Multiple sclerosis (MS) is a chronic, often disabling disease that attacks the central nervous system (CNS), which is made up of the brain, spinal cord, and optic nerves. In the United States, between 350,000 and 400,000 individuals have MS, which results in significant impairment in mobility. The type, severity, and frequency of symptoms can vary widely from person to person and even in the same person over time. The unpredictable nature of MS presents challenges to the patient, the practitioner, and the family members that are involved in the patient’s life. The interdisciplinary team strives to minimize the impact of the disease through medical, emotional, and rehabilitative strategies.

Physical therapy is an integral part of the care and treatment of people with MS. In the United States, physical therapists must complete a minimum of a bachelor of science degree from an accredited physical therapy program and are professionally licensed in the state where they practice. The opportunity to work with patients diagnosed with MS is a privilege, because patients are typically motivated and appreciative and have a wide variety of symptoms that require an individualized approach to treatment and goal planning.

Evaluation and Outcome Tools

The physical therapy evaluation and ongoing assessment of people with MS include several accepted assessment measures. The Multiple Sclerosis Walking Scale–12 is a subjective scale shown to be a valid measure of the effect of MS on walking in a community-based sample of individuals with MS. Another subjective measure is the Numeric Pain Rating Scale, which is a 0–10 ordinal scale of pain severity. This scale should be accompanied by the other aspects of pain assessment, ie, site, duration, quality, and frequency.

Fatigue is one of the most commonly reported symptoms, occurring in ~80% of people with MS. Physical therapists administer the Fatigue Severity Scale and Modified Fatigue Impact Scale, which have been found to be reliable measures of fatigue severity in MS. People with fatigue related to MS have an average score on the Fatigue Severity Scale of 6.5 out of 7.0. On the Modified Fatigue Impact Scale, a score of 0–28 is minimal fatigue, 29–56 is moderate fatigue, and >57 is maximum fatigue. These self-report scales are easily implemented and are responsive to change.

Traditional evaluation measures such as manual muscle testing, range of motion, postural analysis, and gait analysis are important in the evaluation process. These measures give the physical therapist critical information for establishing a treatment plan. However, they do not directly enable the therapist to measure the patient’s function and set goals in measurable terms. Objective functional measures are vital to the physical therapy process and are needed to document progress and justify reimbursement.

The outcome tools to measure gait speed and function that are most widely accepted are the 25-Foot Walk Test and the Timed Up and Go Test (TUG). Lerner-Frankiel et al. defined the concept of community ambulation: community ambulators need to be able to walk an average of 332 meters with near-normal velocity and an ability to step up/down curbs to walk efficiently within the community. When extrapolated to objective clinical test measures, the minimum speed needed to cross an average crosswalk is 5.79 seconds in a 25-Foot Walk Test. This fact indicates that speed matters, and treatment methods for strengthening in...
addition to orthotics or devices that return energy are necessary to improve function in many patients.

In individuals with endurance challenges, physical therapists use the 6-Minute Walk Test to measure ambulatory distance, which has a strong correlation to subjective measures of ambulation and physical fatigue. For practical purposes, some MS clinics may use the 2-Minute Walk Test as a substitute outcome measure, but this test may not capture the full effect of fatigue on gait function and has not been validated.

Balance difficulties are a commonly reported symptom in MS. Balance can be adversely affected through various causes, eg, weakness, spasticity, sensory deficits, visual-vestibular disorders, or fatigue. The Berg Balance Scale is recommended as a reliable primary outcome measure for MS patients. The Dynamic Gait Index has also proved to be a reliable measure of dynamic balance in people with MS and is a recommended primary outcome measure. A subjective report of the frequency of falls within a specific time frame is a reliable measure and correlates with changes in the Dynamic Gait Index and Berg scales. Cattaneo et al. concluded that balance rehabilitation is a useful tool in reducing the fall rate and improving balance skills in subjects with MS. Therefore, the physical therapist must determine the different causes of balance deficits to facilitate a positive outcome.

