Deepen Insights

HOW MUSCULOSKELETAL ULTRASOUND IS ENHANCING REHABILITATION CARE

BY MOOYEON OH-PARK, M.D.

Physiatrists have long relied on imaging techniques to link structural abnormalities to clinical findings, thereby improving diagnostic accuracy and outcomes of interventions for musculoskeletal disorders. Traditionally, imaging studies are performed and interpreted outside the office of clinicians, who then review the results in follow-up visits. However, the introduction of ultrasonography in physiatric practice enables physicians to evaluate a variety of musculoskeletal and neuromuscular conditions in the clinic.

Musculoskeletal ultrasonography (MSK US) is relatively new to the rehabilitation field but represents a dynamic tool to assess and treat joints, muscles, tendons, ligaments, nerves and other soft tissue pathologies. Proper training and appropriate use of this important technique allow clinicians to reap its full benefits at the point of care and optimize patient outcomes.

KNOW YOUR TOOLS

Ultrasound technology has been used in the medical field for many decades in areas including obstetrics, surgery and general medicine. The traditional approach typically relied on lower-frequency transducers, which are for deep tissues such as those in the abdomen. Through advancements, high-frequency transducers were developed to visualize relatively superficial structures, including the musculoskeletal system. Many physiatry practices are equipped with MSK US, including the Kessler Institute for Rehabilitation campuses.

Diagnostically, MSK US may serve as a complementary or alternative tool to radiography and other imaging approaches by providing an objective view of damaged structures. Compared with radiographs, nuclear imaging, computed tomography (continued on page 2)
(CT) and magnetic resonance imaging (MRI), ultrasound is more affordable, is highly portable, offers higher-resolution images, and can be readily integrated at the point of care without radiation risk or contraindications.

However, the benefits of MSK US are operator-dependent: Poor understanding of the tool’s applications and limitations may hamper its ability to improve patient care. Rehabilitation clinicians should know what anatomy and pathologies are best suited to this modality.

For instance, MSK US is an excellent diagnostic tool for tendon pathologies of the shoulder but may have limited value in evaluating labrum pathologies, for which MRI would be better. Similarly, MSK US is highly proficient at revealing muscle and tendon tears and joint effusions of the knee; however, it may not be the best way to assess meniscal pathologies. There have been reports on the role of point-of-care ultrasonography in detecting heterotopic ossifications among patients undergoing inpatient rehabilitation. Studies are needed to examine whether using MSK US for diagnosis saves costs in physiatric practice.

**TARGETED INTERVENTIONS**

In addition to its diagnostic value, ultrasound is a remarkable asset in image-guided interventions for musculoskeletal conditions. While fluoroscopy and CT are often used for injections in the spine and hip, sacroiliac and other large joints, MSK US is more widely used for the joints and soft tissue of the limbs without exposing patients to radiation. By improving the accuracy of needle placement compared with blind technique, ultrasound-guided interventions potentially translate into improved clinical outcomes. For example, the ability to better monitor the needle pathway means a higher likelihood of avoiding critical structures such as neurovascular bundles adjacent to the intended target, in turn minimizing complications.

This application of ultrasound technology has been particularly effective in evaluating and managing spasticity after stroke and traumatic brain and spinal cord injuries. Combined with electrical stimulation or needle electromyography, MSK US offers accurate localization of target muscles and nerves during needle placement in chemodeneration treatment.

Additionally, MSK US can be used to enhance pain management by peripheral nerve blocks, especially in patients with high body mass index.

**RAPID DEPLOYMENT**

Ultrasonography has a clear role in improving providers’ awareness of anatomical pathologies at the point of care by supporting both static and dynamic evaluations—something MRI and radiography cannot offer. This is critical because dynamic assessments convey unique information about the functionality and stability of tendons, muscles and other structures that static reviews do not provide as readily.

MSK US can be used during clinical evaluations to rapidly gather information to support and improve diagnosis and treatment decisions. The ability to visualize potentially injured structures in real time has also made it a boon to sports medicine, where its availability for immediate assessment of injuries on the field or in the locker room gives MSK US a distinct advantage over less-portable imaging modalities.

