Stroke Rehabilitation and the AlterG

Introduction
It's the third largest cause of death behind heart disease and cancer. It's a leading cause of serious, long-term disability in the United States. And on the average, it will cost individuals $140,048 in their lifetime for necessary care of lasting deficits.[1] What is it? Stroke. What it is? Devastating.

There are about 6.4 million stroke survivors alive today.[1] Many of them will suffer lasting financial, psychological, and physical consequences for the rest of their lives. As a result of the debilitating nature of their stroke, many survivors can develop other medical sequelae including: diabetes, cardiovascular disorders, pneumonia, seizures, and even fractures from falls. And each year, approximately 795,000 of these stroke survivors will suffer a new or recurrent stroke, which only adds to their disability.

Because stroke recurrence is a concern (patients who have had a stroke are five times more likely to have another stroke[2]), risk factors must be managed appropriately to prevent the cycle of further physical impairment and subsequent disability. One of the key ways to decrease risk factors such as hypertension, diabetes, and high cholesterol is with physical activity.

What Happens In Neuro Rehab?
In a stroke, or cerebrovascular accident (CVA), there are sudden, focal neurologic deficits as a result of ischemic or hemorrhagic lesions in the brain. A variety of deficits can result, based on the location of the lesion. Impairments can include loss of:

- Sensory function
- Motor function
- Mental abilities
- Perceptual capabilities
- Language function

The motor deficits in stroke patients are usually classified as hemiplegia (paralysis) or hemiparesis (weakness). And with poor volitional movement accompanied by significant weakness, what do most PT's do? They strengthen those weak muscles. Progressive Resistance Exercises (PRE's), Proprioceptive Neuromuscular Facilitation (PNF), and electrical stimulation can be used to try and assist in the process.

The problem in focusing solely on muscle strength with an underlying brain injury is the fact that you are not getting to the root problem. The brain is the issue, not just the muscles, so that is where the major retraining needs to occur. Working on isolated muscle groups will not be fruitful if the damaged brain is not able to reorganize and reeducate itself to send signals to the muscles that need to move. Since brain damage cannot be reversed, true "healing" in the musculoskeletal sense does not occur with brain injuries. Instead, what we are looking at is a "rewiring" of the motor and sensory cortices of the brain to help the body relearn movement. This is the core of what much of neurological rehabilitation is based upon.

Motor Learning
In motor learning theory, the assumption is that patients can improve with practice. By practicing task specific and goal-oriented activities, scientists and researchers hypothesize that patients can possibly encourage cortical change

through volitional movement. This brain plasticity, ability to change and adapt, is what ultimately leads to “healing” in neurologic patients.

There are several types of rehabilitation techniques based on motor learning principles. One gaining more attention recently is Constraint-Induced Movement Therapy (CIMT). The basic premise of this treatment technique is to help patients overcome learned non-use. What usually happens after stroke, is patients develop compensatory strategies with the unaffected limb. Problems with attention to the involved side result in overuse of the uninvolved extremity. Thus the affected limb has a lot of potential that is “unrealized” because it is not used or avoided.[3]

With CIMT, the goal is to force use of the involved limb. With the upper extremity, this is achieved by placing the unaffected limb inside a sling for 90% of waking hours over 2 weeks. The affected limb is then used repeatedly for 6-7 hours per day over these 2 weeks in a variety of different exercises and activities. By forcing use of the affected limb, there may be a functional reorganization in the undamaged motor cortex, possibly resulting in improved motor ability.[3] Some alterations CIMT has been shown to produce include changes in brain metabolism, blood flow, and electrical excitability.[4] Because change can be elicited, there is possibility that the irreversible damage caused by infarcts can be limited by these neuroplastic responses.

Stroke and BWSTT

In neurological rehabilitation of the lower extremities, one way to force use and encourage practice is through Body Weight Supported Treadmill Training (BWSTT). Treadmills themselves are popular because of the ability to combine active repetition, task-specificity, and proprioceptive training with aerobic exercise. The ability to

encourage improvements in ambulation, coupled with increased cardiovascular fitness, is important for this group because of the potential positive impact on function as well as the other medical issues these patients may have.

In a study performed by *Harris-Love et al (2001)*, they looked at the gait patterns of 18 chronic hemiparetic stroke victims overground and on a treadmill. Hemiparetic gait is usually variable in stride-cycle characteristics due to sensory and motor deficits of the patients. In their study, these researchers collected results that demonstrated that treadmill walking produced an improvement, resulting in a more consistent and symmetric gait pattern.[5]

In another study by *Luft AR et al (2008)*, a randomized controlled trial with 71 stroke patients looked at a treadmill exercise group versus a control (stretching) group, to see if task-repetitive treadmill training could improve gait and fitness. Not only did they see improved ambulation in these stroke patients, these investigators were able to show through functional MRI, that cerebellum-midbrain circuits were

recruited, likely reflecting neural network plasticity.[6]

In the *Barbeau H and Visintin M* study (2003), they compared 50 stroke subjects receiving locomotor training with body weight support (BWS) to 50 stroke patients receiving locomotor training with full weight-bearing. Their conclusion was that retraining gait with a percentage of body weight supported resulted in better walking and postural abilities than the control group. In fact, they stated that older patients with stroke and subjects with greater gait impairments benefitted the most from training with BWS.[7]

Why the AlterG?

