Walk This Way

Treadmill and task-oriented training mobilize people with stroke, Parkinson's, and other neurologic diseases that impact gait.

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At 59 years old, Steve Mitchell was ready to start a new chapter in his life. Newly retired from a high-level position with the Federal Government's Social Security Administration, he planned to sail down the East Coast's Intracoastal Waterway. He had also landed a part-time consulting gig at a Baltimore firm. But on April 13, 2008, as he was driving home from working on his 33-foot sailboat, his retirement adventure took an unexpected turn.

"I was talking to a friend on my cell phone and I kept dropping the phone and picking it up again," recalls Mitchell. "My friend said I was slurring my words and then suddenly, I couldn't control my car."

Mitchell pulled over, got help, and landed in the emergency room with an ischemic stroke. During six weeks of intensive physical, occupational, and speech therapy, Mitchell had one-on-one attention from therapists who were specially trained to help him overcome his new disabilities. Instead of sailing the crystal blue, he was relearning how to walk, talk, and move his fingers.

"One of the main problems with stroke is that people get these motor deficits that cause them to lose their functional independence," says Richard Macko, M.D., professor of neurology at the University of Maryland and director of the Veterans Affairs (VA) Rehabilitation Research and Development Center of Excellence in Exercise and Robotics. "There's a 70 percent fall rate within the first year after a stroke. Plus, fitness levels are half normal and the energy cost of walking for stroke patients is about double that of people who haven't suffered a

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stroke because of the abnormal nervous system connections. And that's a bad combination."

Unfortunately, stroke patients aren't the only people who have trouble walking. Problems with gait (how a person walks) and balance are pervasive across neurologic disease. And while the area of the brain that's affected may differ depending on whether a patient has Parkinson's disease, stroke, multiple sclerosis, or even old age, the end result is the same: a loss of coordination, mobility, and independence. "Even when patients need assistance to live, if they can walk (and walk well), that level of dependence is greatly reduced," says Jessie VanSwearingen, Ph.D., P.T., associate professor of physical therapy at the University of Pittsburgh.

WALKING PROUD

Walking is actually a very complex task that requires an integration of multiple systems in the body. It's so complex, in fact, that if there is a disruption to any of the centers that are related to processing information coming into the brain (like where your foot is in space or where your body is) or the centers responsible for sending commands back out from the brain (like "lift your foot"), your ability to walk will be compromised. Add frailty and fear to the mix, and it's amazing any of us gets around.

"Some people think of walking as a sixth vital sign because it's so sensitive to changes in almost any body system," says Dr. VanSwearingen. Some medications—such as those for Parkinson's—may improve patients' ability to walk. But more often than not, the medications people receive for neurologic disorders cause more problems with gait than they alleviate.

"Exercise empowers patients, giving them a greater sense of control over their lives and their condition", says Lisa Shulman, M.D., professor of neurology at the University of Maryland and co-director of the Maryland Parkinson's Disease and Movement Disorders Center. "We generally overlook the power of nonpharmacologic interventions like exercise, which reinforce the patient's need to feel in control and may sometimes even have more potent effects than conventional pharmacologic therapies."

Unfortunately, when a neurologic condition strikes, walking is often the first ability to go. "They're afraid to fall," observes Dr. Macko. "Even patients who are mild to moderately impaired only take about 1,000 to 2,000 steps per day, and that can socially paralyze people and lead to severe physical deconditioning." After a stroke, most patients are off balance, so they become fearful and hesitant, which in turn affects the timing of their gait. What's more, walking this way requires a lot of energy, so people simply stop doing it. Then they lose practice and reaffirm to themselves that they can't walk.

"Mobility depends not just on our ability to walk and maintain our balance, but also on intact cognitive function," says Dr. Shulman. "In real life, we rarely walk without also attending to a cognitive task. If people have both gait problems and cognitive problems, that's a double jeopardy situation, and they're more likely to fall." But effective exercise programs that engage the body with movement (and repetition), while also including an element of problem solving (e.g., getting from point A to point B), can help remedy both weaknesses. In fact, studies show this type of "task-oriented training" turns on growth factors that improve cognitive function, specifically speed of thinking, distractibility, and working memory. So not only does regular exercise enhance our ability to walk and balance, but it may also protect the aging brain.

TREADMILL TRAINING

When Mitchell started Dr. Macko's exercise training study at the Maryland Exercise and Robotics Center of Excellence at the Baltimore VA Medical Center, he was walking on the treadmill for 20 minutes at a time. Gradually, he worked his way up to 50 minutes. But throughout the course of the six-month study, the trainers maintained his speed at two miles per hour. The goal for this program, of course, was endurance. While researchers can't say that walking on a treadmill is "fun" for all patients (Mitchell claims he felt like a hamster), they can say that most people enjoy the camaraderie involved with these types of programs—and the results. Studies show that treadmill training reduces the energy cost of walking and improves confidence more than activity programs focused on walking, balance, and strength.