### Treatment Principles and Patient Education

The treatment of a chronic disease such as MS presents many challenges to the physical therapist. The chronic nature of the disease rarely lends itself to the traditional two or three sessions per week for physical therapy, except in the case of acute relapses or after specific events that lead to functional deficits (eg, acute pain, injury, or postsurgical rehabilitation). Rising copays, reimbursement caps, and stricter limits on therapy visits have made the provision of rehabilitation to individuals with chronic disease more difficult. As a result, many patients are referred for physical therapy to be educated and to help establish a customized exercise program to help address functional deficits.

Ideally, a program that requires the skilled services of a physical therapist in the clinic is combined with a home exercise program that may be performed independently or with assistance from a caregiver. The rehabilitation program is then periodically modified on the basis of changes in condition and the individual’s progress toward set goals. This type of program provides rehabilitation that is progressive, individualized, and cost-effective. The incorporation of local resources (eg, water exercise classes, yoga, Tai Chi) offers an adjunct to a home exercise program while providing peer support through enjoyable activities. These resources are an option in a long-term wellness plan for people with MS, which is critical given the chronic nature of the disease.

Many sources indicate that MS patients benefit from rehabilitation programs in daily function and quality of life. A customized exercise routine is an important part of the rehabilitation program and must be based on the specific needs of each individual. The principles of exercise with MS, however, are different from the principles of exercise with many other conditions. For example, traditional strength training for people without MS generally focuses on maximizing exertion and performing repetitions that approach a point of muscular fatigue. For people with MS, this type of exercise can be counterproductive and may induce further fatigue. Instead, a program of moderate exertion that focuses on maintaining consistent quality of movement is preferable when building strength.

The principle of exercising to only a moderate level of exertion is applicable to all forms of exercise with MS, ie, stretching, strengthening, balance, coordination, and aerobic. This exertion principle also applies to household tasks, recreational activities, and work activities. The Rating of Perceived Exertion scale is used to help people with MS understand the proper intensity of their exercise routine. The scale ranges from 0 (no exertion) to 10 (maximal exertion). It is ideal to identify an intensity level that is individualized, based on subjective level of exertion, appearance of symptoms, heart rate, blood pressure, and respiratory threshold. The scale can be applied during a fitness assessment or through close monitoring of an existing exercise program. A score of 3 indicates a moderate level of exertion, which is the target for most people with MS.

When teaching people with MS how to exercise, the physical therapist can apply some basic rules to explain the principles. The 2-hour rule, which states that the patient should feel the same or better after 2 hours of exercise, is simple but easily understood by patients and caregivers. The physical therapist can use this rule as a guideline in modifying the exercise program. The exercise should be comfortable and enjoyable. The physical therapist and patient must determine together what type of exercise and activity the patient would enjoy. Options include water- or land-based activities, group or individual exercise, and written instructions or a cus-
excessively warm fit.

when incompatibility with shoes, and a confining, drawbacks to these AFOs for MS clients are excessive. AFOs are designed to reduce the ankle range of motion, give stability, and protect the joint. However, their weight, incompatibility with shoes, and a confining, AFOs may be either articulated or solid. In general, articulated versions are used when rehabilitation potential is higher and proximal strength is adequate to handle the added weight of the articulation. Solid-ankle AFOs are appropriate, their light weight and energy-restoration features have led to greater compliance and patient satisfaction. Carbon-fiber AFOs generally come in two styles: 1) an anterior shell with a medial or lateral upright that creates a knee extension moment at heel strike while preventing foot drop and 2) a posterior shell that compensates for ankle dorsiflexor weakness, returns energy by providing a spring effect when the toe pushes off, and helps with toe clearance during the swing phase of gait. In addition, customizable carbon-fiber AFOs present hope for the future because they can accommodate foot deformities along with having the lightweight, energy-returning properties of the off-the-shelf carbon-fiber AFOs.

