivering evidence-based therapies to osteoporosis patients and identifying those at secondary risk.

Vestibular Rehabilitation

To meet the high demand for vestibular therapy, an intensive educational program was designed to expand our provider pool and provide patient-centric care with an emphasis on research and education. The training is based on the Herdman Vestibular Competency Course — the gold standard training program — which also includes advanced instruction that accommodates the rapid evolution of current literature.

Course of Study

Beginning in late 2009, more than 650 Cleveland Clinic therapists were polled to attract staff members interested in vestibular disorders. Each recruit completed a self-study course from the American Physical Therapy Association (APTA). The APTA curriculum provided fundamental education in anatomy and physiology, along with basic evaluation and exercise principles for vestibular and balance therapy. The integration between the vestibular and musculoskeletal system to maintain balance and postural control formed the foundation for learning.

Following the self-study course, therapists participated in several weeks of intensive training with established vestibular clinicians at Cleveland Clinic’s main campus. They mastered modules in evaluation and exercise techniques and practiced treatment interventions.
Case study videos showing patient eye movements were used to train practitioners to identify symptom patterns. To ensure the highest skill level, all trainees were required to participate in Herdman training and certification, an additional intensive six-day course ending with a competency examination. In April 2010, the Herdman graduates were deployed across the health system in specialized vestibular clinics.

Expanded Network

We now have a core group of 17 therapists assigned geographically to strategic locations across the health system to meet a rapidly growing number of physician referrals. The team meets quarterly to address organizational, research and academic agendas. Discrete data logging through an integrated electronic medical record allows tracking of patient outcomes on a case-by-case and aggregate basis.

Osteoporosis Rehabilitative Therapy

As the vestibular rehabilitation training effort was launched, therapists in the Osteoporosis and Bone Health Rehabilitation Program were developing a similar course of study. In the first quarter of 2011, the 400 physical and occupational therapists received concentrated training in the most current treatment techniques for patients with osteoporosis and bone mineral density disorders.

Consistency of Care

Our program’s aim is to use evidence-based medicine to positively affect the impairments, functional limitations and pathophysiology of bone disease, with the added mission of implementing a coordinated carepath across a large health system.

Similar to colleagues in the vestibular therapy program, leaders of the osteoporosis team examined the medical literature to identify the most current, evidence-based research. Team leaders were funded to attend conferences taught by national and international speakers. They worked in collaboration with a varied group of physicians treating osteoporosis at Cleveland Clinic. Treatment algorithms were merged into a system-wide Cleveland Clinic standard of care for this patient population.

From a clinical perspective, the program was designed to develop specific guidelines for exercise intervention. The training program has resulted in a simple, systemized protocol that can accommodate most patients, whether the need is to attenuate bone loss, build bone, or protect bone in frail patients. All therapists are trained to consistently give the right dose of exercise to each patient by following current guidelines.

Along with exercise, the program focuses on training therapists to educate patients on the importance of proper body mechanics used during activities of daily living, with the goal of optimizing posture, supporting the spine and reducing the incidence of falls.

Identifying At-Risk Populations

Our osteoporosis and bone health team also undertook this effort in order to be more adept at identifying patients at risk. Many patients seen by our PTs have a primary diagnosis other than osteoporosis, such as joint issues, bone fractures or history of long-term steroid use. At risk for suboptimal bone health, these patients are identified by the therapy team and counseled to seek medical attention. Patients also benefit from an organized and proscribed patient education strategy. High-quality educational materials are accessible to clinicians for distribution to clients from an internal SharePoint site. Additionally, a new e-mail journal targeting treating therapists, BoneBlast, is under development as another means of continuing education and outreach.

This expanded, research-based therapist education model will be implemented in other Cleveland Clinic centers, aligning with physician champions in each area. The approach taken by both the vestibular and osteoporosis rehabilitation programs represents a model that other large healthcare systems can adopt, and is designed to be used across the spectrum of inpatient, outpatient, and home care therapy programs.