**ENHANCED EDUCATION**

Lastly, ultrasonography can serve as a crucial instrument in graduate medical teaching (see “The Current State of Curricula”). Although a large proportion of physiatrists use MSK US, there has been a vocalized need for more formalized training and device access. As a result, several authoritative bodies—including the American Academy of Physical Medicine and Rehabilitation, the Association of Academic Physiatrists, the American Medical Society for Sports Medicine and the American Institute of Ultrasound in Medicine—have developed clinical practice guidelines, workshops or other training opportunities to ensure adequate provider knowledge and application.

The learning curve for MSK US use can be lengthy. However, the ability to harness a tool that can provide more accurate and efficacious real-time diagnostics and interventions makes the time and effort a worthy investment for clinicians and patients alike.


**THE CURRENT STATE OF CURRICULA**

Formal standardized training and accreditation in musculoskeletal ultrasonography are key to reducing variations in the application and quality of the examination’s use. A recent survey of MSK US teaching across all diagnostic radiology and physical medicine rehabilitation residency programs, adult rheumatology programs and sports medicine fellowship programs in the U.S. underscores the extensive incorporation of this technology into professional curricula.
People with disabilities were thrust into the spotlight during the recent presidential campaign when now-President Donald Trump apparently mocked a newspaper reporter with a physical disability.

While sad and disappointing, such stigmatizing behavior is by no means unusual for those in the disability community. Even physicians and other health care workers admit they are often uncomfortable treating people with overt visible disabilities. In some cases, that discomfort may manifest itself in insensitivity.

Being so visibly different puts our patients at risk for ridicule. This, unfortunately, may become even more common, given the rhetoric of the past year, which appears to have provided “permission” for some to tease and bully those who are different. Minority status is not determined by race, ethnicity, sexual identification, age, religion or cultural heritage alone. We need to remember that it also includes health status and physical and functional capabilities.

It is our role as the leaders of the nation’s rehabilitation hospitals and units to counter any actions that would stereotype, bully or discriminate against our patients and others with disabilities. Indeed, we have a social obligation to promote a public culture and values of acceptance, sensitivity and respect for people that look beyond physical or cognitive differences.

Rehabilitation hospitals can promote acceptance and social normalization for people who are differently abled in numerous ways. These include:

- Supporting community education programs such as speakers’ bureaus in which people with disabilities are available to go into schools, businesses and other settings to tell their stories. This helps demonstrate through their presence that they are still capable people who merit respect.
- Offering patient and family education and training, including socialization, as part of therapeutic programs. This should include recreation therapy group outings. While these experiences help patients navigate other settings and adapt to their new body image, they can also help our patients learn how to manage the reactions of others, and even how to educate other people about their condition.
- Modeling inclusion by hiring people with disabilities and encouraging others to volunteer in your facility.
- Partnering with community support and advocacy groups. For instance, Kessler Institute for Rehabilitation works with ThinkFirst to sponsor volunteer speakers who visit schools to teach injury prevention and how to relate to people with disabilities.
- Training and hiring physicians with disabilities. It is an incredibly powerful statement to see a clinician practicing despite a physical limitation.
- Speaking out against discriminatory words and actions when you encounter them, whether on the street, in the media or even from friends or colleagues.

It is critical that we in the rehabilitation community help people to see the value, energy and accomplishments of people with disabilities and to understand that bullying, teasing or even staring is inappropriate and should not be condoned.
Stimulating Effects
USING ELECTRICITY TO RESTORE HEALTH AND WELL-BEING FOLLOWING SPINAL CORD INJURY
BY MONIFA BROOKS, M.D., AND GAIL FORREST, PH.D.

For the approximately 17,000 Americans who sustain a spinal cord injury (SCI) each year, permanent and disabling neurological deficits pose a serious threat to daily living and quality of life. While there are currently no treatments to reverse structural damage caused by SCI, skin surface electrical stimulation has emerged as an exciting tool to help patients live longer, healthier and more independent lives. Together, research and clinical advances into this modality are challenging long-held beliefs that injury to the central nervous system is irreparable, giving experts new insights into the science and practice of spinal cord rehabilitation.