**Mobility Assistance**

**Walking Aides**

Mobility problems are one of the most common symptoms for people with MS. An estimated 75% of MS patients experience mobility problems as a result of the disease. Hemmett et al. found that 91% of patients self-reported loss of mobility, with 79% classifying the impact as moderate or high.

When exercise, balance, and gait-training strategies alone do not enable safe ambulation, walking aides may be used for stability and energy conservation. Physical therapists help teach patients how to use assistive devices. Walkers are a common assistive device for individuals with moderate deficits, but rollators are becoming an assistive device of choice because of their ease of use. The four-wheeled rollator also has a seat, which can be useful when the patient needs to recover from fatigue. The three- or four-wheeled styles do not require the user to lift the device between steps (as with a standard walker), which is an important energy-conserving feature for individuals with MS. If walking is only mildly unstable, canes or crutches are common. Compliance with the use of these devices improves, however, if a customized and fashionable cane or walking stick is used, rather than a standard hospital cane, the look of which may carry a stigma.

**Ankle-Foot Orthotics**

Lower-extremity orthotics are a common treatment device that is used to compensate for weakness (eg, foot drop), restore proper foot position, protect joints, restore energy, and help control abnormal movement of the knee. Customized plastic ankle-foot orthotics (AFOs) may be either articulated or solid. In general, articulated versions are used when rehabilitation potential is higher and proximal strength is adequate to handle the added weight of the articulation. Solid-ankle AFOs are designed to reduce the ankle range of motion, give stability, and protect the joint. However, drawbacks to these AFOs for MS clients are excessive weight, incompatibility with shoes, and a confining, excessively warm fit.

Carbon-fiber AFOs have become much more popular with MS clients. These AFOs are traditionally non-customized styles based on shoe size. Because of the noncustomized characteristic, they are not appropriate for clients with foot deformities (eg, pes planovalgus or cavovarus deformities) because these AFOs lack the ability to control the deformities. However, when carbon-fiber AFOs are appropriate, their light weight and energy-restoration features have led to greater compliance and patient satisfaction. Carbon-fiber AFOs generally come in two styles: 1) an anterior shell with a medial or lateral upright that creates a knee extension moment at heel strike while preventing foot drop and 2) a posterior shell that compensates for ankle dorsiflexor weakness, returns energy by providing a spring effect when the toe pushes off, and helps with toe clearance during the swing phase of gait. In addition, customizable carbon-fiber AFOs present hope for the future because they can accommodate foot deformities along with having the lightweight, energy-returning properties of the off-the-shelf carbon-fiber AFOs.

**Functional Electrical Stimulation**

Functional electrical stimulation (FES) is the electrical stimulation of a muscle deprived of nervous control, which provides a muscular contraction and therefore a functionally useful movement. FES has been used for the treatment of foot drop for decades, but technology has advanced to enable wireless communication. Traditional heel-switch devices that have wired connectivity are less expensive but inconvenient for daily use. The newer wireless units have electrodes that are easier to apply than the older models that require wires because their placement is exacted through custom fitting into a below-knee cuff. The two main wireless models, however, are activated through different mechanisms. One device uses a tilt sensor that measures the degree of tibial tilt and activates the FES when a specified and customized degree of tibial tilt is reached. This unit is comprised of a cuff with electrodes that is fit just below the knee, but a foot-plate sensor is not required. The wearer may then walk in shoes, slippers, sandals, or bare feet, and the unit will activate. A second unit uses a gait sensor that is a pressure-sensing, soft foot plate. This gait sensor communicates via wireless technology with an electrode cuff that also fits below the knee. When the heel rises off the ground, the FES activates and dorsiflexes the foot. When the heel strikes the ground, the FES deactivates and allows the dorsiflexors to relax. This type of device requires the user to wear most types of shoes but cannot be used with bare feet.
Its benefits are more likely to be seen when sidestepping or walking on uneven surfaces, because the gait sensor is active during these activities, whereas the tilt-sensor style may be less consistent. The tilt-sensor FES may also be less consistent as the MS client fatigues because the mechanics of gait change and the FES activation may not occur as gait quality varies with the increased fatigue. The choice between the two types of wireless FES is based on user preference, cost, and overall functionality.