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Infrared goggles can be used to assess vestibular function during physical therapy sessions.
Use of Non-Pharmacologic Therapies to Improve Physical and Cognitive Functioning in Alzheimer’s Disease

By Mary Stilphen and Courtney Miller

Located in Las Vegas, Cleveland Clinic Lou Ruvo Center for Brain Health is a pioneer in the integration of physical, occupational and cognitive-linguistic therapy for the treatment of neurocognitive and neurodegenerative disorders. These non-pharmacologic interventions have been shown to amplify the effect of medications and improve motor function, cognition, aerobic capacity, speech, swallowing, sense of well-being and overall wellness.

Although rehabilitation strategies have not been shown to affect broad measures of cognitive function after the diagnosis of Alzheimer’s disease, specific task practice techniques have shown promise in maintaining a patient’s ability to carry out useful, everyday activities. Face recognition, name recall, direction finding, making change for a purchase – performance in all these areas has been shown to improve with rehabilitation treatment.

Although the effect of rehabilitation on cognitive decline is still unknown, it has been shown to improve several domains of quality of life and reduce falls in patients with Alzheimer’s disease. There is considerable empiric evidence to indicate a strong association between physical strength, mobility and the maintenance of community participation. Patients who lose strength become increasingly housebound and immobile, and their risk of fall increases. Regular exercise improves postural stability, helps prevent falls and enables patients to retain a level of activity and socialization that brings enjoyment.

Retraining the Neuromuscular System

Since many disorders are not purely motor or cognitive in nature, maximal gains in function require both cognitive and motor symptoms to be addressed. Specialized equipment in the 1,000-square-foot rehabilitation center at the Lou Ruvo Center for Brain Health facilitates neurorehabilitation by combining the physical and cognitive dimensions of rehabilitation. The equipment supports the goal of delivering carefully measured exercise and task practice regimens that can be controlled for dose, frequency and duration, as well as objective feedback provided to help gauge progress.

The cornerstone of an effort to reduce falls is a virtual reality system that employs a balance platform with a digital surround system. It provides gradually progressive challenges that benefit patients with balance and mobility deficits by retraining the neuromuscular system to improve reactions and stability. Further, the system allows the therapists to quantify a patient’s ability to perform the balance and mobility tasks needed to function safely and effectively in everyday life.

Other state-of-the-art equipment, including an advanced body weight support treadmill system and aerobic equipment with cognitive gaming and display, was selected to accommodate patients with physical disabilities to improve muscle strength, balance and cardiovascular health. The gaming systems are used to retrain reflexes by reinforcing the body-brain connection.
A Population Ripe for Research

The goal of our program is to improve physical function, while building a base of scientific knowledge that will drive the development of novel, effective rehabilitation treatments for Alzheimer’s disease. Cleveland Clinic researchers are particularly interested in documenting the effects of various therapies on patients with Alzheimer’s disease, as well as the potential of rehabilitation to prevent cognitive decline in adults at risk for Alzheimer’s disease. Measuring outcomes is an integral component of rehabilitation. Ongoing outcomes-based assessments of existing and newly introduced programs are being logged and validated to ensure continuous improvement. Access to large numbers of Alzheimer’s patients at the Lou Ruvo Center for Brain Health will accelerate the research process.

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Introducing Cognitive Therapy

Cognitive-linguistic therapy at the Lou Ruvo Center for Brain Health targets attention, memory, visuospatial awareness, executive function, problem solving and safety deficits. Patients with Alzheimer’s disease, Huntington’s disease, dementia, traumatic brain injury, head trauma, mild cognitive impairment and memory loss accompanying Parkinson’s disease or multiple sclerosis may benefit.

One component of cognitive therapy utilizes computer software that stimulates cognitive function by asking a series of questions, which are continually adjusted in difficulty based on the patient’s responses. The program is highly individualized and recognizes an individual’s performance across sessions.

The rehabilitation team members employ cognitive therapy in a multifaceted approach designed to improve the ability of the mind and body to work together.

Cleveland Clinic Lou Ruvo Center for Brain Health in Las Vegas, Nevada. Photograph courtesy of Matthew Carbone Photography.
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General Information 216.444.2000

General Patient Referrals
24/7 hospital transfers or physician consults 800.553.5056

Department of Physical Medicine
and Rehabilitation Physician Referrals
866.588.2264

On the Web at clevelandclinic.org/rehab

Frontiers in Rehabilitation, published by Cleveland Clinic's Department of Physical Medicine and Rehabilitation, provides updates on diagnostic and therapeutic techniques and current research for physiatrists, neurologists and neurosurgeons.