REWITING HISTORY
Functional deficits associated with SCI arise from the inability of damaged axons to conduct electrical impulses. The cascade of ischemic, hemorrhagic and inflammatory effects that occur immediately post-injury further exacerbates the structural integrity of the spinal cord and leads to loss of body functions. These consequences have traditionally been considered permanent, especially in individuals who sustain complete SCI, but that view is changing.

A potential pathway for restoring functioning and psychosocial health following SCI concerns the use of electric currents to induce neuromuscular activity in individuals with intact peripheral motor nerves. Termed functional electrical stimulation (FES), this technique couples noninvasive surface neuromuscular electrical stimulation with coordinated, purposeful movements in the upper and lower limbs and trunk, including walking, standing, sitting and hand grasping. The electrical output is controlled by a programmable microprocessor, allowing devices to reproduce nerve and muscle activity patterns specific to individual motor functions. Commercially available, FDA-approved equipment offers patients the chance to experience FES at home, but in reality few people have access to this technology since it is generally not reimbursable by third-party payers.

Active therapy with FES can aid restoration of muscle trophism in nearly all patients with paralytic muscles, other than individuals with active heterotopic ossification (since FES could induce further abnormal bone growth). Patients with lower motor neuron injuries tend to respond less favorably than those with upper motor neuron deficits, but both groups are potential candidates. Despite its promising effects, the mechanisms of action mediating FES outcomes remain largely unknown.

CLINICAL ADVANTAGES
Therapeutic uses of FES at Kessler Institute for Rehabilitation are varied and have been associated with positive findings, including restoration of locomotor functioning and lower limb activity (see “Getting a Jump-Start”). This can require intensive, repetitious patient training and may be used during therapy in conjunction with dynamic orthotic gait assistance devices. These include exoskeletons and static orthotic devices, such as a standing frame to improve trunk balance during weight-bearing activities while in a supported environment with stabilization of the lower limbs.

Recovery of arm and hand motions, as well as fine motor movements like palmar and lateral grasp and finger pinching, might also be achieved when combined with functional activities like picking up and handling objects. This assists patients in refining their ability to perform daily living tasks, like feeding and personal hygiene, as well as occupational skills. Electrical stimulation can help prevent deep tissue injury by inducing periodic contractions of muscles that are subject to weight bearing while sitting or lying, such as the gluteus muscles. This helps to redistribute pressure and improve blood flow. Speech-language pathologists can also use FES to manage swallowing and speech deficits in individuals with dysphagia following high-level cord damage.

Indirect outcomes are also compelling and include prevention of pain, spasticity, contracture and osteoporosis—all of which can result from immobility and muscle atrophy. Activating muscle contractions is critical for minimizing loss of muscle tissue in the affected area; this has important implications for body composition and the future.
occurrence of comorbid conditions. In the long term, preservation of lean muscle mass helps offset the increased risk of type 2 diabetes and cardiovascular disease that accompanies body fat accumulation common in SCI patients. Hypertension and ischemic heart disease are among the leading contributors to reduced mortality in these individuals; thus, interventions that attenuate dysfunctions in the metabolic profile are highly valuable.

Similarly, some of the most powerful indirect effects of FES come in the form of psychosocial gains, which is significant given the detrimental impact that depression, anxiety and other mental health disturbances can have on mortality and morbidity. The possibility of overcoming a seemingly insurmountable injury and restoring one’s functioning and livelihood is extremely motivating for patients and provides them with a strong sense of hope and commitment to treatment.

DIGGING FOR ANSWERS

What began about six years ago as a research project has evolved into an ongoing program within Kessler Foundation to investigate the effects of stimulation. Studies are supported by numerous state and federal grants, including a three-year, $1.8 million award received from the Department of Defense Spinal Cord Injury Research Program in 2014. Thanks to this and other funding, Kessler Foundation is actively contributing to the empirical base that informs patient practice through a series of novel trials.

Research suggests that neuromuscular electrical stimulation for patients with SCI may increase muscle both in terms of mass as well as volume, which thereby improves blood flow and functionality. Current studies at Kessler Foundation are building on this knowledge through investigations on the effects of combining single- and multimuscle stimulation with functional interventions on clinical outcomes like ambulation and muscle fatigue.