"In order to walk effectively, your leg has to go into extension behind your body so you can push off the ground," says Dr. VanSwearingen. "The treadmill is like a dedicated pacer for walking, primarily because it controls leg extension, causing the thigh to move behind the body. This 'hip extension' elicits an automatic stepping response." But people who have trouble walking often bend slightly forward and they take small steps, so their legs never go behind them and they never get the signal to step. What's more, if their legs are not behind them, they can't push off the ground to propel themselves forward. "When you're on a treadmill, the belt pulls your leg behind you, which is an automatic signal for the stepping pattern of gait. And it does that very consistently," she says. "It also gets the foot into position where push off is possible, and that reduces the need for you to bend your body forward."

GETTY IMAGES

"The brain networks that control walking are largely located deep in the brain, below the level where most strokes occur," says Dr. Macko. "It turns out that repetitive exercise and task-oriented training programs can activate these deep brain networks even up to 20 years after a stroke, long after conventional therapies have hit a plateau." If you're activating these networks on a treadmill, you're guaranteed not only to get a lot of practice, but also that every step is correct—no thinking required. Plus, you can control the speed of the treadmill, starting slowly and increasing speed as the patient becomes more proficient and confident.

"Putting people with multiple health conditions on a treadmill takes courage," says Dr. VanSwearingen—as does stepping on the treadmill. The trick is to have several precautions in place to ensure safety. At Dr. Macko's facility, patients not only have hand rails, but they're also put into a harness, so if they do start to fall, the harness will catch them and prevent any major injury. Most patients also wear heart rate monitors, so the aerobic exercise can be kept at a safe and effective intensity to improve heart health, just like cardiac rehabilitation.

Even so, if patients are white-knuckled and panicked on the treadmill, a four-wheeled walker is a good alternative. People may not need it to walk, but when it starts rolling forward, they'll start walking too, even without thinking about it. Just like the treadmill, a walker offers an external cue that encourages walking, so patients can practice walking without fear or hesitancy. "The only drawback to the treadmill or a walker is that it goes straight ahead all the time," says Dr. VanSwearingen. "Sometimes we need to challenge patients with postural balance, by having them walk in alternate directions or on uneven ground." And that's where task-oriented training comes in.

Another advantage of the treadmill: It automatically drives you to step, and it does so consistently, over and over and over again. In fact, studies show that when cats with cut spinal cords are placed on a treadmill, they learn to walk with their hind legs. "Individuals with stroke or Parkinson's disease have not disconnected their central nervous system from their legs—most of the time, they have only partial deficits," says Dr. Macko. But even a patient with an incomplete spinal cord injury can improve his fitness and walking ability with treadmill training. It's that consistent, repetitive motion of walking on a treadmill that helps the brain "rewire" itself, developing new connections to compensate for the damaged ones. It's a concept Dr. Macko calls brain plasticity, and it's the main reason patients with neurologic conditions can regain their mobility.

TASK-ORIENTED TRAINING

Task- or goal-oriented training is a way of thinking about rehabilitation that promotes motor learning. So instead of teaching patients how to walk by explaining the process (put one

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foot in front of the other, push off with your back leg and try to step forward with that same leg), task-oriented training puts people into situations where they learn by doing. "The goal of the task drives the learning," says Dr. VanSwearingen. "This form of learning challenges the brain to figure out the best solution to accomplish the task." It makes the learning implicit. Of course, it also puts the onus on the trainer to design specific tasks to accomplish the goal of walking better.

"If we want people to learn to vary their center of mass, which is useful for going around curves and adjusting to uneven ground, we ask them to walk in an oval or in different directions," says Dr. VanSwearingen. "But we never tell anyone to use the muscles on the outside of their hip when you're going around a corner and then the muscles on the inside of the other leg to pull you inward. Instead, we just design the task to help them achieve the goal of walking in an oval."

If this sounds simple, it isn't. To be successful, trainers have to structure these training programs to combine motor learning with progressive aerobic exercise, and they have to design the tasks so patients can be successful. They have to know when to back off on training and when to push. If it's too overwhelming, patients are likely to give up quickly. The good news: When patients stick with the exercise programs, they receive great rewards.

Not only do these task-oriented exercise programs help post-stroke patients regain up to 40 percent of their lost mobility, but they also help improve cardiovascular fitness and other health measures, which lowers the risk of recurrent stroke and other cardiac events. What's more, studies show these programs help ward off the muscle deconditioning that can lead to hyperinsulinemia and diabetes.

"Insulin resistance means that cells in the body are capable of taking up less glucose per given amount of insulin. This leads to higher and higher insulin levels, called hyperinsulimia, which in turn promotes arteriosclerosis, inflammation, and diabetes," Dr. Macko explains. "But we can reverse diabetes and impaired glucose tolerance—the prediabetic state—in 58 percent of cases," he adds. With 81 percent of stroke survivors struggling with some sort of impaired glucose tolerance, that's quite a coup.

"Exercise, particularly aerobic exercise, has a potent and rather immediate effect on skeletal muscle to increase insulin sensitivity," Dr. Macko says. "This lasts for 36 to 48 hours after a single sustained aerobic exercise session and then wanes away by three days, but there are clear and established benefits from sustained regular exercise over months. Since skeletal muscle is the largest 'glucose uptake organ' in the body, this makes a big difference to overall glucose control for those individuals that are diabetic or on the road to diabetes. Regular exercise also produces many other beneficial effects on multiple organ tissues and the cardiovascular system, including the heart and blood vessels."