FES is a useful tool for physical therapists in assisting people with MS. Numerous studies report on the significant benefit and effectiveness of FES compared with no device for the treatment of foot drop in a neurologically impaired group of patients.38–39 A separate study compared the use of FES to the use of an AFO. Sheffler et al.31 reported that mean gait speed was generally better for an AFO group than an FES group on all terrains (floor, stairs, walking over obstacle, and in TUG). However, despite this difference, 12 of 14 participants preferred FES to AFO. The higher patient satisfaction with FES may be the result of the active movement it provides, compared to the passive assistance of an AFO.

A major drawback of FES devices is the scant availability of insurance coverage, requiring most users to pay for them out of pocket. The units requiring wires are notably less expensive than the wireless units,26,27 and the costs of FES units are a significant obstacle for many MS clients. AFOs, on the other hand, are generally covered under most insurance plans within the United States. Ultimately, the decision to use FES, plastic AFOs, or carbon-fiber AFOs or to decline to use any device for the treatment of foot drop is a clinical decision to be made by the patient, physical therapist, and physician/neurologist together.

Hip Flexion Assist Orthosis

MS patients often experience a pattern of unilateral lower-extremity weakness in the muscles that are needed to advance the leg during swing, namely weakness in the hip flexors and knee flexors along with the ankle dorsiflexors. For these patients, an AFO or FES cannot provide the assistance needed for more efficient ambulation. Instead, an adjustable hip flexion assist orthosis (HFAO) was developed to enable patients to lift their weaker leg and advance it more easily during gait. In a pilot study of 21 ambulatory MS patients with unilaterally predominant lower-extremity weakness, a statistically significant improvement in gait speed was seen in the 25-Foot Walk Test and TUG and a significant improvement in distance was seen on the 6-Minute Walk Test.35 A statistically significant improvement was also found with the Mellen Center Gait Test, which is a real-world course consisting of walking, turning, and traversing ramps, stairs, curbs, and grass. Patient satisfaction with the device was high, as measured through a customized satisfaction questionnaire. The HFAO was found to be safe and effective, thereby adding another tool to the physical therapist’s options for treatment of gait disorders in MS.33

Spasticity Clinic

Many comprehensive multidisciplinary MS clinics offer spasticity consultations that encompass various treatment options for MS patients. The physical therapist’s role is to help determine the most appropriate course of treatment, working in concert with the physician, an occupational therapist, and other members of the rehabilitation team, as appropriate. During the evaluation, the client’s history is reviewed, and the adverse aspects of spasticity on the individual’s function are documented. Numerous outcome measures are taken, including pain, manual muscle testing, range of motion, balance, Modified Ashworth Scale for affected musculature, Spasms Severity Scale, transfer and bed mobility status, postural changes, and gait tests. Gait quality is routinely videotaped, which allows for pre- and postintervention outcomes to be compared.

Once the spasticity consultation is complete, the multidisciplinary team, led by the physician, meets to determine a consensus on the treatment approach that is most beneficial to the client. Potential noninvasive treatment interventions may include oral medications to relieve spasticity, exercise routines, postural or positioning interventions (including customized seating), neurodevelopmental treatment, splinting, bracing, and patient education. Medical interventions may also include focal treatment of spasticity with botulinum toxin or more generalized treatment of spasticity with an intrathecal baclofen pump (ITB). If botulinum toxin is the preferred mode of treatment, the physical therapist’s role is to suggest muscles to target for injection based on spasticity severity and effect on function.

