Accelerated Cure Project for MS

June 2019

Accelerating research towards a cure for multiple sclerosis

Keep Moving With MS

According to the National MS Society, approximately two thirds of people living with MS have some level of difficulty walking. Many MS symptoms can interfere with mobility, such as fatigue, pain, numbness, weakness, spasticity, lack of coordination, and vision problems. Even depression, which is very common in MS, can interfere with a person's ability to stay mobile and active. Difficulty getting around has the potential to interfere with many aspects of daily life, social events, work, as well as the ability to travel. A few basic strategies may help individuals with MS maintain locomotion. Ongoing management of MS symptoms, either with medications or other therapies, is essential. Adjustments to the home and/or workplace can also help a person with mobility issues function. Something as simple as finding the right shoes can make all the difference for a person living with MS.

If gait difficulties do not respond to therapeutic interventions, mobility assistive devices may be useful tools to help people with MS be more ambulatory and active. This technology allows impaired individuals more independence, helps them to conserve energy, and ultimately improves their quality of life. There are a number of different types of mobility aids that can help. Different devices may be more beneficial, depending on the circumstances. For example, one may be needed at home and another when one is out and about. One device may be necessary for stairs and another for walking on a flat surface. Deciding which to use should be based on an individual's needs and comfort level, as well as convenience and cost. This decision should be made with the help of one's physician and an assistive technology professional, like a physical therapist (someone who has experience in assessing and selecting assistive devices for people with MS).

An orthosis, or brace, can help an individual with muscle stiffness or decreased muscle tone have more control when they walk. Orthoses are available in many types and styles. An ankle foot orthosis (AFO) is most commonly used to support the ankle and foot and prevent foot drop. Foot drop is a condition caused by weakness or paralysis of the muscles involved in lifting the front part of the foot while walking. An AFO helps to prevent the toe from dropping and catching on the ground, thus providing for adequate foot clearance mid stride. AFOs are available in different materials (metal, plastic, or carbon fiber) and can be custom made. Some are solid and some have ankle hinges. They are worn inside the shoe and, depending on the material they're made of, can be made to remain hidden from view. A hip flexion assist orthoses (HFAO) is a mobility aid for those experiencing difficulty walking due to weakness in the hip muscles. This device is designed to improve gait by assisting with hip and knee flexion, as well as lifting the foot mid stride. An HFAO consists of a waistband and two dynamic tension bands that attach to the shoe and may be worn over or under clothing.

Functional electrical stimulation (FES) is a technique that helps with foot drop, as well as balance issues. It can also be used to improve an individual's ability to stand or walk during rehabilitation treatment. FES uses mild electrical currents to stimulate the nerves that activate weakened or paralyzed muscles. An FES device consists of a lightweight battery-powered control box (about the size of a pack of cards) and electrodes that are usually worn continuously while an individual is active. Surface devices, as the name implies, are worn on the surface of the skin. For foot drop, the device is worn below the knee so the electrodes can stimulate the nerve that goes to the muscle that would normally lift the front of the foot. At the moment the foot is about to lift up and swing forward in the gait, the FES device stimulates the nerve and lifts the foot. The stimulation stops when the foot hits the ground again. Two commonly used surface FES devices are the WalkAide and the NESS L300. Parts, or all, of an FES device can be implanted under the skin for added convenience, or to avoid any skin irritation that may occur with surface devices. Examples of implantable FES devices include Actigait and Neurostep.

A number of walking aids with varying bases of support are available for those with mild to moderate ambulatory or balance issues. Individuals who have more disability generally use devices with a wider base of support, thereby decreasing their risk of falling. Canes are designed to help those with mild issues by more evenly spreading the weight on the hips to mimic the distribution that would occur in a normal gait. There are two major types of cane. Single-point canes have a single point touching the floor. Multi-point canes have multiple support points, which make them able to stand on their own and provide additional support for the user. A quad cane has four points touching the floor. Canes are readily available in different lengths, styles and materials. They also come with different handles and adjustability (some can be folded when not in use). Trekking poles serve a similar purpose. A trekking pole is a lightweight walking stick that is similar to a ski pole, but it's made for walking. In 2015, researchers at Rowan University conducted the Trekking Poles to Aid Multiple Sclerosis (TRAMS) study. Participants in the study reported

