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## STROKE REHABILITATION

Technology helps shape an approach to retrain the brain with greater flexibility and less risk of injury

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# Stroke Rehabilitation: Safety First

Technology helps shape an approach for therapists and patients to retrain the brain with greater flexibility and less risk of injury

The patient's growing confidence in the ability to move with appropriate support and safety protocols eases the recovery process and provides earlier family training for increased home exercise performance and ambulation carry-over upon discharge home.

Approximately every 40 seconds, a cerebrovascular accident (CVA or stoke) affects someone in the United States, and at least one of every 20 of those persons dies from CVA-related complications. The majority of CVA survivors are left with varying ranges of physical and mental disability that forever change their lives and the lives of their caregivers. As a physical therapist, I am privileged to provide these patients with an opportunity to recover lost abilities and movement. To provide highly effective treatment, I often consider how the latest stroke rehabilitation technologies can be combined with exercise and therapeutic activity to fit the personal and nuanced circumstances of each patient for an optimized outcome. Neurological re-education techniques are part of the approach many of my colleagues and I use. These techniques, coupled with advanced technology, can produce exponentially greater outcomes than what could be achieved decades ago, but with the technology providing a significantly higher level of safety to the patient and treating physical therapist. Several of these advanced technologies play a role in the treatment protocols at Baton Rouge Rehabilitation Hospital (BRRH), where they are used to provide the highest level of safety and progression for patients affected by a stroke.

Violet Lux, BRRH patient, uses an FES bike to improve biomechanics and the reciprocal nature of ambulation.

## CHALLENGE TO RETRAIN THE BRAIN

Stroke patients can present with left- or right-sided weakness that can range from minor loss to complete paralysis. Regardless of the level of weakness, strengthening for a hemiparetic body can be difficult without assistive technologies to provide body weight support and/or electrical stimulation to affected muscle groups. The main goal of stroke rehabilitation is to retrain the brain through functional tasks (sitting, standing, and ambulation). This retraining is enabled through neuroplasticity, the brain's ability to respond to input from imposed movement to recover brain function. This principle cannot be effectively practiced or achieved through open-chain or anti-gravity positions. Therefore, body weight support (BWS) systems, electrical stimulation (e-stim) via cycling, and ground force plates provide an exceptional bundle of tools to develop and achieve the target level of trunk and extremity strength training a stroke patient needs.

## EVALUATION

Upon initial evaluation of a patient at BRRH, the physical therapist is able to assess trunk control and safety of a patient in both sitting and standing postures with assistance of the facility's BWS system, as needed. The BWS system allows for a patient to be harnessed and connected to a monorail track system from the ceiling. This system can be adjusted to support any percentage of body weight up to 200 pounds, and will not allow the patient to "fall" beyond a few inches from complete upright. The inherent stability and safety of this system provides the physical therapist with an environment to teach the patient confidence in mobility, as well as to progress the patient to standing and walking at an accelerated rate compared to manual facilitation by the physical therapist alone. In many instances, two to three people are needed to aid a stroke patient in the first standing attempt within parallel bars or from a 20-inch mat. This scenario provides multiple instances for harm to the patient and the staff involved, thus creating unnecessary risks and blunted patient confidence during the delicate recovery process.

The BWS system used at BRRH can be utilized in sitting, standing over ground, and over a treadmill. As the patient progresses to ambulation, the monorail track installed overhead allows patient and therapist to move in a forward, backward, or lateral direction as desired over ground. This includes taking advantage of the vertical allowance and recognition provided by the BWS system to ascend and descend steps and significantly reduce the effort the physical therapist needs to expend. For advanced ambulation, the patient may walk on a treadmill while in the harnessed system as well. Manual facilitation for isolated movement strategies and patterns can now be addressed by the physical therapist, rather than the therapist's attention being consumed by providing body weight support to the patient. By leveraging the technology in this manner, the recovery of normalized ambulation patterns is achieved more effectively. Furthermore, the compensations that can increase fall risk for the patient in the future are also limited.