The AlterG Anti-Gravity Treadmill has a huge advantage over other methods in providing Body Weight Supported Treadmill Training. When compared to other similar products available on the market today, the AlterG has proved superior in:

- Ease of use
- Comfort
- Precision
- Reliability

The AlterG M320 Anti-Gravity Treadmill allows for simple entry and exit, an integral component of any product for neurological patients. A shorter step height makes it easier for patients to step onto the M320 and counterweights on the cockpit make it effortless for the patient or therapist to lift it and secure it in place. This permits neurological patients of many levels to take advantage of the hallmark of the AlterG Anti-Gravity Treadmills- the comfortable lifting force provided by our Nasa-inspired Differential Air Pressure (DAP) technology.

Once inside the AlterG Anti-Gravity Treadmill, the gentle lifting pressure from our patented DAP technology provides unparalleled comfort, allowing patients to rehab and exercise longer than in any other unweighting modality. Longer treatment periods translate into more practice or forced use for these patients, which could potentially lead to greater motor learning and functional improvements in ambulation.

With the special calibration system inside all of our AlterG Anti-Gravity Treadmills, we are able to precisely unload someone from full body weight to 20% weight bearing, in 1% increments. This will allow the clinician to find the exact amount of support necessary for their neurological patients to gait train with less effort. Less effort expended on motion, will allow the patients to concentrate more energy on technique. Combined with AlterG technology that helps preserve normal gait mechanics,[8] this could equate to improved neural reorganization as the proper sensory and motor cortices are stimulated in the training and recovery process.

The AlterG is also proven to be reliable in providing a fall-safe environment for patients of all ages, body types, and diagnoses to gait train in. The lower body positive pressure environment in the Anti-Gravity Treadmills, protects patients from the normal forces of falls in a full gravity/full body weight situation. This is another reason why the AlterG technology is perfect for neurological patients with abnormalities in their gait and deficits in their balance.

Conclusion

In one short moment, a stroke can significantly change the physical, psychological, emotional, and financial situation of an individual. Lasting functional impairments can increase burden on family members or caregivers and rob individuals of their ability to be independent. But because of the amazing plastic ability of the brain, those neurological patients with the willpower and the ability to continue rehabilitation can see improvement months or even years after the initial insult. With the AlterG Anti-Gravity

Treadmill, patients now have a safe, comfortable rehabilitation tool to help them achieve this. The key to tapping into the plasticity of the neurological system[9] is to facilitate motor learning. Novel approaches of doing this involving task-oriented training, like body weight supported treadmill training, cannot be performed any better than with the AlterG.

As the old adage says, "Practice makes perfect." And this rings especially true for patients with neurological impairments that need motor learning. While repetition may have been difficult in the past without proper support, with the AlterG Anti-Gravity Treadmill providing a new standard of care for these neurological patients, practice is now possible. And with that, perfect may soon be within their grasp.

References

1) American Heart Association- www.americanheart.org
2) Teasell, RW. Long-Term Sequelae of Stroke. *Canadian Family Physician* 1992; 38:381-8.
3) Krakauer, JW. Motor Learning: Its Relevance To Stroke Recovery And Neurorehabilitation. *Current Opinion In Neurology* 2006; 19:84-90.
4) Mark VW, Taub E, Morris DM. Neuroplasticity and Constraint-Induced Movement Therapy. *Eura Medicophys* 2006; 42:269-284.
5) Harris-Love ML, Forrester LW, Macko RF, Silver KH, Smith GV. *Neurorehabil Neural Repair.* 2001;15(2): 105-12.
6) Luft AR et al. Treadmill Exercise Activates Subcortical Neural Networks and Improves Walking After Stroke (A Randomized Controlled Trial). *Stroke*, 2008; 39:3341-3350.
7) Barbeau H, Visintin M. Optimal Outcomes With Body-Weight Support Combined With Treadmill Training In Stroke Subjects. Arch Phys Med Rehabil 2003; 84(10): 1458-65.
8) Grabowski, AM. Metabolic and Biomechanical Effects of Velocity and Weight Support Using a Lower-Body Positive Pressure Device During Walking. *Arch Phys Med Rehabil* 2010; 91: 951-7.
9) Harvey RL. Improving Poststroke Recovery: Neuroplasticity and Task-Oriented Training. Current Treat Options Cardiovasc Med, 2009; 11(3): 251-9.

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For specific recommendations regarding usage of the AlterG with neurologically impaired patients, please see Dr. Nancy Byl's Neuro guidelines under the clinical data section of our Medical tab at www.alter-g.com.