In the case of possible ITB, the physical therapist provides functional measures before and after a test injection of baclofen to help the patient and physician determine whether ITB is the best mode of treatment. Careful selection of patients is critical to positive outcomes, particularly in a population of ambulatory patients.34 Postoperative rehabilitation after botulinum toxin injection or after the implantation of ITB is
imperative to maximizing functional outcomes. The ITB rehabilitation program is best when completed in a multidisciplinary setting, because suggestions from the physical therapist for dosage adjustments can be made to the physician based on the client’s postoperative spasticity level and functional status. This team approach promotes quicker recovery, with optimal dosage level based on the patient’s needs.

Wheelchair Evaluation
In the United States, the process for clients to acquire wheeled mobility has become more stringent. A physical or occupational therapist is now required to perform a formal wheelchair evaluation for any client who needs custom seating, a power scooter, or a power wheelchair whose insurance is through government sources of Medicare or Medicaid. The therapist helps to determine the most appropriate type of device, whether it is a manual wheelchair, power wheelchair, motorized scooter, or transport chair. Medicaid requires that a standard form be completed for a wheelchair with power or custom seating. Medicare requires a letter of medical necessity to be signed by the treating physician and a face-to-face visit between the client and physician within 45 days of the wheelchair evaluation. Private insurers have varying criteria, with most requiring a letter of medical necessity. All insurers, public or private, require a physician signature to submit a wheelchair claim.

Perhaps the most consistent insurer criteria for a wheelchair of any type is that the patient must need to use the device within the home for mobility on at least a part-time basis, not just for long-distance outings. The therapist’s role is to evaluate the client’s immediate and potential future needs and to help the client acquire the most suitable wheeled mobility device for the immediate term and the next 5 years. The projection is important because most insurance companies consider 5 years to be the minimum period for which wheeled mobility devices are appropriate for an individual and so will not approve a new device within that 5-year time frame, unless there has been a significant change of condition that warrants modification or replacement of the mobility device.

Functional Capacity Evaluation
The Functional Capacity Evaluation (FCE) is a compilation of data to help a client with vocational limitations. The FCE can provide guidelines for physical performance of a client and offer suggestions for reasonable accommodations to help a client return to work or remain at the current position. The accommodations are broken into several categories: activities of daily living, cognitive impairment, fatigue, weakness, fine motor impairment, gross motor impairment, heat sensitivity, speech impairment, and visual impairment.

In the event that a person has significant and persistent functional deficits that prevent the client from gainful employment, the FCE comprises documentation to support a client’s application for long-term disability benefits. The ability to perform the FCE is an integral part of the physical therapist’s role, and the therapist must be familiar with the criteria that define disability under the many different private and government disability plans. For a disease that is estimated to have lifetime costs of $2.2 million per patient, maintaining a steady source of income is of primary importance.

Conclusion
The opportunity to work with individuals with MS is both challenging and emotionally rewarding. New therapies continue to emerge from all aspects of patient care that enable individuals with MS to manage their symptoms with fewer burdens. This article clarifies the role of the physical therapist who practices within the multidisciplinary team of MS specialists whose goal is to help people with MS manage the effects of the disease.

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To the Editor

Thank you for running the interesting Team Focus series on multiple sclerosis (MS) team professionals, including the recent article on the occupational therapist. We appreciate the authors’ mention of the fatigue management program that we created.

For the information of your interested readers, the correct title of the National MS Society (NMSS)—sponsored DVD-based group fatigue program is Fatigue: Take Control. This series has been offered by all NMSS chapters in the United States for several years. It is the first easily accessible MS-specific program that includes the comprehensive recommendations of the fatigue guideline Fatigue and Multiple Sclerosis: Evidence-Based Management Strategies for Fatigue in Multiple Sclerosis.

Hundreds of people with MS have participated in this program. Initial NMSS evaluations showed positive changes in knowledge and behavior by the end of the program that were maintained through the 3-month follow-up. Additionally, a pilot randomized controlled trial funded by a grant from NMSS has shown positive results. A poster assessing the efficacy of Fatigue: Take Control was presented at the 2008 Consortium of MS Centers meeting in Denver, Colorado. Final results will be reported in a forthcoming publication, and a grant application for a multicenter trial is in process.

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