Importantly, these studies are also designed to help elucidate currently unknown mechanistic effects of FES on muscle fiber structure at the cellular level; muscle activation through electromyography; and bone density, bone structure and volume. They also will aid in looking at changes in recovery of function. For instance, one currently enrolling study is exploring and quantifying how training strategies using stimulation can elicit changes in mechanisms, which could provide insight into how FES improves plasticity and functional recovery.

The synergy between research and clinical work at Kessler Foundation and Kessler Institute is well defined, and is facilitated by the close proximity in which the teams work. That most of the Foundation's labs are situated on the hospital’s campus helps support the collaboration and coordination of research and the ability to translate results into clinical practice. This benefits not only the scientific community in advancing the body of knowledge, but also our clinicians in their ability to provide evidence-based care and treatment. Ultimately, this optimizes the potential for rehabilitation and improves the overall quality of life for our patients with SCI.

In one new study, for example, Kessler Institute is implementing a multimuscle stimulation model, which will allow Kessler Foundation researchers to further examine their findings and identify additional mechanisms of effect and applications for the future. Again, this will allow both researchers and care providers to expand the body of knowledge surrounding the etiology and treatment of injury, consider strategies to reduce risk and improve patient outcomes.

FES is unique in that it is one of the few SCI interventions that we know works well for clinical and functional outcomes, psychological well-being and long-term health maintenance. The more research we conduct, the more we can understand and widely disseminate its effectiveness. Building the literature—and refining it through translational approaches—will help promote wider access and routine use of FES in eliciting controlled activation of affected limbs and body areas.

GETTING A JUMP-START

At Kessler Institute, SCI patients are assessed for FES suitability and tolerance very early in the recovery process, typically during the first week of admission post-injury. Since the immediate goal is to minimize muscle loss, FES is provided two or three times per week for at least 30 minutes, depending on the person’s endurance and exercise tolerance. This dosage and frequency is notably higher than in other rehabilitation facilities.

As individuals transition to outpatient care, FES can continue to be integrated into therapy, such as through independent exercise programs that feature FES stationary cycling ergometer training. This equipment, available at all Kessler Institute campuses, pairs cycling motions with electrical stimulation to allow individuals with muscle paralysis to engage in regular exercise, thereby increasing cardiopulmonary fitness, reducing metabolic risk factors, and improving muscle spasticity, tone and strength in upper or lower limbs.
The 21st Century Cures Act
WHAT IT MEANS FOR PHYSICAL MEDICINE AND REHABILITATION

BY BRUCE M. GANS, M.D.

The 21st Century Cures Act, or the Cures Act, as it is now known, was one of the few bipartisan bills to pass both houses of Congress last year. The $6.3 billion landmark legislation, which was two years in the making, has the potential to reshape medical research, the drug and device approval pathway, mental health delivery and even the trajectory of the opioid epidemic.

The most important part of the 1,000-page bill for the rehabilitation community, however, is Section 2040, which enhances the stature and visibility of medical rehabilitation research at the National Institutes of Health (NIH).

This section will ensure a continuation of the process the National Center for Medical Rehabilitation Research recently underwent to create the agency’s Research Plan on Rehabilitation, released in December. That plan was the result of the 2013 NIH Blue Ribbon Panel on Medical Rehabilitation Research report, which concluded that significant reforms to rehabilitation research were needed to maximize the ability of people with disabilities to function, live independently and, if possible, return to work.

Specifically, the Cures Act:

- Creates greater links within NIH to help coordinate rehabilitation research across institutes and centers to streamline priorities and maximize the federal investment in this area.
- Involves the NIH director in coordination activities, raising the stature of rehabilitation science across the NIH’s 27 institutes and centers.
- Calls for the Research Plan on Rehabilitation to be updated every five years after a scientific conference or workshop. The existing research plan had not been updated since 1993.
- Provides for an annual progress report, ties co-funding of medical rehabilitation research projects to the research plan and includes a definition of medical rehabilitation research to ensure consistent tracking across NIH.

The act also funds another key area of interest to the rehabilitation community: the $1.5 billion, multiagency Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative. The BRAIN Initiative is designed to accelerate the development and application of innovative technologies that can treat, cure and even prevent brain disorders. This could be particularly important for the people we serve.