greater self-esteem and less fatigue, and experienced better walking function when using a trekking pole compared with either a straight or a quad cane. Crutches provide more balance than canes during walking by providing a wider base of support. Two types of crutches are available, each of which is named by its location of use. Underarm crutches fit into the armpit during use. Forearm, or Loftstrand, crutches have arm cuffs that cradle the forearms, and handgrips for support. For those with moderate gait abnormalities, walkers provide an even wider base of support. Walkers come in two basic types, each with many different variations. A standard walker has a basic aluminum frame that folds, is height-adjustable, and is available with or without wheels. A walker without wheels must be lifted and moved forward as an individual walks. A wheeled walker, or rollator, can be pushed forward without lifting. A wheeled walker may have additional features including a seat, basket, or handbrakes. It's important to note that changes in posture may occur when using crutches or walkers, as one must lean forward for support. Canes, crutches and walkers must be adjusted to the correct height to avoid issues with back, shoulder, elbow, and/or wrist pain.

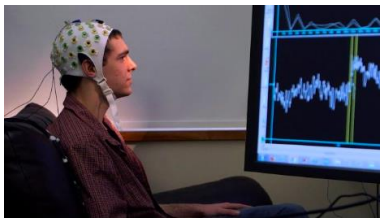
Wheelchairs and scooters provide mobility from a seated position for those who are experiencing ambulatory/more severe balance difficulties and frequent falls. There are three types of wheelchair. Manual wheelchairs move by the user pushing the rims of the wheels. Power wheelchairs are battery-driven and are available in three types according to the location of the drive wheels (rear-wheel, mid-wheel, and front-wheel). Seating options range from basic captain-style seats to custom seat cushions and backrests with power functions. The standard control mechanism for a power wheelchair is mounted on one of the armrests, however this is customizable. The controls typically consist of a joystick and set of buttons that change the function being controlled by the joystick. These functions may include wheelchair movement, tilting or reclining the seat, and elevation of the seat or footrest. Pushrim-activated power-assist wheelchairs (PAPAWs) are a hybrid between a manual wheelchair and a power wheelchair. A person using a PAPAW continues to hand propel the wheelchair using the push rims, however, motors in the hubs of the wheels amplify the user's strength, making it easier to move. Scooters are battery-powered three or four-wheeled devices that turn on and off with a small key. They operate by pressing a forward and backward switch (tiller) and the seat typically swivels sideways to allow easier access. Scooters are often less desirable than power wheelchairs because they tend to be less stable during turns and are more difficult to drive and turn in small spaces. They also have fewer seating options to accommodate users with specific needs.

As mentioned in our May 2018 newsletter, the Multiple Sclerosis Association of America (MSAA) has an Equipment Distribution Program that offers products designed to help those with balance, coordination, and mobility issues. Items distributed through this program include canes, walkers and wheelchairs. MSAA ships products to qualified individuals free of charge.

In addition to these standard mobility aids, a number of innovative devices currently under development may accommodate the mobility needs of people with MS in new and exciting ways. Robotic devices are one of these emerging technologies. One such device, typically used in physical therapy, is the Ekso Bionics exoskeleton training system. This wearable bionic suit enables individuals with any amount of leg weakness to stand up and walk with a normal gait. The user's weight shifting activates sensors in the device, which in turn trigger battery-powered motors to drive the legs to take steps. Another example of this new technology is the H2 Robotic Exoskeleton, developed by researchers in Spain. In a preliminary study, the H2 was shown to be safe and effective in helping stroke victims regain the ability to walk. The Kickstart system is a wearable device designed to help individuals regain walking and other functional abilities, both in physical therapy and in daily life. The hope behind using this type of technology is its repeated use may trigger the brain to form new neural connections that slowly increase movement and functionality in paralyzed or weakened legs, also known as neuroplasticity.