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The Department of Physical Medicine and Rehabilitation is part of the Neurological Institute, one of 26 institutes at Cleveland Clinic that group multiple specialties together to provide collaborative, patient-centered care. The department offers full cross-disciplinary rehabilitation for patients with physical, psychosocial, cognitive and vocational impairments. Patients receive coordinated care across a continuum that spans inpatient rehabilitation, skilled nursing and outpatient therapy at Cleveland Clinic facilities throughout the region. Cleveland Clinic is a nonprofit, multispecialty academic medical center. Founded in 1921, it is dedicated to providing quality specialized care and includes an outpatient clinic, a hospital with more than 1,300 staffed beds, an education institute and a research institute.

Frontiers in Rehabilitation is written for physicians and should be relied upon for medical education purposes only. It does not provide a complete overview of the topics covered, and should not replace the independent judgment of a physician about the appropriateness or risks of a procedure for a given patient.

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Resources for Physicians

Physician Directory
View all Cleveland Clinic staff online at clevelandclinic.org/staff.

Referring Physician Center
For help with service-related issues, information about our clinical specialists and services, details about CME opportunities, and more, contact the Referring Physician Center at refdr@ccf.org, or 216.448.0900 or 888.637.0568.

Track Your Patient’s Care Online
DrConnect is a secure online service providing our physician colleagues with real-time information about the treatment their patients receive at Cleveland Clinic. To receive your next patient report electronically, establish a DrConnect account at clevelandclinic.org/drconnect.

Request Medical Records
216.445.2547 or 800.223.2273, ext. 52547

Critical Care Transport Worldwide
Cleveland Clinic’s critical care transport teams and fleet of mobile ICU vehicles, helicopters and fixed-wing aircraft serve critically ill and highly complex patients across the globe. Transport is available for children and adults. To arrange a transfer for STEMI (ST elevated myocardial infarction), acute stroke, ICH (intracerebral hemorrhage), SAH (subarachnoid hemorrhage) or aortic syndromes, call 877.379.CODE (2633). For all other critical care transfers, call 216.448.7000 or 866.547.1467 or visit clevelandclinic.org/criticalcaretransport.

Outcomes Data
View clinical Outcomes books from the Neurological Institute and other Cleveland Clinic institutes at clevelandclinic.org/quality/outcomes.

CME Opportunities: Live and Online
Cleveland Clinic’s Center for Continuing Education’s website offers convenient, complimentary learning opportunities, from patient simulations, webcasts and podcasts to a host of medical publications and a schedule of live CME courses. Physicians can manage CME credits using the myCME.com Web portal available 24/7. Visit ccfcme.org.

Resources for Patients

Appointments
Rehabilitation Physiatry: 866.588.2264
Physical/Occupational Therapy: Adults, 216.445.8000; Pediatrics, 216.444.6572
Return-to-Work Services/Vocational Rehabilitation: 216.444.WORK (9675)
Orthotics and Prosthetics Center: 216.445.9000.

Medical Concierge
For complimentary assistance for out-of-state patients and families, call 800.223.2273, ext. 55580, or email medicalconcierge@ccf.org.

Global Patient Services
For complimentary assistance for national and international patients and families, call 001.216.444.8184 or visit clevelandclinic.org/gps.

MyChart®
Cleveland Clinic MyChart® is a secure, online personal healthcare management tool that connects patients to portions of their medical record at any time of day or night. Patients may view test results, renew prescriptions, review past appointments and request new ones. A new feature, Schedule My Appointment, allows patients to view their primary physician’s open schedule and make appointments online in real time. Patients may register for MyChart through their physician’s office or by going online to clevelandclinic.org/mychart.
The 2011 “America’s Best Hospitals” survey recognized Cleveland Clinic as one of the country’s leading hospitals overall, with a No. 4 ranking nationwide. Fifteen Cleveland Clinic specialties placed among the top 10 in the United States, and our rehabilitation services are ranked 19th in the country. For more details, visit clevelandclinic.org.

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