In addition, the act authorizes $1.8 billion for the Beau Biden Cancer Moonshot, designed to speed research into cancer prevention and treatments, and $1.5 billion for the Precision Medicine Initiative, designed to transform the promise of genomic medicine into reality. Another area that may benefit our patients is increased funding for regenerative medicine.

In addition, the bill contains provisions to reform the Food and Drug Administration, including improving its ability to recruit and retain scientists and incorporating real-world evidence and patient insights into product development and regulatory approvals. For instance, it requires that the agency establish a structured framework for the meaningful incorporation of patient experience data into the regulatory decision-making process, including the assessment of desired benefits and tolerable risks associated with new treatments. There are also new incentives for antibiotic development.

One other area of interest in the bill is funding for several health information technology initiatives, including creating a reporting system on electronic health record usability, interoperability and security; establishing a provider directory to facilitate data exchange and solutions to interoperability originating in the private sector; and calls for better policies to link patients to their medical records and avoid duplication.

As the author of an editorial in The New England Journal of Medicine wrote: “Congress has provided an enormous gift to science ... a gift that reflects a deep confidence in the promise of biomedical research to make discoveries and develop cures in the 21st century.”

It will be interesting to see how the provisions of this important piece of legislation play out over the next few years and to gauge its impact on the rehabilitation and disability communities.
When maintaining health is anything but routine

BY THOMAS LAMMERTSE, M.D.

A recent report in the American Journal of Public Health1 highlights the inadequacy of health maintenance among people with disabilities, including those with mobility or cognitive deficits. These conditions carry a significant risk of increased mortality and morbidity due to chronic illnesses such as cardiovascular disease, hypertension, diabetes and cancer. Given that rehabilitation populations are living longer, the importance of routine health and wellness behaviors has become increasingly imperative for reducing long-term negative physical, psychosocial and economic consequences—and both clinicians and patients play a role in making certain this is achieved.

CRITICAL VULNERABILITIES

Compared with adults who don’t have disabilities, those with physical or cognitive challenges are at a heightened risk of obesity, tobacco use and inactivity.1 Their utilization of preventive care—such as routine wellness exams, cholesterol screenings, colonoscopies, pneumonia and influenza vaccinations, and breast and cervical cancer evaluations—also lags compared with the general population, and the greatest disparities occur among individuals with severe or complex impairments.2,3

Preventive care is crucial for patients with disabilities given their diminished physical reserve to fight infections and higher risk of self-injury from falls. Immobility is pervasive throughout this population and a major contributor to preventable diseases such as hypertension and diabetes. These individuals also tend to have many comorbidities and take numerous medications without proper education on dosage and frequency; this can also pose a risk to overall health.

OVERCOMING OBSTACLES

The primary challenge that rehabilitation patients face in terms of routine health care and screening involves poor accessibility. This unfortunately exists on multiple levels, including lack of reliable transportation, buildings or patient rooms that are not wheelchair-friendly or pose other difficulties, and widespread unavailability of appropriate medical equipment such as adjustable exam tables.

Attitudinal and educational barriers also abound. Some health care providers may be unaware of how inaccessible their facilities are or how to modify them, while others can have a negative mindset or misperceptions about the urgent need for preventive services in people with disabilities. Similarly, individuals may perceive their injury as an insurmountable barrier and fail to make routine appointments. Primary and specialty care clinicians also often need training in how to work with rehabilitation patients, such as assisting with wheelchair transfers.

Cognitively, certain neurological conditions such as stroke or traumatic brain injury are associated with decreased judgment and reasoning and/or increased impulsivity, all of which could impinge on self-care. For injuries with a sudden onset and in people who were previously healthy, reactive depression may occur, which can exacerbate existing illnesses or lead to new ones through detrimental lifestyle choices such as substance use.

A TWO-WAY STREET

Preventive care and screening recommendations for people with disabilities are largely in line with those for the general population. Rehabilitation providers should make an effort to give all individuals comprehensive wellness education, but they should also offer practical advice about diet, exercise and healthy lifestyle. Clinicians can further assist by linking patients with case managers, since they are knowledgeable about community resources such as local transportation services or home-based health programs.