Researchers in London and Singapore have developed a wheelchair that may be easier to use than a regular powered wheelchair because of its shared control system. This new technology is in part controlled by the user, and also by pre-programmed paths. An assistant walks the chair through the desired pathway while the chair records the path. The user controls speed, starts, and stops, as well as any deviations needed to avoid obstacles on the pre-programmed path. The wheelchair returns to the path once the user steers around the obstacle and relinquishes control. The benefit of this approach is the user doesn't need to worry about navigation or planning a path, they only need to focus on avoiding obstacles and speed control. If the user wishes to navigate in new areas, new paths must be created.

For individuals with limited dexterity, the joysticks and switches on power wheelchairs can be quite difficult and sometimes painful to use. To address this, researchers are developing control systems that can be operated by parts of the body other than the hand. For example, investigators at the Georgia Institute of Technology are working on a Tongue Drive System. As the name implies, this system is controlled by the position of the user's tongue. Sensors in a magnetic tongue stud relay the tongue's position to a headset, which then executes up to six commands based on the tongue position. The Tongue Drive System holds great promise for individuals who have lost the use of their arms and legs. Brain Computer Interfaces (BCIs) are another emerging method that may allow a person living with paralysis to control a motorized wheelchair through thought alone. BCIs read signals from the brain and use computer chips and programs to translate the signals into action. Researchers in Germany designed a BCI-controlled wheelchair and tested it in 15 healthy subjects. Their results suggest BCIs are feasible for wheelchair control, however data also revealed a number of design issues that require further modifications and study.



Wheelchairs designed for indoor/outdoor use on a wide variety of terrains (including climbing stairs) are also under development. In 2003, Johnson & Johnson's Independence Technology Division manufactured and sold the first iBOT 3000 mobility system. This revolutionary four-wheel-drive wheelchair could navigate stairs, curbs, and other varied surfaces. It could lift a seated user to standing height by raising up and balancing on two wheels, and travel in this mode by using sensors and gyroscopes to maintain the chair's balance. The original iBOT was a huge success, however it was discontinued in 2009 because of slow sales due to its high cost and lack of insurance coverage. A 2016 press release suggests that the next generation of iBOT motorized wheelchair is under development. Track chairs are a new type of power wheelchair that uses a combination of wheels and a caterpillar track to move. French researchers tested one such device, the TopChair, in 25 people with spinal cord injury. Results showed all participants were able to successfully operate the device indoors and outdoors. However, it's important to note that no studies have evaluated the benefits of the TopChair in people with MS.

In 2007, Canadian researchers investigated the use of the Segway to assist those with mobility issues. Segway riders stand on a small platform supported by two parallel wheels while holding onto handlebars above the platform. A twist grip on the left handlebar is used to steer the device. The rider leans forward or backward to move the device forward or reverse/stop, respectively. Study results suggest the Segway is a useful mobility aid for a wide range of disabilities, including MS, and subjects found the device easy to use. Another useful up-and-coming mobility aid is the Alinker. This device supports the user's weight while walking. The Alinker allows the user to sit upright at eye level and is equipped with handlebars for added support. It is a lightweight (26 lbs) three-wheeled walking bike with an arched aluminum frame connecting two 16-inch front wheels with an 8-inch rear wheel. An adjustable seat is mounted toward the middle of the arched frame. It has a rear-wheel brake, and is designed to fold up and fit in the trunk of a car. The rear wheels can also be removed easily during transport and storage.

A wide variety of mobility aids are available to help those with ambulatory difficulties. Whether the aid is of an innovative design and features, or tried and true, user acceptance of any device is key to its success. When faced with the possibility of using a mobility aid, a person with MS may view this prospect as a failure or as giving in to the disease. Some may be concerned once they use an assistive device they will become dependent on it. Others may worry about how they might be viewed or that others will think less of them. It's important to view a mobility aid as a tool to help maintain, or even improve independence and quality of life. These devices allow individuals living with MS to participate in their lives more fully, with confidence and in control of their body and movements. In addition, mobility aids keep those who use them safer, conserve their energy, and even prevent future problems.