GOING THE DISTANCE

Researchers aren't clear on which combination of training parameters are most effective (amount and timing of body weight support, belt speed, and acceleration), but they do know that treadmill training in conjunction with task-specific training techniques is critical for long-term wellness among patients with neurologic conditions.

Unfortunately, most stroke rehabilitation programs end within two to three months after the original episode. And when it comes to Parkinson's disease (or even old age), there are no systematic physical therapy or exercise recommendations to help walking and balance.

"In general, rehabilitation is largely focused on putting out fires," says Dr. Macko. "If a patient falls, they get an assisted device. If they're having trouble with motor skills and movement, they get a six-week course of physical therapy, or 12 weeks if they're lucky, and then they're back on their own."

Highly specialized exercise facilities and programs are in short supply and are not accessible for most patients. "We need to move these high-level exercise programs out of the ivory towers of academia and into the community where they can really help people over the long term," says Dr. Macko.

Experts agree that the camaraderie that accompanies community exercise programs is another key to long-term wellness. Exercising with patients who are facing similar disabilities may help motivate patients to get better sooner than they would on their own.

"There was one woman in the program who could walk great on the treadmill, but she had to use a cane to walk without it. She was really tentative," says stroke survivor Steve Mitchell. "A bunch of us encouraged her and she started walking on her own, just like that. A lot of it is mind over matter. Your body has to be ready to do it; but you have to know that your body is ready." And sometimes that takes a little push.

While insurance companies may not pay for patients to participate in long-term exercise programs, with a little tenacity and resourcefulness, patients can learn how to make do on their own. "You're not going to get better by sitting in a chair all by yourself and watching TV," says Mitchell. "You really have to be proactive about searching for exercise classes through senior centers and other avenues." With time, you might even get to those classes the old-fashioned way—by walking. NN

Ten Tips to Get You Moving

If you have problems walking and often lose your balance, or if you're out of shape and get winded quickly, those warning signs should prompt you to consider a regular exercise program to improve function. "Walking should be as good as it can be so you don't have to expend much energy just to get around," says Dr. Jessie VanSwearingen.

Here, patients and experts weigh in with their top 10 tips to help get you moving again. Check with your neurologist before attempting these.

1 **USE A WALKER (OR A GROCERY CART):** Walking with a four-wheel rolling walker allows you to practice walking patterns while also providing support and an automatic cue to move forward at a smooth and consistent pace.

2 **WALK TO THE BEAT OF MUSIC:** Some disruption in the timing of steps is often a subtle early gait problem. Walking to music and taking a step with every beat encourages timing of steps and consistency in the timing aspect of the walking pattern.

3 **WALK IN A SWIMMING POOL:** Stroke survivor Steve Mitchell takes an aquasize class every week to improve flexibility, strength, and balance. "There's no danger of falling and injuring yourself in the pool—and it's fun," says Mitchell. "The class has four guys and 26 women. Those ladies can kick your butt if you don't keep up with them."

4 **WATCH YOUR SHADOW:** The more you study your shadow as you walk, the better equipped you'll be to identify where and when you're wasting energy. Once you recognize which of your movements are wasted, you can work toward reducing them and increasing your energy.

5 **ROCK IN A ROCKING CHAIR:** While in the rocking chair, use alternate legs to generate the rocking. "This allows you to practice alternating leg movements of walking while also experiencing some movement of the trunk (body), all while safely sitting," says Dr. VanSwearingen.

6 **SHIFT YOUR BALANCE:** With your feet about shoulder's width apart, face a counter top and use it for hand support, if necessary. Then shift your hips and trunk together to one side until you feel most of the body weight over on the leg. Then reverse and shift hips and trunk together over the other leg. Shift your weight back and forth at a continuous pace, smoothly switching directions and feeling the pressure of the body weight over one leg and then the other.

7 **WALK AROUND THE TABLE:** Push the chairs aside so there's a clear path around the table. Place your hand (the one on the side of the body next to the table) lightly on the table surface and begin walking around the table. Focus on sliding the hand gently over the surface as you walk around the table. "The goal is to slide the hand lightly over the table as you walk all the way around—without stopping, slowing, or hesitating the movement of the hand over the table surface," says Dr. VanSwearingen.

8 **SET SMALL GOALS, THEN KEEP EXPANDING YOUR GOALS AS YOU MEET THE SMALLER ONES:** "I remember how thrilled I was in the rehab hospital when I was able to move my left pinky all by itself," says Mitchell. "My next goal was to be able to give my friend Eric the finger when he came to visit me," he jokes. "It took me two weeks of work, but I did it!"

9 **BE SAFE:** Falls are no fun, but they do happen. Learn how to get up off the floor by yourself.

10 **GET EMOTIONAL SUPPORT:** Mitchell's support came from Linda, his wife of 38 years. "When I was down, Linda could lift me up. When I needed a swift kick in the rear, she provided it—usually with gusto," says Mitchell. "I would not be where I am today in my rehab without her love and support."

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