But patients must do their part, too, and should be encouraged to become advocates for their own health by asking questions of their providers. Kessler Institute for Rehabilitation tries to facilitate this by involving families and caregivers in their loved one’s treatment through our Care Partner Program. Here, the patient designates someone who can be continuously involved in the rehabilitation course and can help ensure patients maintain medical appointments and adhere to other lifestyle recommendations.

Every person has the right to wellness, but the greater one’s physical or cognitive impairments, the more challenging it will be to adapt to a healthy lifestyle. Through awareness, education and accommodations, rehabilitation patients can have the same opportunities as everyone else to live long and productive lives.

Telemedicine in rehabilitation care

BY BRUCE POMERANZ, M.D., MMM

Leveraging computerized and web-based technology represents a critical pathway to improving health care access, delivery quality and value. While telemedicine is new and exciting territory, its adoption raises a multitude of considerations and questions. Kessler Institute for Rehabilitation is helping drive the conversation through our initial evaluation of a robotic telemedicine device designed to help bridge the gap between patients and physicians.

EXTENDING SERVICES
Widespread implementation of telemedicine in rehabilitation, and overall, is in its infancy. The barriers that rehabilitation medicine has encountered mirror those facing other specialties: getting buy-in from providers and patients; adjusting to a new model for care delivery; navigating financial obstacles including costs and lack of reimbursement from third-party payers; and addressing practice issues such as privacy standards and hospital privileging.

But the potential upsides are numerous and possible game changers in health care advancement and reform. One of the biggest driving forces behind Kessler seeking telehealth technology is to provide the highest-quality medical care to patients efficiently and in a manner that allows for communication with clinicians who are unable to come to Kessler. This necessitates finding a way to overcome geographic barriers to patients’ access to care, which is critical for achieving the best outcomes while decreasing risk of adverse events and acute medical hospital readmissions. Providers across all fields recognize the value of being able to evaluate and treat patients irrespective of their location. Moreover, sending individuals from the rehabilitation hospital to appointments with outside specialists may interrupt treatment.

INITIAL UPSHOTS
Kessler is conducting a trial to examine the use of a robotic device called the InTouch Health RP-VITA (remote-presence virtual and independent telemedicine assistant). The machine serves as a mobile videoconference platform that the clinician accesses by computer, tablet or smartphone. Patient-provider interaction is supported by a camera, microphone, monitor and stethoscope, all of which allow anyone in the vicinity to see and interact with the physician on-screen. The physician can operate the robotic device in person or remotely, and it can navigate the room as needed to more closely assess the patient.

Although Kessler is in the initial stages of evaluation, being an early adopter allows us to prepare for the anticipated gradual ramp-up in the medical world’s increased utilization of this technology. The primary aim of the trial was not to fully integrate the device into routine patient care, but to better appreciate its strengths and limitations and consider how it could enhance care quality and delivery, such as how it could make clinical consultations easier and more efficient. To make our evaluations as meaningful as possible, clinician- and patient-driven data were collected to assess such factors as user satisfaction, feasibility, potential value and reactions to the RP-VITA. Responses were largely positive and encouraging toward integrating it into our existing capabilities.

Early results from the trial have helped staff identify situations where the RP-VITA could be of best use. For instance, it was clear that evaluation of surgical wounds could be readily completed through the robotic device. Assessment of pressure wounds, however, often relies on maneuvers that are hard to conduct remotely, such as probing the wound or assessing for odors. It also became apparent how the technology could enhance clinician consults: Not only could it help Kessler staff provide physical medicine and rehabilitation care for patients inside the hospital, but it could also facilitate referral of our populations to a wider spectrum of consultations and other services from providers beyond our specialty.

BLAZING THE TRAIL
While some acute care facilities are using telemedicine for certain patients (such as those needing urgent decisions relating to acute stroke care in the emergency department), Kessler appears primed to be among the first rehabilitation hospitals to implement this approach broadly for its population. This new model for care delivery has much to offer in facilitating efficient, comprehensive diagnosis and treatment. But it is equally important that we ensure individuals feel well cared for and that we learn as much as possible about these tools so we can maximize their potential.

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