## HIGH-TECH HELP FOR BALANCE AND LIMB FUNCTION

Once a complete movement evaluation is performed in all postures utilizing the BWS system, the physical therapist is able to efficiently determine the most affected muscle groups—whether hypo or hyperactive—and develop treatment strategies to maximize return to function. At this point, technologies such as a computerized balance system, a functional electri-

Craig McQuibby, BRRH patient, uses a computerized balance system to improve dynamic balance while attended by Michael Smith, rehab tech, and Theresa Cambre, PTA.

cal stimulation (FES) stationary bicycle, and FES upper- and lower-extremity prosthetics can be utilized to improve static balance and strength of trunk and lower-extremity muscle groups specifically.

## COMPUTERIZED BALANCE SYSTEM

Achieving and maintaining a midline or upright position can be difficult for a stroke patient because of a hemiparetic side that may not have complete sensation and proprioception. The computerized balance system includes a ground force plate on which the patient stands, aided by lateral rails built onto the device. The physical therapist provides a posterior guard to the patient who is using the computerized balance system as needed. Primary weight support, weight shifting deficits, limits of stability, and control of static stance with perturbations can be determined through the assessment portion of the system. Any deficits established can then be retrained utilizing the same system while maintaining a record of progress and demonstrating trends regarding balance strategies. The program provides the patient and physical therapist with real-time visual feedback that offers data about performance and results. This data, in turn, helps build the patient's confidence and can positively motivate the patient toward continued progression. With improved bilateral weight support and efficient, effective weight shifting, a patient is able to progress with aggressive gait training, improved self-awareness, and decreased fall risk upon discharge home.

## FUNCTIONAL ELECTRICAL STIMULATION

The FES bike and FES prosthetics are two technologies used at BRRH that provide controlled electric current to an affected lower extremity in facilitating strength, endurance, and ambulation biomechanics during functional task performance. To improve biomechanics and the reciprocal nature of ambulation, the FES bike is utilized by placing surface electrodes on the patient's hemiparetic lower extremity (gluteals, quadriceps, and hamstrings) to provide active propulsion of the lower extremity cycle in a sequenced and reciprocal manner. Resistance can also be added to supply greater strength training as desired by the physical therapist. Once positioned in the FES bike, the patient is supported by a tall seat back and surrounded by arm rails. The therapist can assist the hemiparetic lower extremity with normal lines of movement as well as push force, while the machine and patient provide the manual labor of strength training.

Similarly, FES-enabled prosthetic technology is widely used in stroke rehabilitation for targeted lower-extremity electrical stimulation. Therapists at BRRH most often utilize such a device designed for use on the lower leg in gait training. The level of gait training this technology supports ranges from basic to advanced, and has application for use over ground and on a treadmill. By providing stimulation to affected ankle dorsiflexors to elevate the toes and allow for foot clearance during the swing phase of the affected extremity, the physical therapist can address trunk stability and muscle control for appropriate movement patterns. This FES prosthetic can be coupled with the BWS system to treat stroke patients whose conditions are more complex.

Some facilities and therapists also find the use of pressure mapping systems and sensor-loaded walkways useful in evaluation of gait and balance for stroke patients. Sensor-loaded walkways designed as portable units can offer the therapist data capture and analysis, as well as the ability to generate reports.

The ability to utilize these resources at BRRH during evaluation and throughout the plan of care for my stroke patients has greatly improved patient outcomes and satisfaction with efficient and safe progression. The patients' growing confidence in their ability to move with appropriate support and safety protocols eases the recovery process and provides earlier family training for increased home exercise performance and ambulation carry-over upon discharge home. After working previously in a setting that did not offer this degree of advanced technology, I recognize the daily importance of these tools in maintaining my patients' safety while moving along the pathway toward recovering function. I may even be able to extend my career years beyond expectation with the added assistance of body weight support, which decreases the likelihood that I may have to stop a patient's fall with my own brute strength. RM

***Ashley M. Henk, PT, DPT,*** *graduated from the LSU Health South - Shreveport PT Program in 2012. Since then she has worked primarily in an inpatient skilled nursing and acute setting. Recently, Henk began working at BRRH in the outpatient Day Neuro Program, where patients spend 4 to 5 hours per day working with PT, OT, and ST to maximize functional recovery. Henk has primarily treated patients with neurologic deficits including CVA, TBI, SCI, and multitrauma. Approximately 75% of her current patient population includes stroke patients. She has served on a state and national level for the APTA both as a student and a professional.*